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ACTOR NETWORKS FOR INNOVATION IN RURAL SOUTH AFRICA: THE CASE OF AGRO-PROCESSING ENTERPRISES IN MOPANI DISTRICT

By

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0610985M

A dissertation submitted to the Wits Business School, University of the Witwatersrand, in partial fulfilment of the requirements for the degree

Doctor of Philosophy.

Johannesburg, 2019

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DECLARATION

I, **Kgabo Hector Ramoroka** hereby declare that this thesis, "**Actor networks for innovation in rural South Africa: The case of agro-processing enterprises in Mopani district**", is my own, unaided work and that all sources have been indicated and acknowledged. It is being submitted for the degree of Doctor of Philosophy to the Wits Business School, University of Witwatersrand, Johannesburg. This thesis has not been submitted before for any degree to any other university.

Signed on the_____ day of _____20___

_____

Kgabo Hector Ramoroka

ABSTRACT

Innovation processes in rural contexts occur in systems that are diverse, coupled with complex challenges. Dealing with complex systems requires an understanding of the social dynamics of actor networks and innovation. This study attempted to provide insights on the compositional dynamics of actor networks, and how they influence interactive learning and innovation among agro-processing enterprises in South Africa. The guiding research questions to help address the study objectives are: What are the structural characteristics of actor networks for innovation in rural contexts? What are the roles and functions of different actors within these networks? what kind of actors and linkages facilitate interactive learning and innovation among rural enterprises? And what types of institutions facilitate or hamper innovation processes in rural contexts?

To answer the questions, exploratory research that adopted an egocentric social network analysis together with an evolving set of instruments developed by the Human Sciences Research Council, entitled the Rural Innovation Assessment Toolbox (RIAT) was undertaken. The theoretical basis for this study is grounded in systems of innovation, agricultural innovation systems and actor-network theory.

The findings show that innovations in South African rural contexts are process oriented and largely incremental. Enterprises engage in adopting and improving available practices and ideas to solve problems and take advantage of commercial opportunities. This process involves the use of internal enterprise resources and external resources through networks. It is further revealed that actor networks are diverse and loose, characterised by inequalities and weak institutions. Network linkages with formal enterprises take the form of relational contracting and are often event-based. Enterprises opt for external and non-redundant purposely-built linkages that bring relevant resources and knowledge. The mechanisms that enterprises use for learning are informal ones, such as copying and imitating and formal ones, such as, project meetings. Formal institutions such as hygiene and food safety and informal institutions such as traditional authority are crucial for innovation in rural South African contexts.

This study suggests that successful innovation interventions for social and economic development require innovation policies that incorporate social aspects of innovation

in rural contexts. Thus, there is a need for shaping the innovation space and promoting the co-creation of innovations between local and external actors. The following theoretically and empirically-informed policy formulation pointers are listed: Recognise and promote innovation processes at enterprise level; create an innovation or network systems that embraces diversity and complexity of actors; Initiatives and incentives are needed by different actors at different levels of the innovation systems to interact as a way of promoting co-innovation and establishing effective local institutions to overcome red tapes in the formal systems of innovation.

DEDICATION

This work is dedicated to:

My parents, Tatishi John (dod. 2009) and Raisibe Josephina Ramoroka;

Many that may find my work insightful and take the arguments forward;

My community in the small village of Mongalo;

The rural innovation team of the HSRC and the research funder;

The rural actors who keep on innovating despite resource deprivation; and

All the scholars who are debating and sharing African innovation and development narratives.

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As part of this PhD process I am part of the South African PhD Partnering Network for Inclusive Growth through Social Innovation and Entrepreneurship (SASIE) network - a partnership of PhD fellows from the Universities of Essex, Witwatersrand, Pretoria and Nelson Mandela Metropolitan. Time spent at the University of Essex, attending training courses and the Essex Summer School (2016 and 2017) and the SASIE colloquiums, contributed enormously to my PhD. A special word of thanks to Professor Diane Holt (University of Essex) and the South African and UK SASIE fellows.

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LIST OF ACRONYMS

AIS	Agricultural Innovation Systems
AKIS	Agricultural Knowledge and Information System
ANIL	Actor Networks for Innovative Learning
ANT	Actor-Network Theory
BOP	Bottom of the Pyramid
COFISA	Cooperation Framework on Innovation Systems between Finland and South Africa
CPAs	Communal Property Associations
CSOs	Civil Society Organisations
CUPP	Community University Partnership Programme
DACST	Department of Art, Culture, Science and Technology
DRDLR	Department of Rural Development and Land Reform
DST	Department of Science and Technology
DSTI	Directorate of Science, Technology and Industry
DUI	Doing, using and interacting
EEPP	Energy and Environmental Partnership Programme
HACCP	Hazard Analysis and Critical Control Points
HSRC	Human Sciences Research Council
ICT	Information Communication Technology
IKS	Indigenous Knowledge Systems
IVC	Innovation value chain
IID	Innovation for Inclusive Development

LDoA	Limpopo Department of Agriculture
LED	Local Economic Development
LEDA	Limpopo Economic Development Agency
LLiSA	Living Labs in Southern Africa network
MDASA	Moringa Development Association of South Africa
MORCASA	Moringa and Cassava Growers Association
MDM	Mopani District Municipality
NACI	National Advisory Council on Innovation
NARS	National Agricultural Research System
NGO	Non-Government Organisation
NPOs	Non-Profit Organisation
NSI	National System of Innovation
OECD	Organisation for Economic Co-operation and Development
QUNO	Quaker United Nations Office
R&D	Research and Development
RIS	Regional Innovation Systems
RIAT	Rural Innovation Assessment Toolbox
S&T	Science and Technology
SANEDI	South African National Energy Development Institute
SANSI	South African National Systems of Innovation
SIS	Sectoral Innovation Systems
SNA	Social Network Analysis
STI	Science, Technology and Innovation

T&V	Training and Visit
WFP	Wolkberg Fruit Processors

CHAPTER 1

STUDY OVERVIEW

1.1 Introduction

The notion that innovation only exists within formal enterprises with adequate research and development capabilities is widely common. There are a number of emerging frameworks about how innovation contributes to enterprise competitiveness. These include bottom of the pyramid (Prahalad, 2005), below the radar (Kaplinsky, 2011), frugal (Agarwal and Brem, 2012), grassroots (Gupta et al., 2003) or inclusive innovation (Foster and Heeks, 2013).

In these frameworks, rural actors are viewed as consumers/ users and rarely viewed as innovators. South Africa's national system of innovation acknowledges that the rural sector is a critical element of the national system of innovation. To that effect, rural based knowledge or innovation in the form of indigenous knowledge systems is protected through the Indigenous Knowledge Systems (IKS) Act, which seeks to strengthen the contribution of IK to social and economic development in South Africa (DST, 2004).

Despite the sustained contribution of rural innovation to the national system of innovation, the dynamics of rural innovation has not been fully explored. How enterprises in rural areas use innovations to maintain their competitive edge has also received inadequate attention. This study seeks to contribute to closing this gap by providing insights into the social dynamics of actor networks and innovation processes in rural contexts. To better understand the dynamic nature of innovation in rural contexts, attention is paid to actor networks and interactive learning concepts.

Actor networks are complex structures of actors that consider all activities that influence the development, transfer and use of innovative knowledge. As a result, learning, information exchange and innovation are affected by the contexts and structures in which the innovating enterprises are embedded. Moreover, the innovative capability, absorptive capability and innovation performance are influenced by network structural features (Ferru and Rallet, 2016). While networking

among innovation actors is recognised as a driving force of the innovation process, the social dynamics of rural actor networks remain ambiguous and underspecified (Rutten, 2014). Limitations remain in the literature about the composition and content of linkages (Jack, 2005; Liverpool-Tasie and Winter-Nelson, 2012; Lamers at al., 2017) and the role of different actors in supporting innovation (Hermans et al., 2013; Kumar 2014). There is also a general limitation in the understanding about the origins of innovation in marginalised contexts (Huber and Fitjar, 2016).

Actor networks and their importance have been a subject of significant inquiry in innovation studies (Freeman, 1991). They have been shown by previous research to have a positive impact on interactive learning, knowledge creation and innovation (Gilbert et al., 2001; Powell and Grodal, 2005). They are also a foundation for systems of innovation (Esparcia, 2014). In essence, innovation occurs through an on-going process of learning, searching and exploring (Lundvall, 2009; Singh and Bhowmick, 2015). As recognised in extensive literature (Powell et al., 1996; Bell 2005; Fritsch and Kauffeld-Monz, 2010; Knell, 2011; Isaksen and Karlsen, 2016), networks serve as a locus of learning that cater for both formal and informal learning processes and sharing of indigenous knowledge and scientific knowledge at all levels of the society. Despite a widespread acknowledgement of the importance of networks, there is still limited empirical evidence that provides insights on the composition of actor networks in relation to innovation (Chaminade and Plechero, 2012) and on the roles of diverse actors in networks (Hermans et al., 2013; Asheim et al., 2016).

It is acknowledged that innovation networking among actors enhance their innovation performance (Powell et al., 1996; Fritsch and Kauffeld-Monz, 2010; Knell 2011) making it necessary to study the nature and dynamics of networking systems. However, in the existing contributions on network research, the realities of innovation and social relations in poor rural areas are rarely discussed. These studies have not explored, in depth, questions in relation to what the actor attributes are; what kind of network linkages matter for innovation; to what extent such linkages are systemic in nature; and what the roles and functions of different actors are (Chaminade and Plechero, 2012; Hermans et al., 2013; Kumar, 2014; Chindime et al., 2016). While previous studies have contributed to the understanding of how actor networks may

support the development and introduction of innovations, there is still limited empirical evidence that reveals the interplay between actor network composition, interactive learning mechanisms and innovation output or change among enterprises in the rural context. In addition, there are gaps in our understanding of the ways in which networks facilitate learning and improve innovation (Bessant et al., 2012).

Innovation is a network-driven process, especially in poor and underdeveloped societies. Organisations do not innovate in isolation but do so through different types of networks (Knell, 2011). Moreover, improved innovation performance is increasingly associated with networking and interactive learning (Lundvall, 2007; Lam and Lundvall, 2007). By logical extension, interactive learning plays a key role in improving organisational innovative performance (Lundvall, 2007). Krätke (2010) and Rutten et al. (2014), among others, claimed that innovation networks nurture interactive learning processes but how actor networks influence interactive learning is poorly understood in innovation studies. If the innovation network offers an incubation milieu for interactive learning, then it is natural for the structure (make up and composition) and workings of the innovation network to have an impact on the efficacy of interactive learning processes (Powell and Grodal, 2005). In line with this argument, to explore the innovation gap that exists among resource poor enterprises, it is necessary to separate the two concepts of networks and interactive learning (Parrilli, Aranguren and Larrea, 2009).

From the systems of innovation perspective and network approach it is emphasised that public and private sector actors as well as policy makers are involved in the innovation process (Todtling et al., 2009). In addition, it is pointed out that universities and science councils are key innovative knowledge producers in the National Innovation System (NSI) approach – the adopted policy framework in South Africa (Kruss, 2006; Kruss and Lorentzen, 2011). In South Africa as in certain other developing countries, the policy perspective is on innovation carried out by formal organisations within formalised structures which results in the poor being isolated from the process (Hart et al., 2012; Lorentzen, 2010). This said, there are studies which recognise innovation among enterprises in rural setting and non-formal structures and that observes how rural enterprises engage in innovation networks to boost their innovative capabilities and performance (QUNO, 2015).

The impetus for this study emerges from the observation that, while the NSI acknowledges the existence of rural innovation in the form of IKS, rural network innovation systems are poorly conceptualised and understood. In an attempt to bridge this gap, this study explores ego-centred actor networks to portray the composition of actor networks in relation to learning and innovation using evidence from rural South Africa. Theoretically the study draws from systems of innovation, agricultural innovation system and network theory.

1.2 Problem statement

Innovation activities in rural areas have been largely ignored in the mainstream innovation literature. There is no doubt that rural enterprises do engage in innovative activities. However, what lies behind their success in innovation in the midst of challenges has remained unexplored. Their innovation ecosystem or landscape remain unknown.

This study argues that a framework of innovation in rural areas exists. This framework is composed of the social and technical aspects imbedded in networks. The micro behaviour of actors; characteristics of their networks, interactive learning patterns and institutional context can inform and strengthen policies aimed at improving innovation in rural areas.

Mavhunga (2017), for instance, calls for research that considers the dynamics of innovation in African contexts, while Soumonni (2016), contended that the socio-economic imperatives of lower and middle-income groups should take increased priority in innovation studies. Thus, the conditions under which enterprises engage in interactive learning and innovation should be considered in policy formulation. Many authors (Booyens, 2016; Booyens et al., 2017; Kruss and Lorentzen, 2011) concur that, the South African STI policy pay scant attention to the micro-level behaviour of rural-based enterprises, such as networking patterns. In this sense, innovations from the peripheral areas are often left out of policy making processes.

Despite the increasing realisation of innovation in rural contexts, a major part of the public tends to consider innovation in rural areas to be a linear process. This could be explained by a shortage of fact-based knowledge on how innovation actually occurs in rural contexts and the death of non-research and development-driven

enterprises engaging in innovation in such settings (Hart et al., 2015b; QUNO, 2015). Due to this difficulty, the micro-dynamics of innovation of how networks are composed and how knowledge and resources are produced, shared and adapted through interactive learning for the purpose of innovation, are unknown. Most importantly, appropriate policy interventions for individuals and groups in rural areas require understanding of innovation as a process (Mhula-Links et al., 2014). Innovation in rural areas and in the informal sector is a complex process in its nature and needs to be interpreted in its context.

Notwithstanding the progress that has been made in innovation studies on understanding actors' interactions, networks, institutions and learning, the experiences in less-developed countries (Daniels, 2017) are largely absent in the literature. Empirical evidence on rural innovation in the mainstream innovation literature is also limited (Triomphe et al., 2014; Singh and Bhowmick, 2015). Williams and Woodson (2012), Adebowale et al. (2014) and Daniels (2017), among other scholars highlighted that, a higher proportion of mainstream innovation studies are largely based on experiences in developed countries. Rural innovation activities by rural enterprises remain hidden and undocumented (QUNO, 2015; Mavhunga, 2017). The attempts to measure innovation by rural based enterprises beyond the simplistic view of innovation as invention are still in their infancy (Hart et al., 2014; QUNO, 2015). Evolutionary geographers point to the need to investigate the micro-behaviour of actors to strengthen theoretical frameworks and inform policy interventions (Urraya et al., 2017).

Departing from the premise that firstly, innovation is an interactive process of knowledge generation and use of local and non-local know-how, and secondly, actors are embedded in networks of heterogeneous actors, this research study pays attention to network components, interactive learning and institutional contexts of innovating enterprises in Mopani District, South Africa.

1.3 Formulated aim of the study

The broader aim of the study is to explore the compositional dynamics of actor networks and how these influence interactive learning and innovation among rural based agro-processing enterprises in South Africa. Specific objectives are:

a) To characterise actor networks for innovative learning among enterprises in rural contexts.
b) To investigate the kinds of actors and linkages that facilitates learning and innovation among rural enterprises.
c) To investigate the roles and functions of different actors within actor networks of learning and innovation
d) To explore the types of institutions that facilitate or hamper innovation process in rural contexts.

1.4 Research questions

The key question behind this study, is what are the compositional dynamics of actor networks and networking behaviour of socially and economically-oriented enterprises in rural areas of South Africa? In addition, the study sought to answer following questions:

a) What characterises actor networks for innovative learning among enterprises in South African rural contexts?
b) What are the roles and functions of different actors within actor networks?
c) What kinds of actors and linkages facilitate interactive learning and innovation among rural enterprises?
d) What types of institutions facilitate or hamper innovation processes in South African rural contexts?

1.5 Concept of “rural” or “rurality”

The term “rural” is a multifaceted concept with no standardised definition. Scholars often use socio-economic characteristics as a differentiator between rural and urban areas (Eager, Versteeg-Mojanaga, and Cooke 2014; Jacobs and Hart, 2012). This classification includes low population densities, larger travel distances from city centres, high dependence on agriculture and natural resources for livelihoods, and poor access to basic services, such as health care, education, electricity, water, adequate nutrition and economic opportunities as common characteristics for rural areas (Eager et al., 2014; Jacobs and Hart, 2012). Hart and Jacobs (2012), note two frames (economic and historical politico-legal) of classifying rural areas in the South African contexts and thus commercial farming areas and the former homelands or

traditional authority areas. Commercial farming areas are large-scale farming surrounding big cities, while former homelands or bantustans are areas constituted of villages and small towns (Jacobs and Hart, 2012).

There are notable differences in rural characteristics such as culture, demography, economy and the environment. And large commercial farming rural areas may share more similar characteristics with a metropolis than former homelands that are isolated in and around small towns. Former homelands rural areas in South Africa are characterised by small land holdings used for small scale activities for survival (Aliber and Hart, 2009). Although agricultural activities continue to be considered as the key sector in rural areas, other sectoral activities are observed such as services, artisanal manufacturing, tourism etc (Jacobs and Hart, 2012). Jacobs and Hart (2012), argue that the supply and demand of relevant skills in these sectors are underspecified. In the same vein, the informal economic activities contribute immensely to the standard of living for rural inhabitants. However, the contribution of these activities has seldom received scholarly and policy attention. Therefore, there is a need for research on marginalised rural areas.

1.6 Significance of the study

Innovation is recognised as a basic element of competitiveness. Therefore, innovation is of paramount importance in rural areas. With the increasing realisation of innovation as an engine for growth, development practitioners are confronted with the question of how best can policy support innovation in rural areas. In this context, this study argues that understanding the social dynamics of innovation can strengthen policy formulation and thus improve the competitiveness of rural based enterprises.

In South Africa, an overarching question has been how to build, strengthen and promote systems of innovation that will strengthen innovation in rural areas (Muchie, 2003). The latter presents a need for studies that focus on innovation in marginalised contexts. Ngwenya and Hagmann, (2011), Smith, Fressoli, and Thomas (2014) and others, have questioned the relevance of the conventional systems of innovation framework in rural and informal sectors. Although different factors contribute to understanding innovation, this study focuses on the social aspects of the innovation

process in a South African context. Thus the self-organising practices of actors and the complexity of innovative activities.

From a development or policy perspective, this study contributes to the current debates about South African innovation policy and the South African National Systems of Innovation (SANSI). The conventional national systems of innovation approach paid scant attention to the efforts, interest and practices of the rural and marginalised poor (Schot and Steinmueller, 2016) and contributed to social exclusion. An application of a broader framework that addresses the activities of innovators in relation to their contexts could provide insights into the dynamics of innovation in the rural sector, which could guide policy practitioners in the development of intervention programmes.

This study sought to contribute to three levels of innovation domains that integrate three theories i.e. Systems of Innovation (SI), Agricultural Innovation Systems (AIS) and Actor Network Theory (ANT). This approach provides insight on the micro-level of the systems of innovation. It also contributes to how micro, macro and meso levels can be linked to strengthen the national system of innovation.

Secondly, the study sought to contribute to the scholarly interpretation of rural based innovation. Various scholars, such as Mugabe (2009), Muchie (2013) and Hermans et al. (2013), emphasised the need for a greater understanding of the linkages, combinations, roles of actors and learning in the system.

Thirdly, the study sought to contribute methodologically to the research methods used to analyse rural-based innovation. The study adopted an exploratory case study using a combination of Rural Innovation Assessment Toolbox (RIAT) and Social Network Analysis (SNA). This approach provides a bottom-up approach and an actor and process-oriented method to exploring innovation in an informal context.

1.7 Outline of the study

This study comprises of seven (7) chapters. Chapter 1 is the study overview. It provides an introduction; problem statement; formulated aim and objectives of the study; research questions and an understanding of the concept of rurality. Chapter 2 of this study presents the theoretical and conceptual framework. Chapter 3 provides

a definition of conceptualisation of key concepts and critique of the literature. Chapter 4 is the research methodology. It provides the research approach adopted to address the research questions. Chapter 5 presents the findings of the research study, while chapter 6 provides general discussion of the findings. The last chapter presents the conclusion and recommendations.

CHAPTER 2

THEORETICAL AND CONCEPTUAL FRAMEWORK

2.1 Introduction

Rural innovation is embedded in social structures, which form a system of networks. However, the discourse on innovation processes in rural contexts has focussed on the diffusion of technologies (QUNO, 2015). The systems of innovation perspective involving actor-oriented approach is employed to explore the social dynamics of actor and learning trajectories among rural-based innovators. The theories grounding the study include; systems of innovation (SI), agricultural innovation systems (AIS) and actor-network theory (ANT). A combination of these theories provides an actor and process-oriented approach that allows exploration of the dynamic nature of innovation processes in rural contexts. This chapter deliberates the theoretical lens through which the social dynamics of innovation are viewed. Actor networks, interactive learning, and institutions are themes that lay the basis for understanding the micro-level activities of actors, and are discussed in the conceptual framework.

2.2 Theoretical framework

In rural contexts, innovation is understood as a process of introducing new or making adaptations to products, processes, organisational and marketing strategies that add value to social or economic outcomes (Singh and Bhowmick, 2015). Current theories of innovation tend to focus on innovation as an output the of innovation process in formal sectors. This study applies SI to seek explanations about the systemic nature of innovation and ANT to investigate how networks forms evolve over time, and how actors are brought into the network. Network components, learning patterns and institutional contexts are explored to unearth the social dynamics of rural actor networks and innovation.

2.2.1 Systems of Innovation

The SI framework is proposed as one of the important approaches to studying the process of innovation. SI considers innovation as a systemic and complex process

that depends on interactions between innovation actors and their environment (Lundvall, 2010). It pays attention to both structure (networks) and processes (learning processes) (Foster and Heeks, 2013). SI, anchored in evolutionary economics, emerged as a corrective and alternative approach to neo-classical economics. The evolutionary economic perspective introduced a non-linear systems of innovation (Nelson and Winter, 1982), in which the institutional setting facilitates innovation activities.

The SI approach became widely diffused and popularised in the work of Freeman and Lundvall in the 1980s (Freeman and Lundvall, 1988). However, the idea of National System of Innovation (NSI) dates back to Frederick List's idea of national systems of political economy (1841). Debates in the literature on NSI led to the development of SI concepts that looked at innovation at the regional level (Cooke et al., 1997), sectoral level (Malerba, 2002), local level (Mytelka, 2000) and technological level (Carlsson and Stankiewitz, 1995). Innovation networking and interactive learning are embedded in a social, cultural, political and economic environment (Hart et al., 2012).

SI is defined as a group of elements and their relations that have an influence on the development, adoption, adaption, implementation and diffusion of various types of innovations within a given socio-economic space or region. Social, economic, political and institutional actors play a crucial role in social and economic development through innovation processes (Hart et al., 2012). Learning and networking are central to innovation in, and at different levels of the society (Edquist, 2010; Booyens and Rogerson, 2015). Esparcia (2014), among others, coined the idea that geographical proximity and institutional proximity has become critical for innovation processes. To understand the socio-economic dynamics of rural innovation, the characterisation of actor networks as a locus of innovation becomes necessary. Actor networks act as a foundation for innovation systems (Lundvall, 2010), and they bring together local and non-local actors through the process of learning and innovation (Esparcia, 2014).

The conventional NSI was developed, using specific experiences in developed economies (Muchie, 2013; Joseph, 2014; Adebowale et al., 2014; Daniels, 2017). The emphasis was on finding ways to organise science, technology and engineering

for increased economic development (Muchie, 2016; Daniels, 2017). The concept of NIS was adopted by many industrialised countries in the late 1990s (Eklund, 2007, Muvhunga, 2017). The earlier version of NSI encouraged the establishment of an institutional set-up of public and private actors that fostered knowledge and skills transfer which produces research and development (R&D) based innovation (OECD, 1997). The earlier version of NSI faced critics and failures in less-industrialised economies (Muchie, 2003).

The application of the conventional SI in less-developed economies assume the existence of formal and fully functional innovation structures and institutions (Lorentzen, 2010). In rural context, innovation systems are either non-existent or dysfunctional. They are largely characterised by structures and institutional frameworks that are informal (Joseph, 2009; Daniels, 2017). Hart et al., (2012) argued that both formal entities (such as firms, research institutes, universities) and informal entities (such as NGOs, micro-enterprises, community cooperatives, and small-scale farms) engage in the process of innovation in rural areas (Hart et al., 2012). However, such interactions between formal and informal actors remained unexplored. The question of the nature of SI, if they exist in rural contexts and who are the innovators are unanswered (QUNO, 2015).

Muchie (2016), in his writing on systems of innovation in an African context, argued for an SI for integrated development that consider a combination of social, economic and environmental factors, as well as knowledge, learning, innovation and capability building. In spite of the presence of critiques about the NSI framework, the SI perspective remains relevant to studying innovation in the informal sector. Studies on AIS acknowledge that innovation in the agricultural sector and rural areas is a multifaceted process that is affected by institutional, environmental, socially, economic and technological factors. These factors are considered crucial in the systems of innovation framework (Foster and Heeks, 2013). With a focus on the micro-level of the SI, the theoretical lens enables the researcher to map out actors and explore the institutions that facilitate innovation in rural context. This can also lead to the identification of actors and on how such actors could be integrated into the macro- and meso-levels of SI. Furthermore, SI emphasises the importance of

learning, cooperation, and knowledge exchange in networks, and interdependencies among actors and institutions (Markard and Truffer, 2008).

South African National Systems of Innovation (SANSI) consider government institutions, research institutes, higher education centres and formal private sector actors as key actors in NSI to promote innovation (DACST, 1996). The NSI framework has faced critiques for paying scant attention to the informal sector (Hart et al., 2012). In an effort to strengthen the NSI, indigenous knowledge systems (IKS) was adopted. IKS recognises traditional activities in South African rural activities and it also encourage collaborative effort in innovation (DST, 2004).

SI is integral in understanding the nature of innovation and could be analysed at different levels, at regional, national, sectoral, and technological (Markard and Truffer, 2008). This study considered insights from both regional innovation systems (RIS) and sectoral innovation systems (SIS), as the concept of innovation was partly territorial and to a large extent based on regionally or sectorally-centred networks of innovators (Doloreux and Parto, 2004). Additionally, RIS highlighted the importance of specific regional resources available to enhance innovation and entrepreneurship (Doloreux and Parto, 2005).

The concept of RIS has been gaining increasing attention from policymakers and scholars since the early 1990s as a framework for understanding innovation process in a region of an economy (Doloreux and Parto, 2005). The RIS approach recognises the uneven geography of innovation and the complexity of the process of generating knowledge (Asheim, Grillitsch and Trippl, 2016). In less developed contexts, the question remains as to whether a RIS even exists (Asheim, Grillitsch and Trippl, 2016). Thus, key regional actors may be poorly integrated into networks and may not able to foster innovation. Nevertheless, it is argued that innovation processes can also be understood by examining micro-specific or sector-specific trajectories of innovation.

The concept of SIS was coined by Franco Malerba (2002). The SIS approach is useful to examine the differences and similarities in the structure, boundaries of sectors and factors affecting innovation within and across sectors (Baskaran and Muchie, 2017). The sector-specific approach focuses on (i) knowledge and

information flow, (ii) actors, networks and institutions and (iii) links between these actors. A sector is composed of actors, agents and institutions that interact through market and non-market linkages to generate knowledge for the purpose of innovation and its commercialisation. Even though a sector-specific approach has many advantages, it also has disadvantages. One of the noticeable challenges is that it may be difficult to distinguish between national and sectoral boundaries as interactions between actors are influenced by institutions at both national and sectoral levels (Baskaran and Muchie, 2017). Despite the limitations of RIS and SIS, they still provide valuable insights in understanding the interplay between different levels of systems of innovation within a nation.

Generally, there is limited research work in mainstream innovation studies that focuses on systems of innovation on the bottom billion (Lorentzen, 2011), with less published work that documents innovation in these contexts (Joseph, 2014). Nonetheless, prevailing work on innovation recognises innovation in agriculture and rural sectors (Kraemer-Mbula, 2011; QUNO, 2015). The rural economy is the key developing sector in most developing countries. Most of the contributions to SI perspectives in rural economies come from the work produced in AIS. This makes AIS relevant for examining networking and innovation among rural enterprises. The AIS perspective looks at innovations beyond the technocratic elements of science-based innovation, and considers non-technical innovations. It emphasises a wide range of actors that contribute to developing such innovations (Kraemer-Mbula, 2011).

2.2.2 Agricultural Innovation Systems

For a long time, agricultural innovation has been concerned with discovering and transferring new technologies to farmers for improving production. The dominant strategy was that investment in research R&D could enhance innovation (QUNO, 2015). Nonetheless, the conventional understanding of innovation as inventions, technology transfer and adoption has faced criticisms for not reflecting on the complexity of agricultural systems, which led to changes in the systems thinking in AIS. Over time, new organisations and institutional arrangements were established in the agricultural sector. The earliest approaches were the national agricultural research system (NARS) framework; agricultural knowledge and information system

(AKIS) and training and visit (T&V). The latest change or shift is AIS, which was grounded in the NIS perspective.

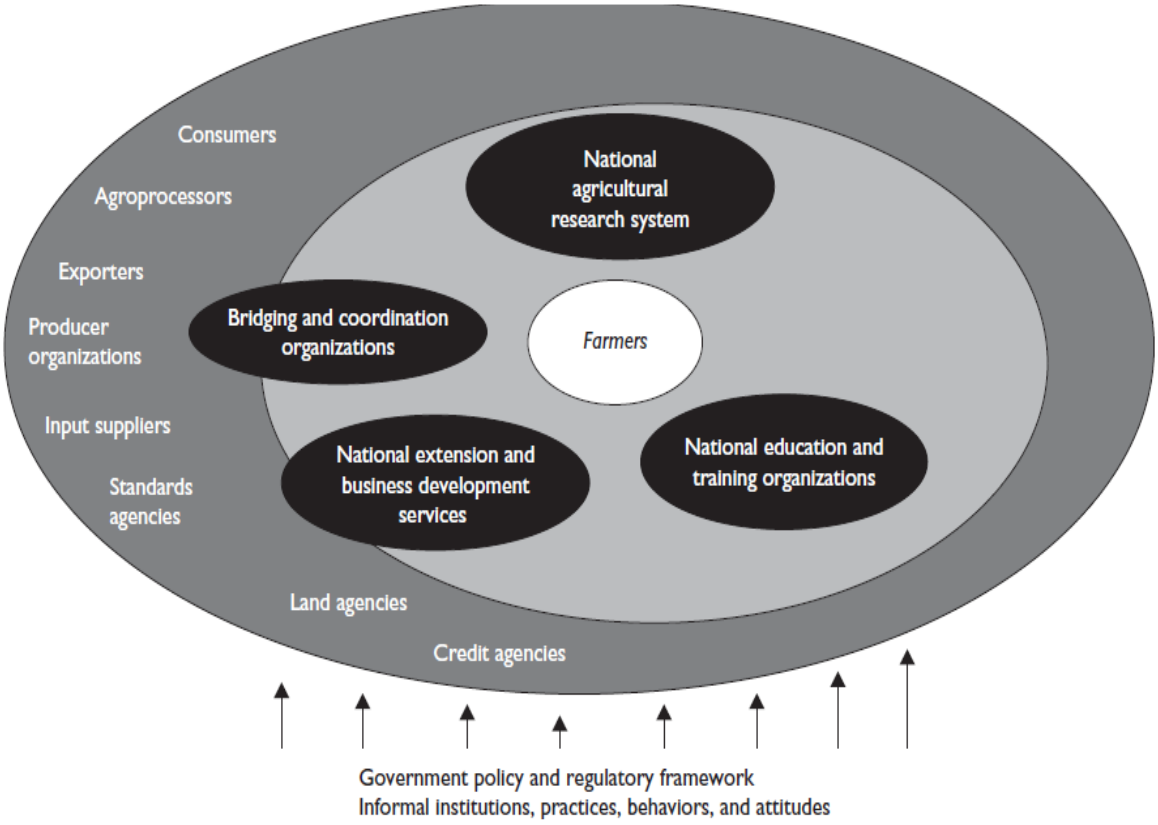
The *national agricultural research system (NARS)*: The NARS framework is about strengthening research capacity and knowledge production through infrastructure and policy support (World Bank, 2006 cited by Ayinde and Muchie, 2014). NARS is concerned with a top-down, linear approach to R&D.

The agricultural knowledge and information system (AKIS): This system links people and institutions to promote mutual learning and generate, share and utilise agriculture-related technology, knowledge and information (FAO and World Bank, 2000). According to Berdegué and Escobar (2001), AKIS distinguishes between agricultural research and extension, and innovation and technological change. A key focus is on innovation and other institutional arrangements to promote learning.

Training and Visit (T&V): The key focus area of T&V is in training of farmers, allowing them to practice and visit the farms to ascertain the adoption of the technology (Ayinde and Muchie, 2001). TandV emphasises the role of extension services in agricultural development. Little attention is paid to networking and interaction with other actors (Ayinde and Muchie, 2014).

Figure 2.1 presents a framework for AIS. The figure shows the main actors, interactions between actors as well as policies, institutions and many other external factors that affect the innovation process. Research, extension, education, and training are key components of AIS (World Bank, 2012).

Figure 2.1: Conceptual framework of AIS



(Source: World Bank, 2012)

Agricultural innovation systems (AIS): Over the years, the conventional technology transfer model had dominated in innovation in the agricultural sector (QUNO, 2015). Systemic thinking in innovation in the agricultural sector was only adopted recently, culminating into the AIS. In the AIS context, innovation is viewed as a process that results from complex interactions among heterogeneous actors stationed in a particular context (Klerkx et al., 2012; QUNO, 2015). In recent decades, the AIS perspective has become increasingly applied as a framework in AIS (Klerkx, Aarts and Leeuwis, 2010). The processes of networking and interactive learning that takes place among different set of actors are at the centre of an AIS approach (Klerkx, Aarts and Leeuwis, 2010; Spielman et al., 2011; QUNO, 2015).

The proponents of an NSI perspective have maintained that innovation emerges from interactions and knowledge flows between different actors in the public and private sectors (Spielman et al., 2011). This is in contrast with the conventional

technology models that viewed innovation as a process whereby farmers are passive adopters of knowledge, produced by research and development-driven organisations. In the agricultural sector, innovation is not confined to formal R&D organisations but other actors, including those in the informal sector who have a role to play (QUNO, 2015). Thus, innovation could result from different interaction processes and it could have multiple sources. These innovations may be a result of a combination of new institutional and organisational arrangements (QUNO, 2015).

Klerkx et al. (2012) highlight the role of infrastructure, policies, institutions in enhancing innovation in the agricultural sector. This perspective qualifies the role and existence of networks in an innovation system. Actors are embedded in the networks to access new knowledge and resources (Esparcia, 2014). In this case, AIS can be viewed as self-organising and growing networks of actors, collaborating in a cohort that is in pursuit of developing a certain novelty and making some improvements of existing innovations (Klerkx et al., 2012).

In less developed economies, some of the actors are poorly embedded in the NSI and institutions are weakly developed and poorly enforced (Szogs, Cummings and Chaminade, 2009). Another key feature of innovation systems in less-developed economies is the dominance of informal innovations and networks, as well as high number of micro-enterprises (Szogs, Cummings and Chaminade, 2009; Iizuka, 2014). These economies are characterised by a dominance of small-scale farming and farm-related activities. In the process, the agency of actors and the socio-institutional environment play a key role. Institutions (policies and rules of the game) matter; they influence the behaviour of the innovators and their interactions (Klerkx et al., 2012). Esparcia (2014) argues that different elements of the systems of innovation, i.e. geographical and institutional proximity, have a great effect on the adoption, adaptation and transfer of different types of innovation in the local context. In the same vein, the establishment of functional networks that act as the foundation of AIS is necessary for the combination of local and external knowledge (Esparcia, 2014).

Actors engage in interactive learning processes to share knowledge. But interactions in innovation processes could be both – science, technology and innovation (STI) mode, and doing, using and interacting (DUI) mode (Jensen et al., 2007). STI is

based on the production of codified scientific and technical knowledge through formal institutions while DUI is based on the exchange of knowledge in tacit form (Jensen et al., 2007). Innovation is therefore understood as a social learning process that considers the roles of supporting actors (QUNO, 2015) and a functional system of innovation could, for this reason, be regarded as a “social system” (Soumonni, 2016).

In essence, a systemic nature of innovation processes through a social system requires a collective effort of public and private actors, as well actors in rural areas through actor networks that are rooted in areas where rural innovators operate (Soumonni, 2016). For instance, government and private sector actors played a key role in the cassava innovation systems in Ghana and Nigeria (Gatune, 2016). This presented a system geared towards producing social and economic gains to a wider community (Muchie, 2016). Little is known about the nature of actor networks in emerging systems of innovation and how the composition of these networks affects the innovative and learning capabilities. For instance, Hermans et al. (2013) alluded to the need to understand the functions and roles of heterogeneous actors in innovation processes, while Hart et al. (2012) raised questions about who the actors were, and how their networks functioned.

2.2.3 Actor Network Theory

ANT is also known as the sociology of translation. it originated in the mid-1980s in the work of Bruno Latour, John Law and Michael Callon in an attempt to understand the role of actors in Science, Technology and Innovation (STI) activities. Actor network in ANT is considered as a heterogeneous amalgamation of actors and inanimate entities and are referred to as actants. An actant, be it an individual or group, can associate or disassociate with other actors at any given time (Crawford, 2004). According to Crawford (2004) each actant is equally important in the process of innovation. Analytically, ANT provides a detailed description of a network and treats network builders as primary actors (Cresswell, 2010). From this viewpoint, complex relations between actors (governments, technologies, knowledge, texts, money and people) can be explored in rural areas, providing insights on social dynamics in innovation processes.

Under ANT, innovation is viewed as something that does not have fixed characteristics but rather as something that transforms through the process of improvement and use (Harty, 2010). Harty (2010) added that the effects of non-human actors or innovations on the networks in which they were developed, emerged from the associations and reconfigurations. Thus, an actor is anything that causes action and an actor can only act in relation with other actors (Cresswell, Worth and Sheik, 2010).

ANT does not separate science and technology from social processes but rather tries to integrate science and technology into social processes (Crawford, 2004). It further dismisses the idea that social relations are independent of non-human actors (e.g. technologies) (Latour, 2005). According to Cressman (2009), ANT can be used as a tool to explore the complexities of a sociotechnical world. It does not differentiate between entities but rather values the relation between entities and suggests that any entity reaches its significance in relation to another (Crawford, 2004).

An ANT-oriented approach is positioned to provide an understanding of the composition and development of actor network. ANT examines the nature of networks, actor identities, actor roles, activities and their outcomes, and the influence of resources on actor behaviour (See Latour, 2005). In the context of this study, an ANT-oriented approach could reveal micro-level activities, as well as the cultural, political, economic, and institutional environment that influence innovation processes among innovating enterprises in rural areas. This said, the elements of ANT provide a means to examine actor networks and the introduction, adoption, implementation, improvement and use of various types of innovations in rural areas.

ANT is concerned with understanding actors (human and non-human) and their interactions (Cresswell et al., 2010). Moreover, ANT is a useful tool to examine spatial relations and how they became a network of actors (Murdoch 1998:357). The main elements of ANT are the actor world, translation and the actor network. the actor world looks at how heterogeneous networks are formed, how they function, and how they change over time (Cresswell et al., 2010; Hu, 2011). Therefore, the notion of actor network refers to the amalgamation of human and non-human actors, such as machines and animals (Crawford, 2004).

Actor-network theorists refer to translation as the process of building networks. The translation process presents an approach to understanding the nature and composition of network space. According to Schneider et al. (2012: 244) translation explains the processes where network actors' identities, features, attributes, behaviours and interests of entities are (re)defined or (re)constructed with the intention to establish relations. Translation involves four elements to fulfil its objective: problematisation, which seeks to identify and define actors in relation to their contribution in the network; interessement/interposition which is about aligning actors with their roles; enrolment refers to a state when actors become part of a network; and mobilisation seek to explain the act of persuading other enterprises to become part of the network (see Callon, 1986).

Translation is a continual activity in network formation. Actors enter and leave networks as they want. The focus is not necessarily on interactions among actors but on the distribution of roles and seeking resources necessary for innovation. In this process, it is important to get buy-in from all participants to get resourceful actors to join the network. Crawford (2004) notes that understanding how and why actors translate is crucial to networking activity and performance to ensure familiarity, similarity and simplicity. ANT can zoom in on the patterns of networks at any point in time and the roles and objects of exchange in the network (Cresswell, Worth and Sheik, 2010), explaining how networks are ordered and reconfigured. This also deals with different attributes of actors and how they influence innovation and learning.

2.2.4 Discussion of the theoretical lens based on SI, AIS and ANT

In general, the SI and AIS approaches are relevant as a framework in innovation studies. These approaches are relevant as conceptual frameworks for innovation in rural contexts. Nevertheless, they have notable shortcomings. They have emphasised research and development artefacts as beneficial novelties and the social aspects of innovation remain underplayed. In addition, innovation in the informal sector received limited attention. The SI approach may need to be adapted or combined with other approaches to understand innovation that caters for the social aspects in rural contexts (Muchie, 2003; Iizuka, 2013). In this study, SI and AIS approaches are combined with ANT. ANT is relevant to rural contexts as it explicitly considers the network components. An "actor network for innovative

learning (ANIL)" framework is proposed to explore the social nature of innovation among innovative enterprises in rural contexts.

The actor network for innovative learning proposes an actor and process-oriented analysis that recognises the outward looking behaviour of innovating actors in under-researched settings. ANIL provides a necessary first step for promoting and understanding the key features of innovation that is concerned with solving both social and economic challenges. Under ANIL, actor networks and interactive learning concepts are looked at separately. In this context, Hart et al. (2015) suggests that an approach that focuses on actors and their micro-behaviour is crucial for understanding innovation in marginalised contexts.

To sum up SI, AIS and ANT: among these, SI overlooks the social practices of individual enterprises in rural contexts; AIS is grounded in the SI, it has inherited some of the limitations of an NIS perspective. In AIS, small-scale producers are not explicitly recognised as innovators but rather as users of innovations developed by formal firms (Joseph, 2017). ANT's materialistic view discounts the agency and the role of institutions in the process of innovation. Nonetheless, an integration of SI, AIS and ANT provides theoretical lenses for exploring the compositional dynamics of actor networks for innovation in a rural setting.

It is acknowledged in the literature that rural contexts comprise of complex networks, but they rarely received scholarly attention (Szogs, Cummings and Chaminade, 2009). Following an AIS perspective, small-producer innovations are often need-based and solution to local challenges and problems driven (QUNO, 2015). QUNO (2015), among others, reiterates that the role of small-scale farmers remained largely unacknowledged in the innovation process. The conundrum of innovation processes in rural contexts present a need for systematic research to grasp a nuanced picture of the dynamic nature of networking and learning for innovation.

Networking and learning is at the core of innovation but how network attributes relate to learning and innovation in rural contexts is under researched. The proponents of SI have emphasised the role of networking, learning, and institutions, particularly in formal structures. Several scholars (Muchie, 2013; Joseph, 2014; Adebowale et al., 2014) have questioned the applicability of the standard SI framework in the informal

sector. Thus, the NSI needs to be broadened to assist in understanding the processes of innovation in complex and dynamic innovation systems in rural contexts (Muchie, 2013). The starting point would be to investigate who the actors in rural contexts are, what characterises their innovation networks (compositional dynamics), which institutions are present, and what institutional support is necessary for innovation in these contexts.

Since the early 1990s, the system of innovation approach has been accepted and used as a framework for public innovation policies in many countries (Marcelle, Nkhumise and Vawda, 2013). Many governments have facilitated institutional arrangements that fostered research and development, interactive learning and innovation, but the extent to which rural enterprises have experienced support of this nature has not been identified (Marcelle, Nkhumise and Vawda, 2013).

Evolutionary and institutional economists using the concept of NSI, embarked on research that focused on how knowledge was created and adapted through interactive learning processes. Most of their work paid attention to how systems and networks evolved and how institutions influenced innovation at meso and macro-levels in established systems of innovation. Thus, research on NSI has focused on multiple actors including governments, universities, industry and capital to understand innovation processes. Despite the existing contributions in the innovation systems literature, the questions about the roles and functions of different actors, the linkages between economic and non-economic actors, and the process of learning and innovation have remains unanswered. Thus, the relation between the technical and non-technical aspects of innovation remains unknown.

This study argues that the systems of innovation framework should be modified to recognise third-sector enterprises as innovators. Small scale producers play a key role in solving societal challenges through innovation. The role of informal activities should be taken cognisance of to better understand innovation processes in the informal sector (Bhaduri and Sheikh, 2013). Little is understood about the initiation and origination of innovation in under researched areas.

ANT is concerned with understanding the properties of actor networks, how they are distributed, and how they have evolved. The ANT approach is useful in studying

innovation processes in rural contexts: it helps to conceptualise complexity and fluidity of the social world. It appreciates reality and helps develop a picture of the dynamic actor relations and how they are connected to each other. The central idea in ANT is tracing relations between network actors. It looks at how networks come into being, the nature of links, how actors become part of a network, and how networks function. The composition of networks is particularly important in a system. A long-standing assumption of ANT is that it puts value on materials, while humans provide a good tool to investigate the interrelations and the influence of knowledge and resources on innovation process. The inclusion of non-human actors (inanimate entities) distinguishes it from other network theories (Hu, 2011).

ANT conceives networks as being materially heterogeneous and it is concerned with the process of how these actors are brought together (Hu, 2011). The characteristics of actors and their activities have an effect on the nature and functioning of actor networks (Cresswell et al., 2010; Cressman, 2009). According to Crawford (2004), ANT provides a conceptual framework for interpreting the processes through which actor networks are examined. ANT appreciates the multiple realities performed by different actors in different contexts (Cresswell, Worth and Sheik, 2010). Thus, the innovation dynamics in one context may not be predicted using experiences in the other contexts.

Like many other approaches, ANT has its limitations. The literature highlights the fact that ANT does not consider actor attributes, actor intensions to collaborate, routines, learning experiences and culture (Cresswell, Worth and Sheik, 2010). For this reason, an SI perspective needs to complement ANT. In addition, ANT does not view the world into macro, meso and micro in its application as a tool but focuses on investigating the micro-level. Nevertheless, ANT is conceptually relevant to explore the complexity of rural enterprises, their interactions and the flows.

The social dynamics of innovation form the core of the necessary and sufficient conditions and support for innovation-driven development in rural contexts. Understanding these dynamics would be the first step in recognising the potential role of rural innovation actors, including famers, and building institutional contexts that facilitates their capabilities in addressing challenges of poverty and inequalities. In addition, this could assist in finding ways to link research and development to rural

innovation activities. The relevant SI, AIS and ANT elements relevant to this study are presented in Table 2.1. The three theories adopted as the framework for investigating the social dynamics of innovations are broad and dynamic. Innovation processes in rural contexts could be understood through actor attributes, network composition, learning and institutions. These aspects are intertwined with actor networks for an innovative learning framework, which involves actor network components, interactive learning patterns and institutions.

Table 2.1: Summary of some key elements

Element	Description
Actor	Enterprises, organisations, Individuals and resources
Innovation	Products, new processes, organisational arrangement and marketing strategies
Relations	Close, lose or flexible relations, formal or non-formal, local or not
Learning	Implicit and explicit, wider social processes
Institutions	Research institutions; High education training; Public agencies; Formal and informal rules
Actor enrolment	Position in the actor network and involvement in innovation activities
Translation process	Roles of diverse actors, patterns of knowledge sharing, network effects

(Source: Author)

2.3 Conceptual framework

This section on the conceptual framework seeks to provide direction to the study. Grounded in SI, AIS and ANT, three constructs are selected as analytical lenses. The lenses applied include 1) network components (actor attributes, links and flows), 2) interactive learning and 3) institutions. The lenses try to explain the social dynamics of actor networks and innovation in rural contexts. The framework allows the exploration and identification of relevance of particular actors, interactive learning patterns, as well as the institutional context that influences innovation process and formation and functioning of network systems.

The study adopted SI for the following reasons: it espouses a holistic approach to innovation; it places networking and interactive learning at the centre of focus; it

embraces the roles of institutions among actors involved in innovation processes; and it considers the interdependence of actors in networks and innovation processes. Nonetheless, the conventional SI approach does not embrace the so-called rural micro-enterprises (Nur, 2012) or the non-conventional actors (Iizuka, 2014) and their role in innovation. This research is believed to offer insights into how actor networks interact with rurality. The deployment of an ANT-oriented approach to rural innovation could show that the social dynamics of an innovation value chain interact with various components in rural contexts.

The framework rejects the conventional linear perspective that views innovation as technological change and adopts innovation as an interactive learning process among actors. An innovation system is viewed as a single unit, comprising actors, innovation activities the actors are involved in, their interactions and ways of learning, and the institutions that govern their practices and behaviour. Systems can be found on several levels, e.g. national, sectoral, regional and local (Geels, 2004; Lundvall, 2007; Lam and Lundvall, 2007). A system involves two or more components with some relation among them in the pursuit of a common goal (Edquist, 2010).

The study commences with a conceptual discussion, based on systems of innovation and ANT, and resumes by studying how local enterprises generate, exchange and use new knowledge to create new or improved products, services, new methods of production, new ways of marketing products, and organisational arrangements through actor networks in rural areas. Innovation as a process refers to the social processes that result in innovation development, such as interactive learning, searching and exploring (Johnson and Lundvall, 2001). The core elements of SI that relates to structure and process are the following: innovation; actors; learning; relations and institutions (Foster and Heeks, 2013). With reference to the adopted framework, the focus is on innovation in a rural context, rural actor networks and actors, interactive learning practices, relations and institutions. The contributions of the concept of translation and actor enrolment are used to offer more insights into understanding the innovation space.

2.3.1 Rural innovation activities

In marginalised contexts, innovation takes a distinct form. It relies on both traditional knowledge and conventional knowledge (Mhula-Links, Hart and Jacobs, 2014). Such innovations provide value to the society (Marcelle, 2014). Innovation includes processes and outputs (OECD/Eurostat, 2005). These processes or activities include; the creation of new innovations, the use of innovations; their improvement, their transfer. And outputs include; products, processes, marketing strategies and organisational arrangements (OECD/Eurostat, 2005).

2.3.2 Actor network components

Following Conway and Steward (2001), the study pays attention to actors, links and flows. In this study, actor enrolment is endorsed and tailored to embrace network dynamics related to properties of network members, such as resourcefulness and position in the network. Actor attributes, links and flows determine the capacity to participate in innovation activities and influence innovation outputs. ANT's translation process explains the roles of actors, information sharing and learning activities. Translation tries to describes how actors strive to sell ideas to others and generate sustained support for these ideas (Crawford, 2004).

An actor network consists of nodes and linkages. The nodes represent actors while linkages represent various types of relations between actors (Martin, 2013). Networks can be based on both formal linkages (contract based) and informal linkages (joint membership in a group). They are often created with an intention to develop a specific innovation, while some of the actor networks are of a social nature and embedded in inter-personal relations (Martin, 2013). These networks are not static but evolve over time (Klerkx and Aarts, 2013).

2.3.2.1 Network and actors

A network consists of a set of actors along with a set of linkages of a specified type that links them into an actor network (Borgatti and Halgin, 2011). Network linkages are differentiated into two types: states type and event type (Borgatti and Halgin, 2011; Berrou and Combarneous, 2012). State type linkages have continuity over time. They include kinship (e.g. father) roles and affective relational linkages, while

the event type linkages are short-lived in nature, for example, email exchanges over transactions (Borgatti and Halgin, 2011).

A distinction can be made between formal and informal actor networks (DeBressen and Ammese, 1991; Head, 2008; Shearmur, 2011; Huggins et al., 2012; Klerkx and Aarts, 2013). Formal networks are those collaborative practices and activities based on a contractual basis (Van Aken and Weggeman, 2000). They can be formed with a deliberate action or goal. Examples of formal networks include strategic alliances and joint ventures (Van Aken and Weggeman, 2000). The contractual agreements in a formal network setup specify the objectives of the network, the goals, the anticipated contribution by each actor, and network life (Van Aken and Weggeman, 2000). Formal networks consist of regulations, contracts and rules that link actors and activities with varying degrees of constraint while informal ones are mainly informal in nature, linking actors through open chains and very difficult to measure (Freeman, 1991; Fischer, 1998).

Unlike formal networks, informal actor networks are not based on detailed contractual agreements. They can emerge at any time and level in an innovation process. Informal innovation networks have an emergent character; they are not created with a deliberate action but emerge organically as a result of interactions of enterprise representatives (Van Aken and Weggeman, 2000). However, in some instances, informal networks emerge as a deliberate action by the mobilising actor (Van Aken and Weggeman, 2000). Actors often collaborate into informal networks based on mutual trust. In informal networks, collaborative activities have loosely defined boundaries.

In both formal and informal collaborative arrangements, we can observe unilateral exchanges, bilateral and multilateral exchanges of innovation know-how. According to Van Aken and Weggeman (2000), in some cases knowledge is exchanged for financial gains and in some cases for the sake of knowledge itself. The latter shows the importance of reciprocity in network relations particularly in bilateral network relations.

In enterprise innovation, network forms are observed among a wide range of enterprises. In many cases, networks are formed by different enterprises belonging to different industries and sectors (Corsaro et el., 2012). These actors have different characteristics and resources which influence their level of importance in a network. These actors include NGOs, community cooperatives, local associations, traditional offices, small individual enterprises, government agencies, local and district municipalities. Actors engage in learning and innovation networks for different reasons and at different levels in a value chain.

2.3.2.2 Links and flows

The nature of linkages between actors influence the structural composition and functioning of the actor networks (Jack, 2005). Borgatti, Everett and Johnson (2013), assert that linkages characterises networks. These network linkages facilitate that circulation of knowledge (van der Valk, Chappin, and Gijsbers, 2011). Some of the network linkages are non-contractual and informal in nature, often distinguished by both formality and informality. The features of interest include the strength of relations and the formality and informality of relations.

The strength of linkages in a network defines the quality of a relation (Jack, 2005). Nonetheless, there have been conflicting claims about the benefits of both weak and strong network linkages (Jack, 2005). The network linkages can also be differentiated by their content or flows such as resources. Thus, the content of linkages could define the strength of the linkages. For instance, Berrou and Combarnous (2012) and Jack (2005), argue that the actual objects of exchange (flows) are more important than the level of interaction in a network.

2.3.3 Interactive learning process

The process of interactive learning is undertaken by organisations in innovation networks. Lundvall (1996) argued that strategic know-how and competencies in innovation are developed interactively and shared in innovation networks. Consequently, innovations networks are drivers of interactive learning (Asheim et al., 2011). In addition, organisations use different forms of networking and collaboration to improve the process of interactive learning (Lundavall 1996; Lam and Lundvall

2007). Bessant et al. (2003) emphasise that networking is aimed at increasing knowledge through forms of interaction.

There are different types of innovation networks (Powell and Grodal, 2005), but, how these network types shape the process of interactive learning has not been clearly identified. There is scant literature available that entwines the two strands of ideas of interactive learning and innovation networks. In the organisational learning literature, the basic idea is that the way an organisation is structured and the routines followed will have a major effect on the rate of learning that takes place. Therefore, the conditions under which interactive learning (for example, organisational forms and networks) take place, play a fundamental role in directing the process of learning for innovation. Interactive learning brings together different actors from across sectors and regions (Lam and Lundvall, 2007). In this context, the question that is being explored is how forms of networking shape interactive learning in rural settings. Lundvall and Lam (2007) highlight that social capital plays a crucial role in interactive learning. Amin and Cohendet (2000) points out that during this learning process, individuals and organisations share experiences, communicate and negotiate. Interactive learning is not defined in terms of duration. In formal setting, interactive learning mechanisms are in codified form. There are few linguistic and cultural constraints for the transfer knowledge because multilateral system of trust relations can most easily be organised (Lundvall et al., 2002:222).

2.3.4 Institutions

Under the SI framework, institutions are recognised as rules of the game. They influence the behaviour of actors which engage in the innovation process. Institutions also refer to formal bodies that provide support to actors in a system of innovation (see Heeks and Foster, 2013). In this context, institutions have a significant relevance to understand the social dynamics of innovation in less understood settings. Innovation is influenced by both formal and informal institutions (Foster and Heeks, 2013). Enterprise behaviour and functioning is influenced by local institutions. However, it is also critical to examine formal rules that may impact on innovation process.

The innovation process is affected by institutions at different levels; international, national, regional and local levels. In rural contexts, whether or not these institutions are favourable is unknown. In South Africa, the government through their innovation policies attempt to promote institutions that are effective. Such government instruments include the white paper on innovation (DACST, 1996). In the context of this study, it is necessary to explore the institutional context and make up that influence innovativeness in marginalised and less researched rural areas.

This study seeks to provide insights on how institutions influence network composition, learning and innovation. It identifies existing institutions and explores the role of institutions in shaping innovation process in rural contexts. Sotarauta (2017), asserts that the roles of specific institutions in innovation process are poorly understood and little appreciated. Exploring the institutional make up in rural contexts contribute to understanding the social dynamics of innovation. It further enables us to identify gaps in intervention programs and strategies.

2.4 Summary and research questions

This study uses a combination of ANT and SI as the theoretical lenses to understand the social dynamics of innovation among rural based enterprises. This approach allows in depth exploration of the composition and function of actor networks pertaining to innovation activities.

With the aim of unearthing the compositional dynamics of actor networks in relation to learning and innovation, this thesis uses actor network components, network activity, innovation activities and institutions grounded in both ANT and SI. The key themes are presented in Figure 2.2. The themes included actor network composition, technical and social aspects of innovation and innovation output or change.

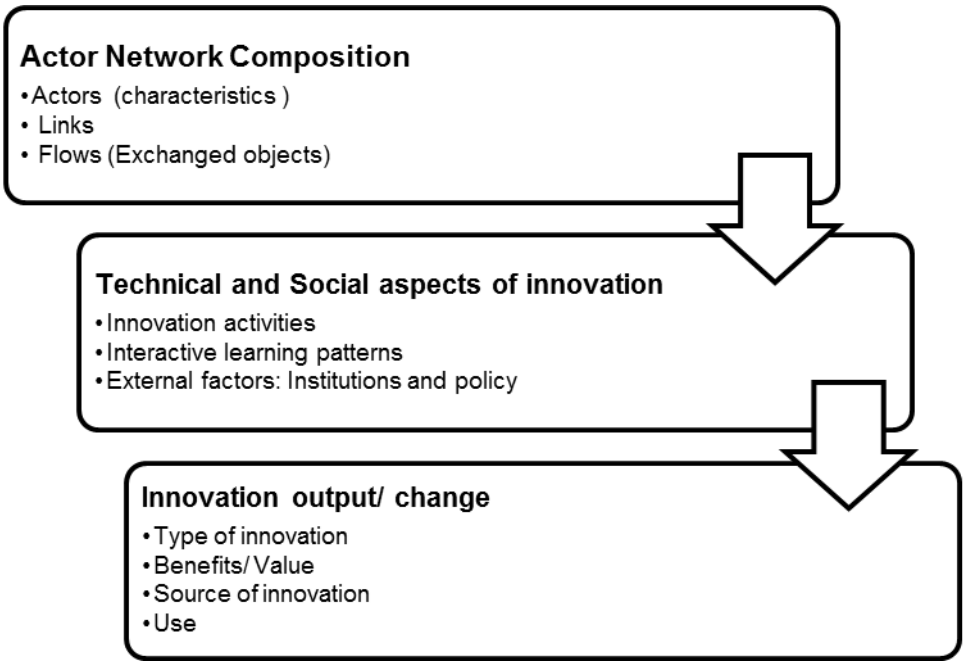
Actor network composition: This is the part that addresses the network environment. This part relates to the structure of the network and characteristics of heterogeneous actors. There is a need to identify and profile actors in rural innovation systems, examine their roles and functions in the system, and to form networks. The actor-network composition relates to the process of translation in ANT. This part seeks to explain the relational factors, associated enterprises, and material elements at

different levels of the network. It also explains the process of translating the interest of enterprises to align them with the actor network.

- Technical and social aspects: this broadly covers the social practices, technical practices, learning patterns, as well as the institutional environment. Innovation processes are affected by the social, cultural, political and economic environment.

- Innovation output or change: Innovation is understood as both a process (collaborating within networks and participating in interactive learning activities) and an outcome (new or improved organisational structure, product, process or marketing strategy).

Figure 2.2: Graphical representation of themes: Social dynamics of innovation process

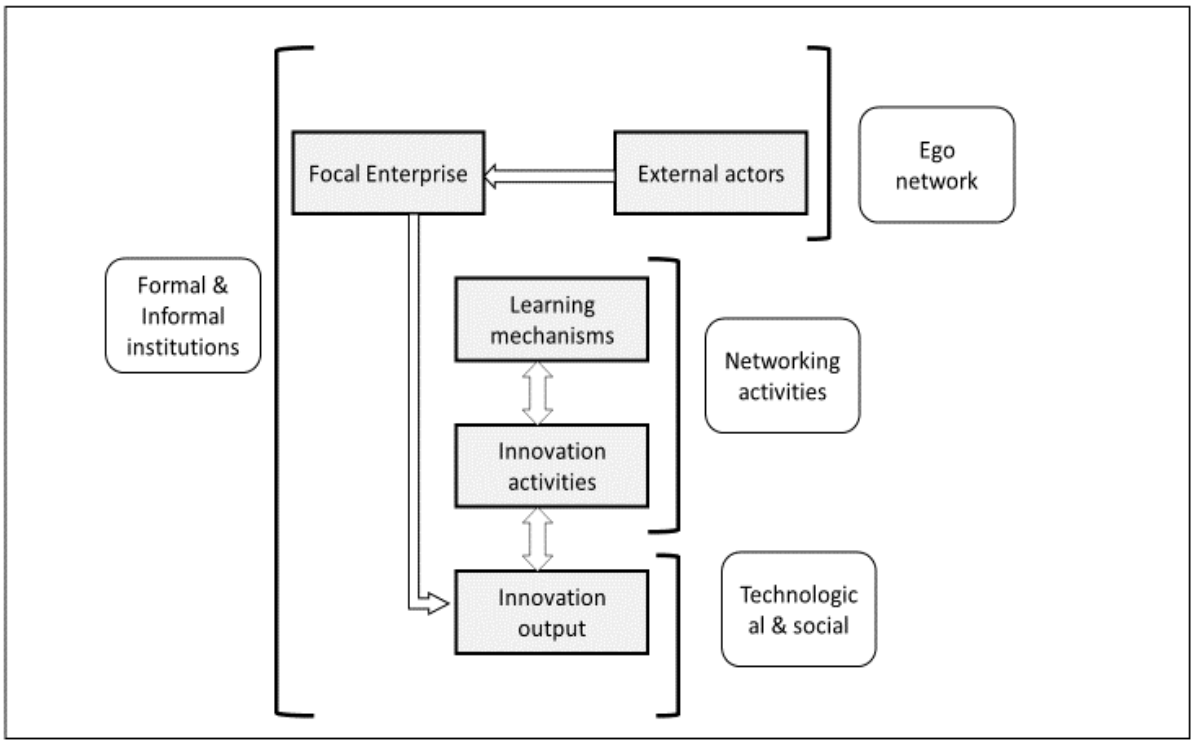


(Source: Author)

Figure 2.3 provides a graphic representation of the conceptual framework. This helps to focus on data collection and to inform data analysis in the study. The focus is on an innovating actor (referred to as an ego). An actor collaborates within a network to fulfil a certain innovation goal. The processes of knowledge creation (learning), information exchange, and resources transfer take place within the actor network.

Innovation processes consist of both social and technical practices. These processes are influenced by external factors such as institutions.

Figure 2.3: Graphic representation of the conceptual framework



(Source: Author)

In studying the social dynamics of innovation in a rural context, the following overarching research question was asked: what are the compositional dynamics of actor networks and networking behaviour of socially and economically oriented enterprises in rural areas of South Africa? This question is underpinned by the following additional questions:

- What characterises actor networks for innovation in rural contexts?
    - To answer the first research question, attention is paid to; Actor attributes; nature of linkages (formality/informality and reciprocity) and flows (object of exchange).
- What are the roles and functions of different actors within these actor networks? To answer the second research question, attention is paid to; How alters or ego-network members contributed to the innovation activities of the focal actor (network activity and emerging types of networks).

- What kind of actors and linkages facilitate interactive learning and innovation among rural enterprises?
    - To answer the third research question, attention is paid to; Actor attributes and the nature of relations and type of know-how exchanged. These factors are believed to facilitate learning.
- What types of institutions facilitate or hamper innovation processes in South African rural contexts?
    - To answer the forth research question, attention is paid to; Institutions and rules that influenced the behaviour of focal actors in the innovation processes. The formality and informality of institutions influence networking in different ways.

2.5 Conclusion

In rural areas, enterprises engage in innovative activities that contribute to solving challenges faced by the local society. Some of these enterprises engage in innovation activities for commercial purposes. However, the insights behind the sustained contribution and engagement in innovation activities in the midst of challenges in not known ((Triomphe and Rajalahti, 2013; Singh and Bhowmick, 2015). This chapter presented the theoretical and conceptual framework that guides the analytical approach adopted in this research study.

To contextualise the proposed study ideas, SI and ANT are used to investigate the micro-level aspects of the innovation process. This chapter examined SI, AIS and ANT. Arguments for such an overlay of theories was also provided in the chapter. In the chapter, an attempt was also made to link the research questions with the relevant themes for analysis.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

There is an extensive literature on innovation and networking, but most of the existing literature is based on the experiences of urban-based innovation that originates from large corporates. The critical role of rural-based enterprises' innovation in addressing challenges such as unemployment is seldom acknowledged (QUNO, 2015). The rural innovation process and the systems in which this process is embedded are poorly understood. In the same vein, the social dynamics of actor networks and learning received limited attention (Booyens and Rogerson, 2016; Booyens, Hart and Ramoroka, 2017). In less developed areas, the empirical literature on rural innovation is still young (Kumar and Bhaduri, 2014; Singh and Bhowmick, 2015). For these reasons, this study surveyed relevant literature from different contexts (rural or non-rural focused) with an emphasis on the relation between networking and learning for innovation.

This chapter critiques the concepts of innovation, actor networks, and interactive learning in the context of rural-based innovation using South Africa's experience. The discussions and arguments presented are grounded on selected literature on SI, AIS and ANT.

3.2 Defining concepts

3.2.1 Defining and conceptualising innovation

Innovation as a scientific field has been studied for over half a century. The concept of innovation was first introduced by Joseph Schumpeter in the 1930s and 1940s. In the traditional literature, the innovation process was viewed as a linear process of technology development at the firm level (Hart et al., 2012; Iizuka, 2014) through formal R&D activities. In the early 1990s, the evolutionary economic perspective suggested a non-linear systems framework of innovation called systems of innovation theory (Lundvall, 1992). This framework suggests that, the innovation

process is an interactive learning process among actors, influenced by market and non-market factors (Lundvall, 2010).

In recent decades, innovation has been recognised as a complex process which includes technical and social dimensions (Pereira and Romero, 2012). In the third edition of the Oslo Manual (OECD and Eurostat (2005), innovation is defined as "the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organizational method in business practices, workplace organization or external relations" (OECD/Eurostat, 2005: 46). Furthermore, innovation activities and outputs are distinguished. Innovation activities include invention, adoption, adaption and diffusion of innovations while outputs include the four types of innovations, namely products, processes, organisational or institutional and marketing and communication strategies (OECD/Eurostat, 2005). In general, innovation is defined as the process of making changes to products, services, processes, organisational structures and formulating strategies in an organisation, economy or society (Neumeier, 2011; Pereira and Romero, 2012; Singh and Bhowmick, 2015).

With on-going critiques of the linear model of innovation, the scope of rural innovation has gradually broadened (Spielman and Davis, 2009). Moreover, actor network theory research (see Latour, 2005), systems of innovation research (e.g. Lundvall, 2009) and agricultural innovation systems (e.g. Klerkx et al., 2012) have shown that, innovation occurs within a network of actors with the same or different characteristics, through a process of generating and sharing knowledge and resources. Innovation is therefore, understood as an interactive learning process (Lundvall, 2009) that involves a combination of technical and social knowledge and practices (Klerkx et al., 2012). Innovation emerges as a result of social (e.g. civil society) and economic actors (e.g. commercial private enterprises) engaging in networks for innovations (QUNO, 2015). In these networks, individuals, enterprises, groups and communities adopt, adapt and share knowledge and resources to develop new or improved products, processes, institutional and marketing strategies (QUNO, 2015).

It is acknowledged that individuals and organisations do not innovate in isolation; instead, they engage in a continuous interaction process of learning. In rural

contexts, in particular, enterprises form a complex web of interactions through which resources and the knowledge needed for innovation are accessed. Thus, innovation results from an exchange of knowledge and resources which are economically and socially relevant (Singh and Bhowmick, 2015). Innovation from a rural-development perspective goes beyond the limited focus on technological innovations but also include non-technological innovations. But these innovations are for both commercial and social benefit (Neumeier, 2011). In this regard, innovation in the rural context refers to the development and use of new or existing knowledge, to address social and economic challenges (Marcelle, Nkhumise and Vawda, 2013). With this said, innovation is a process of change. This process of change is also influenced by individual or societal needs, dreams and future aspirations (Klerkx, Van Mierlo and Leeuwis, 2012).

The concept of innovation has expanded beyond the simplistic view as a breakthrough in science. It is a co-evolutionary process. It can be regarded as a process of combining different facets; technical, social, economic and institutional, for a significant improvement or change (Hart et al., 2012; Klerkx, Van Mierlo and Leeuwis, 2012). In this process of change, other factors such as knowledge and resources can influence the formation of network linkages. Pereira and Romero (2012), notes that, technical and social aspects of innovation cannot be separated. Williams and Woodson (2012), for instance, maintain that innovation is a set of organisational processes that lead to the development and introduction of technologies, science and services. Therefore, innovation should be considered as a complex process of change.

In rural contexts, innovation can be developed jointly with external actors and they are not confined to the use of indigenous know how (Daniels, 2014; Muchie et al., 2017). Marcelle, Nkhumise and Vawda (2013), defined innovation as an interactive process of generating, sourcing and applying new knowledge and resources for economic and social benefit. This study considers the following characteristics of innovation: Innovation is about newness or change that is significant (Sullivan, 2008) on existing products, processes, organisational arrangements and marketing strategies. In the process of innovation, actors engage in invention, adoption, adaptation and/or diffusion of new ideas (OECD/Eurosat, 2005). Innovation has both

social and economic value (Hart et al., 2012). Innovation occurs from an interactive learning process (Lundvall, 2010).

3.2.2 Emerging concepts on innovation

Through assessment of emerging innovation concepts, we sought to position rural actors in an innovation landscape. These emerging concepts entail innovation at the bottom of the pyramid (BOP) (Prahalad, 2005); grassroots innovation (Gupta et al., 2003); social innovation (Neumeier, 2016); innovation below-the-radar (Kaplinsky, 2011); frugal innovation (Agarwal and Brem, 2012); and inclusive innovation (Foster and Heeks, 2013).

The concept of the bottom of the pyramid (BOP) was coined by C. K. Prahalad, (2005) a well-known business scholar and consultant (Watsh et al., 2005). BOP from a business-management perspective, emphasises that big companies can benefit from innovation by doing business in rural contexts, and providing products that are affordable to the poor (Kolk, Rivera-Santos and Rufín, 2013). BOP alludes to the need to understand the conditions in which the bottom billion live (Pralahad, 2006). Big formal companies are viewed as key innovators and the rural residents as users of their innovations. Holding the same ideas, below-the-radar innovation encourages shifting capabilities towards pro-poor growth (Chataway, Hanlin, and Kaplinsky, 2014). These two concepts present a top down innovation approach (Iizuka and SadreGhazi, 2011).

Grassroots innovation goes beyond the traditional top-down approach of development (Gupta, 2013). Grassroots innovations are a result of a bottom-up processes, emanating from communities and users (Cozzens and Sutz, 2012). These include participatory, empowerment-oriented approaches, and innovative practices that are implemented by rural dwellers such as smallholder farmers (Letty, Shezi, and Mudhara 2012). Smith, Fressoli and Thomas, (2014) note that different actors including the locals, governments, R&D institutions and aid agencies partake in these processes. Seyfang and Smith (2007) recognise “grassroots innovations” as networks of activists and organisations generating novel bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved.

The notion of social innovation has recently gained traction in innovation scholarship. It is about innovations with immediate social and community benefits (Hart, Jacobs and Mangqalaza, 2012). In general, the outputs are social and public goods (Harris and Albury, 2009). In this regard innovations in the private sector, such as vaccines, are not considered as social innovations. Others argue that internet search engines, for example Google, developed in the private sector are owned by private enterprise, but are social innovations because the value to society outweighs profits to the developer private enterprises (Phillis, Deiglmeier and Miller, 2008).

Another concept that gained importance in pro-poor innovation is frugal innovation. Frugal innovations are defined as innovations which are “cheap, tough, easy to use and developed with minimal amounts of raw materials” (Rao, 2013). Frugal innovations are understood as products developed by firms in emerging economies, targeting only markets in developing countries that were serving the bottom of the pyramid (Prahalad, 2005). The idea behind frugal innovations was to provide products and services that were suitable and affordable for the middle and lower income groups.

The most recent concept is inclusive innovation – also referred to as “innovation for inclusive development”. The concept of inclusive innovation has spread widely among policymakers and scholars all over the world. Inclusive innovations are considered as innovations that create and enhance opportunities to improve the wellbeing of the marginalised groups. It is also referred to as innovation for the poor and innovation by the poor (Cozzens and Sutz, 2014). Chataway et al. (2014) argue that inclusive innovation needed to be understood and developed in the context of a holistic conception of the innovation cycle, making a distinction between process and product innovation and the roles played by the poor as producers and consumers. In essence, inclusive innovation has two aspects: involvement of the poor in the design and development process, and inclusiveness in the output (Foster and Heeks, 2013). In addition, inclusive innovation refers to the design and development of innovations that incorporate the needs and interests of the poor (Foster and Heeks, 2013).

These emerging concepts are aimed at providing mechanisms for fostering innovation that addresses the needs of the poor (Iizuka and SadreGhazi, 2011). Despite increasing interest in rural innovation, there is still a lack of systematic

approaches that pays attention to the processes that brings about change, steered by local actors. For example, BOP and innovation below-the-radar focus on how private firms can produce innovations for low-income groups, while grassroots innovation concepts primarily focus on how local knowledge can be used to create opportunities for enhancing rural livelihoods. These concepts do not fully acknowledge that both technological innovations and organisational innovations, developed in any context, can complement each other and contribute to social and economic development in rural areas. In spite of the shortcomings and differences of these innovation concepts, they all seem to acknowledge the need to consider the environment in which the innovation activities take place. In all these concepts, rural enterprises are not fully considered as innovators.

3.2.3 The concept of actor networks

The concept “networks” has emerged as both a theoretical model and practical method within sociological studies of science and technology, as well as within economic theory (Tijssen, 1998). It has become widely utilised in socioeconomic studies and their application to economic problems (Debackere et al., 1994; Murdoch, 2000). There are many definitions of actor networks (see DeDresson and Amesse, 1991; and Freeman, 1991). In a seminal paper on networks, Chris Freeman (1991) regarded networks of organisations as institutional arrangements to overcome challenges of access to knowledge and resources in innovation processes. He further referred to innovation networks as “loosely coupled organisations having a core with both weak and strong ties among constituent members” (Freeman, 1991: 502). Rappa and Debackere (1992) defined networks as “a group of scientists and engineers working towards a solution of an interrelated problem-set and communicate with each other regardless of where they are located”. Powell (1990), regarded networks as a viable pattern of economic organisation. In this study, we adopted a definition of networks as innovation enterprises working together (see DeDresson and Amesse, 1991; Freeman, 1991).

Actor networks, as conceptualised in this study, incorporate relations and interactions between rural enterprises to share knowledge, and learn and exchange resources to enhance innovation capabilities. This study does value the influence that actors, materials and practices have on shaping the network structure and

operation. Thus, within actor networks there are actors and resources which are mutually constituent (Cressman, 2009; Harty, 2010). Networks are evolving mutual dependency systems, based on resource and know-how relations in which their systemic character is the outcome of interactions, activities, rules and institutions (Tijessen, 1998). In essence, networks involve organisations collaborating with one another (Knell, 2011; Corsaro, Cantù and Tunisini, 2012) and network actors retain their separateness and identity as enterprises (Klerkx and Arts, 2013).

Innovation actor networks take different forms and show a considerable range and variety in content (Fischer, 2001). They vary in terms of how they have been organised and as a product of exchange (Powell, 1990; Provan and Kenis, 2008). The content and boundaries of an actor network differs according to specific circumstances. Its nature will be shaped by the objectives for which network linkages were formed (Fischer, 2001). Some of the networks are relatively loose, informal, implicit and decomposable interactions among organisations (DeBresson and Amesse, 1991; Booyens and Rogerson, 2016), whereas others are differentiated according to their contractual or non-contractual arrangements (Powell and Grodal, 2005).

Actor networks are distinguished between formal and informal networks (DeBressen and Ammese, 1991; Head, 2008; Shearmur, 2011; Huggins and Johnston, 2010; Klerkx and Aarts, 2013). Actor networks can also be distinguished in terms of durability and stability (Grodal and Powell, 2005), as well as network length and control (Grodal and Powell, 2005). In some instances, networks are based on shared experiences; short-term combinations to accomplish a specific task; and spatial and strategic alliances (Grodal and Powell, 2005). As a result, networks differ in their structure, features and intensity (Yoqub, 2012), and different types of networks exist in different spatial areas (Murdoch, 2000).

In his classical work on networks, Walter Powell (1990), identified three critical components of networks: know-how, demand for speed, and trust. He considers networks as a fundamental element that enables the transfer of knowledge that cannot be codified such as personal experiences. Tacit knowledge is highly intangible and mobile (Powell, 1990). His argument for “demand for speed” was that

actors use networks to reduce cost and risk. Long-term sustainability of networks also depended on trust among members of a network.

What makes innovation networks different from any other form of interactions is that, they are based on direct relations (Fritsch and Kauffeld-Monz, 2010), and the transfer of knowledge in networks is not limited by regional or national boundaries (Knell, 2011). A basic assumption of networks is that a network actor is dependent on resources and know-how controlled by the other actors within the network. Although network actors are separate entities, their actions and decisions are influenced by other actors in the network. In general, networks are characterised by different factors, such as ownership and distribution of power, which can result in a conflict of interest in the network. Thus, what may be good and beneficial to one actor does not necessarily mean it is good and beneficial to the other actor.

3.2.4 Interactive learning

The concept of “learning by interacting or interactive learning” dates back to the late 1980s. Interactive learning was introduced by Lundvall (2003; 2005; 2007) into the systems of innovation literature. He used it to emphasise how innovating organisations build capabilities and competencies. Interactive learning differs from the process of accessing information (Lundvall, 1996).

It is useful to understand the different types of knowledge. Two types of knowledge are distinguished, and those are codified and tacit (Lundvall, 1996; Johnson and Lundvall, 2001; Lam and Lundvall, 2007). Codified or explicit knowledge can be stored and transferred as information (Johnson and Lundvall, 2001) through formal learning channels (Lundvall and Borras, 1997). Codified knowledge is easier to transfer over long distances. The knowledge in tacit form is deep-rooted in practices and experiences of individuals. It is hard to transfer as codified information. However, that does not rule out the fact that tacit knowledge can be codified (Lundvall, 2003). It is implicit and wholly embodied in human individuals and the only way to transmit tacit knowledge, is through social interaction (Lundvall and Borras, 1997; Lundvall, 2003).

One of the notable differences between codified and tacit knowledge is that codified knowledge can be documented and passed on to others, and be absorbed by those

who can read and understand the specific language. Codified knowledge is exclusive and largely based on science and science-related activities. However, absorbing such knowledge is seldom automatic (Jensen et al., 2007). These two forms of knowledge can be retained by individuals or organisations (Lam and Lundvall, 2007) and transmitted through the learning processes.

3.3 Innovation in a South African rural context

Rural contexts are characterised by a shortage of appropriate technologies, knowledge and infrastructure (such as access to improved crop varieties, advanced irrigation systems). Bitzer and Bijman (2015), state that these factors hamper innovation and growth in less developed areas. Innovation occurs when enterprises and individuals adopt, adapt and transfer new ideas involving other actors. However, for a long time, innovation process has been reduced to the transfer of technologies developed by formal enterprises in the rural space (QUNO, 2015). Another aspect of innovation in rural context, is that innovation is not based only on highly local and traditional practices but also draws from diverse external sources of knowledge and information (Letty, Shezi and Mudhara, 2012).

In South Africa, limited research has been done to explore innovation activities of rural enterprises (Ramoroka et al., 2014). There are relatively few studies that look at innovation from a system-orientated perspective to provide a nuanced understanding of the nature and origin of innovation by rural enterprises (Mhula-Links et al., 2014). Even though the existence of innovation in rural areas is acknowledged, little has been documented about rural innovation (Mapila et al., 2013). Most of extant literature is limited to commercial agriculture in specific sectors (Hart, Jacobs and Mhula, 2013). Hart, Jacobs and Mhula (2013) note that, in cases of innovation in agriculture, the focus is on the use of ICTs to improve productivity and market access. Other types of innovation are underplayed. Bitzer and Bijman (2015) provided insights on South African agricultural innovation systems, using case studies in the citrus sector in their study on "…African agri-food chains" in Ethiopia, Benin and South Africa. Due to its strong focus on export markets, the citrus sector has seen most of the emerging producers being excluded from these agri-food chains. Bitzer and Bijman (2015), argued for institutional innovations that can aid emerging producers with access to export markets. Nonetheless, interventions in

scientific and technological changes are critical in agriculture but remain incomplete without consideration of a wider innovation systems factors and actors (Ayinde and Muchie, 2014).

The Rural Innovation Assessment Toolbox (RIAT) research project undertaken by the Human Science Research Council (HSRC) documented several case studies on the types of rural innovations.

i. Mangqalaza and Jacobs (2014) documented how new ideas can improve the quality of life in rural areas using an example of the rural Marlow Agricultural High School, located in the Eastern Cape, South Africa. This school established links with an experimental farm. The innovation activities included wool shearing, classing and artificial insemination of animals, as well as training on how to use improved farming technologies. The activities at this school relied on external knowledge and resources through relations with other actors.

ii. Ramoroka et al. (2014) presented an example of institutional and organisational innovations, using the Ganyesa Wild Silk enterprise in North West province, South Africa. The Wild Silk enterprise intensified relations with organisations from within and beyond the local municipal borders.

iii. Mhula-Links et al. (2014) documented a case of a female farmer who adopted and adapted the use of liquid fertilizer made from fresh cow dung and water. It was reported that the liquid fertilizer had improved the quality of maize crop on the farm.

Generally, there is a small number of studies in the South African context that explores the process of innovation. Who are the actors? What kind of innovations are introduced? What are the nature of self-organising practices of enterprises? Dealing with complex systems of innovation requires an understanding of the social process of innovating actors (Spielman et al., 2009), and the role of different actors (innovators and support structures) (Klerkx et al., 2012). A few studies note a need for broader understanding of the local innovation landscape. Gouse, Pray and Schimmelpfennig (2005), studied the distribution of benefits for small-scale producers in South Africa who adopted Bt cotton from Monsanto. The programme

was confronted with social challenges (water-borne diseases) and institutional challenges (water legislature). Kahinda, Taigbenu and Boroto (2007), explored the diffusion of rural water harvesting to small-scale producers and households with financial support from the government in rural South Africa. Dalvit et al. (2007) investigated the development and deployment of an e-commerce platform in Dwesa, a rural area in the former homeland of Transkei in South Africa. The programme was designed to bolster tourism and advertise local arts, crafts and music through new marketing innovations. They emphasised the need of considering rural contexts in development interventions to suit specific needs and challenges.

A narrow focus on innovation in certain sectors has led to a present lack of clarity on what constitutes rural innovation systems in their own right. The structural characteristics of actor networks' influence on interactive learning patterns received limited research focus (Rutten et al., 2014). This study considers actor networks and innovation as the drivers of innovation in rural context. This is important as the efforts and practices of enterprises may provide insights on the creation of an innovation ecosystem.

It is apparent that the processes of change within and between enterprises have presented the dynamics of networking for innovative learning among rural enterprises and communities. Through network systems, interactive learning is commonly viewed as a process whereby actor share knowledge rather than transfer knowledge (Tran, James and Pittock, 2017). Owing to these learning patterns, actors develop their common interests and intentions (Tran, James and Pittock, 2017). Actor networks for innovative learning are a useful lens through which rural innovation can be conceptualised. While earlier research (Hart, Jacobs and Mhula, 2013; Mhula, Jacobs and Hart, 2014) have pointed out the important characteristics of rural innovation, rural innovation is still considered rather ambiguous. An understanding of the social dynamics of innovation has the potential to alter the nature and structure of innovation systems.

3.4 Actor networking for innovation

Innovation networking is a recurring topic of debate among scholars and policymakers involved in development. It became popular following work done by

evolutionary economists in the early 1980s, whereby innovation was commonly accepted as an interactive learning process. Yet, because of the predominant view of rural and agricultural innovation as inventions and the adoption of scientific technologies (Klerkx, Van Mierlo, and Leeuwis, 2012; QUNO, 2015), (Klerkx et al., 2012; QUNO, 2015), the social dynamics of actor networks in the context of learning and innovation in rural areas are poorly understood. Also, the social dimension of innovation as a process have not been investigated systematically (Rutten et al., 2014; Lamers et al., 2017).

While networking among innovation actors is recognised as a driving force of interactive learning and innovation, the dynamics of rural actor networks remain ambiguous. The limitations in the existing literature are about the composition and content of linkages (Jack, 2005; Liverpool-Tasie and Winter-Nelson, 2012; Lamers at al., 2017) and the role of different actors in supporting innovation (Hermans et al., 2013; Kumar, 2014). In addition, in rural contexts, the innovative capabilities of some actors are frequently undervalued (Williams and Woodson, 2012) and their role in the systems of innovation not clearly defined (Williams and Woodson, 2012; Neumeier, 2016). There is a general limitation in what is understood under the social dynamics within actor networks and networking processes (Rutten et al., 2014; Huber and Fitjar, 2016).

Networking has grown in importance in innovation research. Different scholars have pointed out some important characteristics of networks. Mugabe (2009) emphasised the importance of institutional linkages in improving innovation. Esparcia (2014), studied innovation projects in several European rural areas, looking at the contributions and the roles played by stakeholders and found that public-sector actors were critical players in the innovation process. On the contrary, some scholars alluded to the need for in-depth research on actor networks for innovation. The dynamics of networks that make up the process of innovation received limited attention in the mainstream innovation studies. Little is known about how actor networks are composed (Hermans et al., 2013) and the trajectories of interactive learning (Sol, Beers, and Wals, 2013). How enterprises in rural context create and share innovation know-how in enhancing their competitive edge is important for development.

An understanding of the characteristics and effects of actor network aspects is critical to understanding the process of innovation. Several scholars have acknowledged the need to understand the mechanics of innovation through actor networks in innovation. Fritsch and Kauffeld-Monz (2010), studied regional innovation networks of research institutions and firms and found that actors contributed in various ways in the process of innovation. In the same study, they indicated a need for further research, focusing on the roles of different types of actors in networks. In the same vein, Hermans et al. (2013), found that, a limited number of actors perform key roles linked to knowledge creation, institutional entrepreneurship and knowledge and innovation brokering. Gubins and Dooley (2014) called for in-depth studies that investigated the roles of actor in networks and the implications of network characteristics in the process of innovation and learning.

Existing research has acknowledged the relevance of the exploration of network structural features that direct learning and innovation. Hermans, Klerkx and Roep (2015) investigated the structural conditions of collaboration and learning in innovation networks across eight countries and found that policies were complex and not suited for evaluating the results of networking and learning. This showed a need for research approaches that were actor-oriented at the micro-level of the systems of innovation.

In African and South African contexts, several scholars have conducted research in an attempt to provide insights on complex innovation processes in different fields and sectors (Spielman et al., 2011; Asres et al., 2012; Booyens and Rogerson, 2015; Ramoroka et al., 2014). Spielman et al. (2011) investigated the Ethiopian agricultural innovation systems and found that changes in the systems, such as entrants of new actors, had an influence on the innovative capabilities of the smallholders. In Asres et al. (2012), differences between networks among communities were observed. However, the determinants of such dynamics in networks and how they related to learning and innovation were underspecified. A research project on measuring innovation in rural districts of South Africa conducted by the HSRC, likewise showed a limitation in the studies that looked at networks and learning in rural contexts (Hart et al., 2012, 2014).

Innovation activities are highly interactive between actors and resources (Hoholm and Olsen, 2012). This is clearly explained in ANT proposed by Callon (2002), Latour (2005) and Law (2007). ANT emphasises the need to go beyond identifying actors, but rather to look at all the elements that influence innovation processes. These elements are referred to as 'actants' (Coulon, 2005). Even though ANT has been largely criticised about the use of non-human actors, it shows how a network partner's capabilities have an effect on whether or not the partner should be enrolled in a network. Thus, social practices and resources influence the nature and formation of actor networks.

3.5 Interactive learning and networking

This section of the study sought to provide clarity on why it is necessary to investigate the relation between network components and interactive learning patterns and how they influence innovation. It wanted to answer the following questions: who are the actors? What do they learn? and what ways or mechanisms do they do so? Interactive learning is not an automatic process but requires purposeful effort from the actor (Dutrénit et al., 2013). "Learning is an activity going on in all parts of society and it is an opportunity open for all citizens regardless if they are scientist or if they are workers engaged in simple tasks" (Lundvall, 1996:3). According to Lundvall et al. (2002), innovating enterprises build competencies through communication and creation, and through the use of potential knowledge for innovation. Kristinsson and Rao, (2008) describes interactive learning as a partnership in which members benefit from increased interaction. Some of these benefits can include production and sharing of knowledge, and a reduction of costs and risks. By building on the comprehensive approach to learning used by Figueiredo et al. (2013), learning incorporates all the interactive ways in which agents acquire knowledge, skills and other cognitive resources needed to engage in innovative activity.

Interactive learning is critical for successful innovation. Actors engage in learning to build innovative capabilities (Gnyawali, 1999), However, interactive learning patterns are complex in nature. This process of learning takes place at a level beyond formal schooling such as communities, farms, schools, streets, and organisations (Johnson and Andersen, 2012). Johnson and Andersen, (2012) asserts that, learning is

embedded in different social structures/ networks and institutions, and it is uneven across different network systems. Thus, the process of learning for innovation involves formal and informal education sources.

In systems of innovation research there is a widespread consensus that interactive learning processes are at the heart of systems of innovation (Johnson and Andersen, 2012). According to Arocena and Sutz (2002), in their work on interactive learning spaces, actors have an opportunity to engage in interactive learning while in search of new opportunities and solutions to their existing problems. Thus, interactive learning and collaboration sit at the centre of innovation processes and promote generation and exchange of knowledge and resources

Learning is a multifaceted process and involves a vast number of interconnected social practices, interfaces and communications (Johnson and Andersen, 2012). One of the key reasons for the establishment of actor networks is to enhance learning and improve innovation performance (Gnyawali, 1999; Lundvall, 2009). Thus, actors access knowledge and information necessary for their internal processes. Interactive learning process within networks is not straight forward (Bessant et al., 2012) but, the characteristics of these networks influence the mechanisms of learning (Gnyawali, 1999; Bessant et al., 2012).

In the literature it is noted that the effectiveness of learning is influenced by many conditions and circumstances. Some of these conditions and circumstances include structural conditions (Hermans et al., 2013), and actor attributes (Caniëls and Romijn, 2008). This study investigation pay particular attention to actors directly involved in innovation and learning processes and the institutions that conditioned the behaviour of the actors at the local level. It is undeniable that the nature of links between actors affects the flow of knowledge and resources (Moschitz et al., 2015). And process of learning depends on the knowledge that is available to actors and exchange mechanisms. According to Tisenkopfs, Kunda, and Šūmane (2014), knowledge is contextually grounded and actors can only acquire it through interaction and negotiation. Furthermore, knowledge is embedded in social practices situated in specific relations in the local contexts (Tisenkopfs et al., 2014). In the same actor networks, participants have different learning capabilities.

Actor networks can vary in different aspects, such as the type of actor and the nature of relations between actors (Martin, 2013). These aspects influence the patterns through which interactive learning takes place. For instance, actor networks are composed of formal relations that are usually contractual and informal relations that are usually non-contractual, for example, brainstorming groups. Networks are either created or emerge organically. Some are created for a specific purpose and strategically to exploit an existing business opportunity (Martin, 2013). It is not clear how the network dynamics influence interactive learning patterns, particularly in less-developed economies.

Innovation actors seek to collaborate with actors that are resourceful and that will enhance their innovative capabilities (Ahuja, 2000; Hermans, Klerkx and Roep, 2015). Networking and learning are inseparable from the innovation process (Hermans, Klerkx and Roep, 2015). Nonetheless, how these networks influence interactive learning needs some clarifying (Lundvall and Lema, 2014). According to Moschitz et al. (2015), the strength of actors in a network is also influenced by the relations or linkages they form with other actors. In addition, both strong and weak ties between actors contribute to the innovation process. In essence, these networks of actors are mechanisms through which knowledge and resources flow (Moschitz et al., 2015).

Against this background, this thesis explores actor networks for innovative learning in an attempt to understand the dynamic nature of networks in relation to learning and innovation. Delvenne and Thoreau (2012) argue that an NIS approach should cater for complexity and diversity in different nations. An actor network theory is adopted which highlights the role of both human and non-human actors (Latour, 2005). Focusing on actors and other things, such as institutions that affect their behaviour, would show that actors need different kinds of support for different reasons.

3.6 South African case: innovation policy context and strategy

Policy documents such as the White paper on innovation were drafted and some programmes were implemented to improve the South African National Systems of Innovation (SANSI). This section reflects on innovation policy contexts and how such

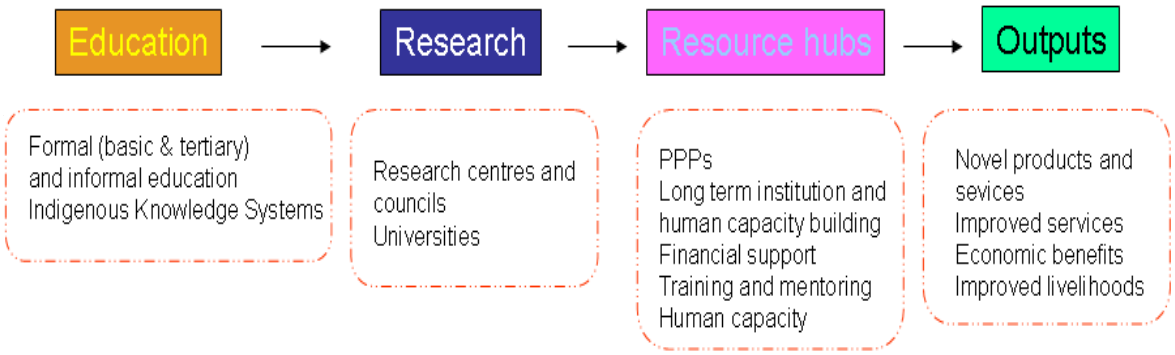
policies and strategies address the concerns relating to innovation in rural areas. This study is particularly interested in the recognition of rural actor networks or systems. We reflect on how such policy strategies support rural innovation. There is a greater emphasis on SANSI as an umbrella framework for innovation and development with an aim of locating rural enterprises in the innovation landscape.

In the 1996 White paper on Science and Technology, the genre and future vision was for all South Africans to enjoy an improved and sustained quality of life, integration into the economy by means of satisfactory employment and participation in the democratic political culture (DACST, 1996). Three goals considered critical in achieving the vision in the 1996 White paper were set. These goals are summarised as follows: establishment of an efficient, well-co-ordinated and integrated system of technological and social innovation which forge collaborative partnerships for individual and national benefit; Adopt a multidisciplinary approach to problem solving and use of resources; include the formerly marginalised for science and technology (S&T) activities and policy making and improve support for different types of innovation for sustainable social and economic growth. The 1996 White paper proposes an NSI that seeks to achieve social, political, economic and environmental goals (DACST, 1996). The NSI consists of government agencies, higher education and research institutions, private enterprises and civil society. It further emphasises the need to include marginalised individuals and groups. This attempt is critical because different actors at different levels of the society contribute to the introduction, diffusion and use of innovations that contribute to the society and nation at large.

SANSI is composed of a set of institutions, organisations and policies that interact to achieve a common goal to benefit the society at large (DACST, 1996). According to the NSI white paper "...a national system of innovation can only be judged as healthy if the knowledge, technologies, products and processes produced by the national system of science, engineering and technology have been converted into increased wealth, by industry and business, and into an improved quality of life for all members of society" (DACST, 1996: 18). SANSI is at an advanced stage. It has established high-quality R&D institutions, an explicit innovation policy, and agencies for supporting innovation with an outstanding technological readiness (Mugabe, 2009).

Noticeable in Figure 3.1 is an exclusion of low-end technology innovation enterprises. In South Africa, the national STI policy agenda has focused on mainstream innovation from the formal sector by firms (see Figure 3.1). Despite the marginalisation of other sectors in innovation and development, the policy goals remain relevant.

Figure 3.1: Schematic representation of the components of the SANSI



(Source: NACI, 2012)

Despite the intentions outlined in the White paper, SANSI seems to have paid extensive attention to formal innovation activities influenced by R&D particularly in urban areas. Rural actor networks and systems of innovation in rural or marginalised contexts are overlooked. There is no mention of the social practices linked to innovation and there is also no mention of the low-end technologies and innovation. How systems of innovation and practices in informal sectors links to the NSI is unknown. The white paper on science and technology remains narrowly focused as it largely recognise key actors and sectors. There is a lack of inclusion of bottom-up innovation processes in marginalised contexts.

In 2007, a review of South Africa's innovation policy was carried out by the Organisation for Economic Cooperation and Development (OECD) Directorate for Science, Technology and Industry (DSTI) on behalf of DST. The review focuses on a report produced by NACI (2006) and the results of interviews with key NSI actors. This review has alluded to the narrow focus on the role of public R&D-performing actors. It further highlighted the need to take into account the role of business

enterprises involved in innovation at different levels (OECD, 2007). The latter provides room to make an argument for rural-based enterprises to be considered as knowledge generators and innovators. In order to account for existing shortcomings, some of which were highlighted in the innovation policy review, a ten-year-plan on innovation was adopted (DST, 2007). The purpose of the plan was to promote a knowledge-based economy, in which knowledge generation become a critical factor of production and innovation. The inadequacy to take into account actor network systems and the non-R&D innovations is notable in the ten-year plan (DST). The focus of the plan rests on the following elements of human capital development, R&D; and associated infrastructure. The socio-economic aspects of the contexts in which innovation and development occur rarely received policy attention.

In an attempt to understanding of what is being achieved in and by the SANSI, the minister the Minister of Science and Technology, Minister N. Pandor commissioned a Ministerial Committee to review the current science, technology and innovation (STI) landscape in South Africa in 2010. The ministerial review report highlighted that shortcomings of SANSI and recommendations by the OECD policy prevails. There was still evidence of a narrow focus of R&D and evidence of a fragmented NSI (DST, 2012). The social dynamics which hinder or influence the success of innovation is not accounted for in the report.

South Africa is at the frontier of technology in the African continent as pointed out in the Science Engagement Strategy 2015 (DST, 2015). In the strategy, the DST takes responsibility for promoting public science awareness, scientific literacy and science engagement. Other key SANSI players, higher education institutions, other government departments, science councils and museums, and partners outside the public sector are expect to take part in promoting science engagement activities (DST, 2015). The science engagement strategy seems to be facing challenges of marginalisation as the proposed communication mechanisms are in formal and codified form. Another envisaged challenge was the narrow focus on individual and formal education. There is no mention of non-formal communication models for those in resource-poor settings.

Government efforts to promote science, technology and innovation are notable. However, based on challenges indicated in the reports above, the challenges of

designing an NSI that is inclusive are more complex especially for a country with a dual economy. Innovation is a complex process, involving any actors. The process does not take place in a vacuum but is influenced by internal and external factors.

Increasing concerns about the challenges faced by the rural sector has led the policymakers to a rural innovation discourse. In South Africa, DST has embarked on innovation policy dialogues in an attempt to address issues related to innovation in rural areas. For instance, the department has developed a concept of Innovation for Inclusive Development (IID) and innovation for local economic development (Ndabeni, 2016). This policy document is concerned with strengthening local systems of innovation and production in a systemic manner (Ndabeni, 2016). The aim is to look at the shift in national innovation policy debates towards the use and role of innovation for driving economic and social change in the rural areas of South Africa (Ndabeni, 2016).

Policymakers and key actors in the NSI in South Africa acknowledge the narrow focus on formal structures in South Africa. There are attempts by a wide range of government agencies and institutions to shift innovation policies away from the dominant R&D-driven innovations by formal actors to a broad NSI framework which is inclusive of the role of networks and activities in the informal or third sector of the economy. In the context of policy shift and development, DST initiated the Cooperation Framework on Innovation Systems between Finland and South Africa (COFISA), the Community University Partnership Programme (CUPP) and the RIAT. COFISA focused on promoting the national, provincial and local innovation systems in South Africa. This initiative acknowledged the influence of networks on knowledge and innovation (COFISA, 2010) but the findings indicate low levels of cooperation between academia, government and the private sector actors in innovation activities in South Africa (COFISA, 2010). Notably, this initiative has paid scant attention to the composition of networks of innovators. COFISA established the Living Labs in Southern Africa network (LLiSA) to support local innovation. While LLiSA acknowledges the role of networking (Mulder, Velthausz, and Kriens 2008) it seems to focus on how ICT can be used to promote networking.

Another example of networking and knowledge exchange is the Community University Partnership Programme pilot, initiated by DST and implemented by the

HSRC. This pilot project focused on university-community engagement (Kruss et al., 2013). The RIAT pilot project focused on measuring innovation in rural district municipalities (Hart et al., 2014). The innovation value chain findings have shown that in the four rural district municipalities, more than 50% of rural enterprises reported that they were part of some form of network (Hart et al., 2014). These studies did not examine the compositional dynamics of actor networks and how they relate to innovation, leaving room for further research that would shed some light onto the nature and dynamics of rural innovation networks. An understanding of the nature of actor network systems could contribute to the process of improving the narrowly focussed NSI and towards knowledge on the dynamics of rural innovation.

This said, there are only a few studies that explicitly focus on innovation in rural areas of South Africa. The focus has always been towards the linkages of these innovations to sectors such as energy, natural resource management, ICT, and engineering (Hart et al., 2014). These studies rarely address networking and innovation, and most importantly, they did not identify innovators or examine their roles and functions in the systems of innovation. For example, Kruss (2006) studied knowledge networks in formal high-technology sectors and emphasised the role of the higher-education sector within these networks. Booyens (2015), conducted a study in the Western Cape in South Africa, on global-local trajectories for regional competitiveness. She pointed to the need to consider strategic networking linkages to access global knowledge flows.

3.7 Conclusion

The literature on innovation, networking and interactive learning has been reviewed. On reviewing the literature, it emerged that innovation is a process of change, positive or negative to the existing activities. As a departure from the traditional trends, it was also found that there is limited literature and empirical studies on rural innovation in South African. Furthermore, in reviewing the literature on actor networks, it was found that there is a limitation in our understanding of the compositional dynamics of actor networks. It also showed that there was a lack of empirical research on networks that provided insight into the conditions of innovation in rural contexts and did not provide answers to questions, such as who were the innovators? what was the nature of their networks? how did they learn in their

networks? what were the factors that shaped their innovative behaviour? and what was the role of rural based actors in the national systems of innovation? Several scholars indicated their need for further research in contributing to closing this gap. Interactive learning trajectories lining to actor networks aspects are under researched. There is a general lack of empirical research on the self-organising practices of learning and innovation among rural based enterprises.

CHAPTER 4

RESEARCH DESIGN AND METHODOLOGY

4.1 Introduction

The previous chapters outlined the context of this study and the current chapter provides research design and methodological approach used. In Section 4.1 the research paradigm that underpins the approach adopted is outlined. The following sections include research design, data collection and analysis.

A brief profile of the study area is provided under the data collection section. The focal enterprises which form the cases were documented in an HSRC research project on rural innovation, entitled the "Rural Innovation Assessment Toolbox" (RIAT), commissioned by DST. RIAT is an on-going research project that was initiated in 2012. A combination of secondary and primary data was used. Additional primary data was obtained during intensive case-study research as part of RIAT phase 3. The empirical evidence gathering was limited to agro-processing enterprises in Mopani district of South Africa.

4.2 Methodological paradigm

A research methodology is concerned with how researchers study a phenomenon (Arthur, 2011). According to Vosloo (2014), a researcher needs an understanding and knowledge of research paradigms that underpin different research principles. Paradigms play an essential role in science. The concept of paradigm dates back to the work of Thomas Kuhn (1962) on “The Structure of Scientific Revolutions”. Paradigms are concerned with what the research ought to study, the nature of research questions that are supposed to be formulated in relation to the subjects, the methods to be used, and how the results should be interpreted (Lukka, 2010).

This study was conducted under the “interpretivist paradigm”. The interpretivist paradigm is also referred to as "anti-positivist" and emphasises the ability of a researcher to construct meaning. It regards the social world as constructed by human beings. The interpretivist research seeks to explore how human beings perceive their life world (Mack, 2010). This study perceives the dynamics of

innovation in rural contexts as being rooted in actor networks. As a result, they cannot be observed from outside or using experiences from developed economies. Therefore, there is a need for a research approach that is concerned with activities taking place in a specific context (Mack, 2010).

4.3 Research design

To get a holistic picture of the social nature of the innovation process, an in-depth analysis of the subject matter was required. Yin (2009) points out that a case study approach is appropriate when a researcher intends to have a detailed understanding of an environment or a real-world context. Therefore, this study sought to explore the nature and patterns of innovation in rural Mopani district, South Africa.

According to Yin (2006), research design is the logical sequence up to conclusions in a study. In innovation studies, both quantitative and qualitative approaches are applied and choices are often guided by the research questions. Both of these approaches have their advantages and limitations. In order to gain more and detailed insights into the role and functioning of actor networks for innovation in rural development, it is best to adopt a methodology that allows the exploration of self-organising and interactive practices of actors (Neumeier, 2011). In this sense, case studies are suitable to understand complex social phenomena (Yin, 1994; Yin, 2012), such as the nature and types of actor relations and patterns of innovative learning. In addition, exploratory case-study approaches could provide holistic descriptions and interpretations of innovation activities and actor-network mechanisms (Sørensen, 2004). The key factor for considering a multiple case study approach is that it enables exploring differences within and between settings (Baxter and Jack, 2008).

This study did not utilise statistical or quantitative techniques as a means of analysis because the purpose was not to estimate the statistical inferences or to find a relation between variables. The purpose was rather to explore the compositional dynamics of actor networks in the context of interactive learning and innovation. An understanding of the characteristics pertaining to networks in relation to innovation could provide insights into the social dynamics and nature of innovation processes and actor networks in rural areas of South Africa. The study employed qualitative

research techniques and analysed actor networks, interactive learning mechanisms, and institutions.

The exploratory case-study method was selected to get an in-depth insight into a complex phenomenon by examining actor networks for innovation in rural contexts. The exploratory case-study approach took into consideration the need to understand the context within which the cases were located (Yin, 2012). Richly exploratory case studies enabled the researcher to answer both descriptive and exploratory research questions (Yin, 2012). In exploratory research, qualitative and open-ended methods were used to provide insights into phenomena, processes, and activities in a particular context. This approach was more appropriate in cases whereby the empirical evidence was still young in the mainstream innovation studies literature on rural innovation. This said, the approach was more appropriate for venturing into new empirical and theoretical context. It allowed for the use of iterative mixed methods to study the research problem in depth (Yin, 2009). An exploratory research approach was almost exclusively based on qualitative research strategies which made it more suitable for exploring something new, as in this case, the social dynamics and micro-level activities within local innovation systems (Yin, 2013). Case studies provided rich and detailed exploration of a real-world context and the researcher could rely on various data sources to draw conclusions (Eisenhardt and Graebner, 2007).

To yield a more complete and detailed understanding of the dynamics involved in the innovation process in rural contexts and the nature of actor network and patterns of learning, a multiple case design was selected. The multiple case study approach would allow a broader exploration of the research questions (Eisenhardt and Graebner, 2007). Furthermore, the similarities and differences between two or more settings or phenomena could be compared (Nonthaleerak and Hendry, 2008). Each of the selected case studies provided a narrative based on secondary and primary data.

4.4 Data collection

This section provides information on study area, cases, data collection and provides a brief introduction to egocentric approaches in social network analysis (SNA) that guided data collection and analysis.

4.4.1 Study area and cases

Mopani District Municipality

Mopani District Municipality (MDM) is located in the Limpopo Province, which is one of the deprived provinces in South Africa (see Figure 4.1 below). The district is located in the North-eastern part of the province, and approximately 100 km from the main city in the province. The district municipality covers an area of about 20,011 km², including nature reserves and rivers (Mopani District Municipality Annual Report, 2016/17).

Mopani district comprises five local municipalities, namely: Ba-Phalaborwa, Greater Tzaneen, Greater Giyani, Maruleng and Greater Letaba (see Figure 4.2). Capricorn and Mopani districts are the main economic centres of the Limpopo Province. The Mopani district has four major towns namely Phalaborwa, Tzaneen and Ga-Modjadji and Giyani, the administrative seat of Mopani District Municipality. There are 16 urban areas (towns and townships), 354 villages (rural settlements) and a total of 125 Wards.

Figure 4.1: Limpopo Province map



(Source: Local Government Handbook Limpopo, 2013)

Figure 4.2: Mopani District Municipality map



(Source: Local Government Handbook Limpopo, 2013)

Mopani district is rich in natural resources, such as timber plantations and fruits. Marula is one of abundant fruit in Mopani. It is a fruit from an indigenous tree which is widely processed and used in many products. Tourism, agriculture, mining, trade, and manufacturing were identified as economic sectors with a potential for growth (Mopani District Municipality Annual Report, 2016/17). Most of the produce is exported and some are used in processing value chains. Tomatoes and avocados are examples of fruits that are produced in the district and exported worldwide. Tourism further contributes to the economy of the district, linked to the Kruger National Park. Mopani district, like the other four districts in the province, has a wealth of agricultural resources that are available for processing into various products, such as juice concentrates, dried fruit etc. (Limpopo Agro-Processing Strategy, 2012).

There are several forestry plantations in Mopani district around Tzaneen and the Greater Letaba local municipality, which are dominated by exotic plants species such as Pines, Eucalyptus, and Mahoganies. The foot-hill zones of the mountain ranges contain tea estates. The Tzaneen and Letsitele regions of the Letaba catchments areas support citrus, mangoes, and bananas. The Klein Letaba, Molototsi, and Nsama river catchments are dominated by rural populations with cattle, goats and subsistence farming (State of Rivers Report, 2001). Mopani District Municipality is a major producer of tomatoes in an area known as Mooketsi, which falls under Letaba Local Municipality.

Previous research conducted in the province regarding agro-processing has indicated that the processing and marketing of bananas, mangoes, oranges, and tomatoes were dominated by commercial interests, with rural and emerging farmers confined largely to informal markets (Limpopo Agro-Processing Strategy, 2012: 51). According to this strategy document, these commercial farmers had access to market information which had enabled them to penetrate domestic and export markets. Through their grower's associations, commercial farmers had access to extension workers who provided valuable technical assistance. These resources were not accessible to rural and emerging farmers.

4.4.2 Case selection

In multiple case-study research (larger than two), a sample would normally be four or five cases (Arthur, 2011). Qualitative research largely uses small samples that are selected purposefully (Williamson, 2006). The rationale for purposefully selecting cases is to find those that are information rich to be able to do in-depth analysis. In addition, exploratory case studies require detailed analysis of a subject. In this study, four cases were selected and examined. The study accessed the cases through an on-going HSRC research project conducted on mapping innovation value chains (IVCs) and the impact of innovation. These four cases were from enterprises in the agricultural sector involved in agro-processing of different commodities. The selection was influenced by the interests of the study and the perceived richness of information that can be collected for an in-depth study.

The four cases constituting the sample were selected as examples of innovating enterprises in rural contexts. They were further categorised into funded and non-funded enterprises during establishment. This categorisation has been made for the sake of comparisons and drawing insights on patterns of innovation taking place in different contexts. Notably, the cases have similarities and differences. The selected cases have the following key characteristics in common which influenced selection:

Firstly, the SI perspective was based on the premise that innovation is an interactive process and learning and networking were central (Lundvall, 2010) and involved multiple actors. The following was observed:

- There was some sort of innovation (organisational/ process or technological) that was reported and observed (examples of innovative ideas);
- There was an involvement of heterogeneous group of actors, locally and external based.

Secondly, in rural context innovation was defined by the value it provides to the people (Marcelle, 2014) and it was linked to development. The following was observed:

- Innovating for both social and economic benefits, with an intention to raise living standards
- Seeking a solution to an existing challenge

Thirdly, according to the Limpopo agro-processing strategy (2012), the agro-processing sector has the potential to contribute to addressing economic challenges in rural contexts and stand to be supported:

- Agro-processing (agro-processing sector highly utilised both technological and organisational innovations)
- Located in impoverished local municipality

The selected cases also have the following main distinctive characteristics that allowed for comparison:

- The four cases were based in two local municipalities with distinct features
- The enterprises were producing different products

To sum up, the methodological approach was to start with the implementation of enterprises with the artefacts, or various types of innovation in possession. This was followed by the network of actors around it, referred to as an ego network. Thus, we traced the relations with other heterogeneous actors linked to the artefacts in possession. Since there was no readily available list of innovating enterprises in the rural areas of South Africa, a list of potential enterprises was drawn from the HSRC's pilot research on RIAT. The RIAT pilot evidence showed that an increased number of enterprises engaged in community social services in rural areas (Hart at al., 2014). Individuals, groups, and organisations were involved in economic and social

activities in non-farm sectors, such as public administration, education, and health, transport, hospitality services, retail, and manufacturing (OECD, 2007).

4.4.3 Secondary and primary data collection

For data collection purposes, exploratory case study research allowed the use of multiple sources of evidence, which could include direct observations, interviews, records, documents and physical items (Noor, 2008; Yin, 2012). In order to gain detailed insights about networking and innovation in this context, the study used different sources to access information, namely secondary data collected by the HSRC, documents, published short articles, observations, and key informant face-face interviews.

Two forms of secondary sources were used: first, the existing data collected by the HSRC was studied and relevant data extracted; second, various types of documents depending on availability were collected. Documents included reports, short published articles, and presentations. Additional primary data were collected through conducting in-depth, semi-structured interviews with key informants within the focal actor (enterprise). Additional data was collected as part of the HSRC's RIAT project in-depth case-study research on the potential high impact innovation catalyst (P-HILIC) process. Interview questions relevant to this study are presented in Appendix 1. This study only used evidence that was collected in the Mopani district.

Additional data collection followed a purposive sampling method to select the key informants. Purposive sampling was appropriate where, for example, key informants (such as managers) from an organisation provide a list of individuals to be interviewed, based on their job responsibilities and involvement in the subject of research (Noor, 2008). Innovations within an enterprise needed different persons to be involved: people with specific technical knowledge that could change existing production processes, as well as a those higher up in the hierarchy, who backed the changes in the internal rules and systems (Hermans et al., 2013). This was relevant because the types of innovations, size of enterprises, and nature of operation varied among the four cases selected in this study. For the purpose of this study, key informants were selected at different levels within the enterprise to provide detailed information on innovation activities, networking, learning, and exchange process.

Therefore, the focus of the study was not on individual perceptions within the enterprises but rather on the dynamics of actor networks and innovation. For these reasons, the number of key informant interviews within the enterprises varied. Another reason that influenced the number of interviews was the referral approach adopted in the study.

4.4.4 Interviews

The study was carried out in two semi-structured interview phases. First, it was a pre-survey with the RIAT innovation value chain (IVC) mapping instrument to map out innovation activities and types. The RIAT enterprise survey instrument covered information on enterprise profiling; internal organisational/enterprise environment; and macro-context (Jacobs and Hart, 2015). The pre-interviews were only conducted with the operational manager in each of the cases.

Second, a semi-structured instrument was drafted specifically for this study to make up for information that was not covered in secondary data and the RIAT survey. This actor-network sensitive survey instrument was developed on the basis of an egocentric network approach. Egocentric network methodology builds from “name generator” questions and “name interpreter” questions (Alexander, 2009). Name generator questions were used to construct a list of ego (focal actors) contacts (alters). Thus “name generator” questions were used to prompt actors to describe the external relations configured around them for innovation purposes. The other aspect was “name interpreter” questions. “Name interpreter” questions were useful as they elicited implicit information about the relations between the actor and their external contacts and their activities (Alexander, 2009).

Semi-structured face-to-face interviews were centred on an ego which is the innovating rural based enterprise. Ego network referred to a single actor (focal actor) together with the actors (alters) they were connected to (Everett and Borgatti, 2005). Only an ego (actor) will participate in open-ended and semi-structured interviews. Each ego will present information about the relations between themselves and a set of alters, the attributes of each alter, and the various dimensions of their relations to each alter (Alexander, 2009; Borgatti, 2011; Crossley et al., 2015). In this sense, the information collected would look at the complexity of the multiple network relations

configured around an ego, linked with various types of innovation provided by the ego.

To complement existing information, semi-structured interviews were conducted in each of the four cases: (i) NBef Organics, where the owner and manager was actively involved in the day-to-day operations and provided detailed information on networking, learning and external factors in the enterprise. Further information was sourced from an administrative manager who is also a training facilitator. (ii) At Wolkberg Fruit Processors (WFP) factory, a total of three key informant interviews were conducted with two line-managers – one involved in processing and the other involved in mango supply to the factory, interacting with external actors at an administrative level. The third interview was not effectual as the employee provided limited information on inter-organisational networking at large. (iii) At Mfuneko Rural Biogas, key informant interviews were conducted with the director and technical manager, and the third interview with a partner organisation. And lastly, the interviews were conducted at (iv) Ledzee Estates. At Ledzee Estates additional information was gathered from the manager.

4.5 Research approach for data analysis

Given the complexity of the research questions, a combination of research methods was adopted. The methods of analysis that were employed included RIAT and SNA (ego-network analysis).

The RIAT IVC mapping instrument maps out innovation activities, types, and actors within a geographic area and SNA will be crucial in examining actor-network structures, patterns, and social mechanisms/network effects. Both RIAT and SNA have weaknesses and strengths, however, a combination of the two can provide more robust evidence in the compositional dynamics of networks and their effect on learning and innovation. For example, the RIAT survey instrument captured innovation activities and types, as well as internal and external environment (institutions), but paid scant attention to qualitative network dynamics, while SNA was good in studying social relations but poor in mapping innovation activities.

SNA would contribute to the analysis of network dynamics that included focus on robustness, efficiency, effectiveness, and diversity. Even though RIAT was piloted by

the HSRC, it is still underdeveloped and required further theoretical and empirical inquiry. The study intended to elevate the applicability of RIAT by complimenting it with SNA. The goal with the use of the combination of the two was to explore network effects and dynamics and capture innovation activities, actors and policies in a more systematic way, as well as social mechanisms that characterised innovation in rural areas. Detailed explanations of both RIAT and SNA are provided below. In essence, this choice of methods allowed the exploration of the socio-economic factors that influenced innovation output and outcomes in rural areas. Thus, the study tried to address the questions about the social nature and character of innovation processes.

4.5.1 Rural Innovation Assessment Toolbox

RIAT was designed and developed to investigate IVCs among formal and informal enterprises in rural municipalities in South Africa (Hart et al., 2012; Mhula-Links et al., 2014). RIAT embraced complex processes of knowledge generation, adaption, spread and use for social and economic benefits of the society (Hart et al., 2013). It is an evolving and underdeveloped methodology and was piloted in four rural districts in South Africa. The RIAT development and application was grounded in SI thinking. It adopts the broad definition of innovation, namely as a co-evolutionary process, aimed at addressing the social and economic needs of the society.

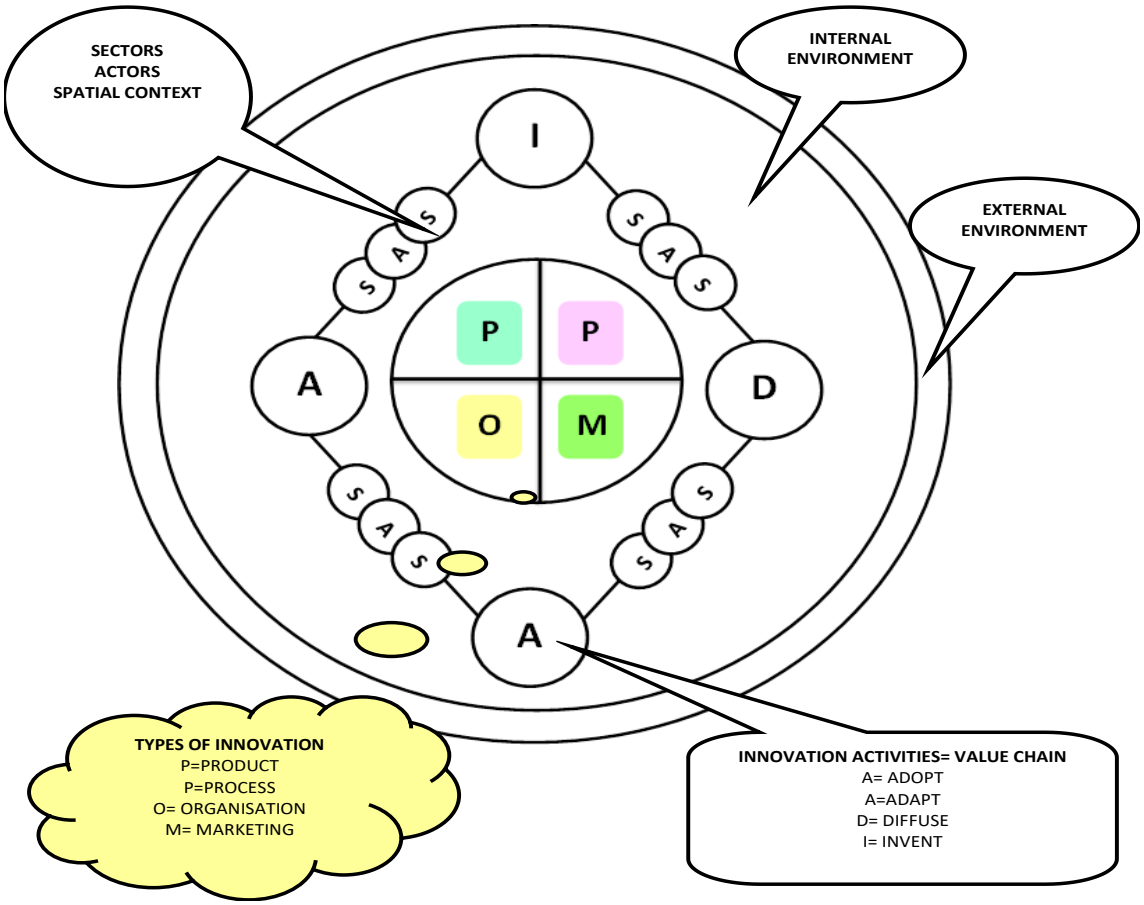
The IVC approach included activities related to knowledge creation, knowledge transformation, exploitation of innovation activities, innovation production and value addition (Hseih, Love, and Ganotakis, 2011). IVC comprised three phases, namely the processes of knowledge sourcing, transformation, and exploitation (Roper, Du and Love, 2008). The social dynamics of IVCs explained the recursive processes and activities undertaken by innovators in the process of creating knowledge, producing innovation, and exploiting innovation (Roper, Du and Love, 2008). In essence, it was about the process of refining innovations. RIAT embraced the usefulness of a combination of internal knowledge and practices and external knowledge sources. Several studies, such as Roper, Du and Love (2008), adopted the innovation production function approach to model firm-level IVC. This approach related to innovation output and knowledge inputs. In any case, the characteristics of

the innovating enterprises were taken into consideration as they had an influence on the efficiency of innovation (Roper, Du and Love, 2008).

The RIAT enterprise innovation mapping instrument was used to explore how actors network within a locality and cooperated in innovation activities with actors outside the boundaries of a rural municipality (Ramoroka et al., 2014). The instrument was best used for identifying innovation activities (invention, adoption, adaption, and diffusion), and various innovation types (products, process, organisational arrangement and marketing strategies). It further traced how actors in a network within a geographic territory interacted with actors outside the boundaries of a rural municipality in the process of innovation. The basic framework of RIAT included the following key components: enterprise profiles, innovation activities, networking and external factors.

The RIAT innovation mapping instrument is summarised in Figure 4.3. The innovation mapping instrument was able to capture information on an enterprise's innovation activities and types, sectors, actors and spatial contexts, as well as the internal and external environmental factors. Innovation activities indicated the actors' behaviour or action of innovating. The activities included invention, adoption, adaptation and diffusion. The instrument also assisted in identifying different innovation types, including product, process, organisational arrangement, and marketing or communication strategy. Sectors, actors, and spatial contexts explained that innovators did not innovate in isolation but interacted with actors from different sectors and localities. Internal and external environment explained that actors have internal rules to obey and external rules in the system that influenced actor behaviour. These rules included formal rules, such as policies, regulations, laws or informal rules, and norms and procedures.

Figure 4.3: RIAT Innovation mapping instrument



(Source: Overview of RIAT Phase 3 presentation, 2015)

A limited number of studies have been published using the framework. However, the evidence has contributed in providing insights about the nature of innovation activities in rural areas among registered and unregistered enterprises that engaged in innovation. The framework further illustrated how actors perceived innovation in rural areas of South Africa (Hart et al, 2015b). Examples of the studies providing insights from RIAT findings were presented in this section. Mhula-Links, Hart and Jacobs, (2014) investigated the nature of innovation and their place in society by paying attention to the formality and informality of the innovators in rural district municipalities of South Africa. The findings have shown that informal innovations occurred in both informal and formal sector of the rural economy. A recent publication by Hart et al. (2015b) on the development prospects among rural enterprises illustrated that private, public and non-profit enterprises engaged in innovation activities. The study further illustrated that networks of enterprises existed

in this context. However, the studies did not provide an in-depth analysis of the network aspects.

Since its inception, the robustness and scope of RIAT have evolved and its shortcomings was continuously addressed. An important feature of innovation in rural contexts was that it did not take place in isolation. Innovations were introduced through actor networks of interacting enterprises and consultants (individuals). Scholars and policymakers emphasised that the potential of innovation depended on how well the system was connected and how well knowledge circulated through SI actors (van der Valk, Chappin and Gijsbers, 2011). The key weakness of RIAT was therefore that it underplayed the agency of actors in the local innovation systems. Here the risk was that actors playing a supporting role in local innovation systems would not necessarily be innovators (QUNO, 2015). A bottom-up view of the roles of different actors and institutions in the context of networking and interactive learning for innovation could provide a more nuanced picture of the rural innovation landscape.

The socio-technical SI in rural contexts are complex and characterised by non-linear innovation processes that involved back-and-forth activities (Kumar, 2014) which provided a scope to explore the composition of network systems. It asked questions such as: who were the actors; what roles did they play; which actors were relevant for innovation, and at what stage of the process of innovation. The role of innovation actors in rural contexts remained questionable. Whether or not actors were passive recipients of innovation and knowledge remained unclear. In addition, RIAT barely clarified what rural SI was; the concept remained elusive. Defining the rural innovation systems would require identifying what constituted a system, what needed to be included and what needed to be excluded (QUNO, 2015).

4.5.2 Social network analysis

SNA is an interdisciplinary methodology developed mainly by sociologists and researchers in social psychology in the 1960s and 1970s, which in time developed into a formalised analysing technique adopted by different disciplines, such as economics (Coulon, 2005). SNA was used in examining social structures (Otte and Rousseau, 2002) - most broadly, SNA viewed social structure as a network with ties connecting actors.

SNA has developed as an approach for studying relations between actors employing various quantitative and qualitative methodologies (Edwards, 2010). Despite the current dominance of quantitative network analysis, there was also a tradition of qualitative driven SNA in network analysis (Alexander, 2009; Edwards, 2010). The choice of the appropriate measure in SNA was guided by what the researcher intended to reveal (Coulon, 2005). In this sense, the study adopted qualitative-driven SNA that considered the configuration and dynamics of networks (Alexander, 2009).

SNA shared many conceptual similarities with ANT but some critical differences remained (Mützel, 2009). Both SNA and ANT allowed qualitative exploration of relations in general. They considered the heterogeneity of network actors. A critical difference was how these two approaches viewed actors. SNA considered non-human actors as passive actors while ANT viewed both humans and non-humans as being equally active and important (Mützel, 2009). Interestingly, SNA focused on the existence of social relations among human actors. ANT did not make a difference between social and technical. It failed to provide causal explanations but it was best in providing descriptions of a network (Tatnall, 2010). Overall, the study complimented ANT with SNA to provide an analytical framework that could depict both the characterisation of actor networks and the dynamics thereof. Table 4.1 presented the key elements of SNA and their implication in the current study.

Table 4.1: SNA elements of analysis

Elements	Description	Implication
Ego	Actor of interest	Innovating enterprise (host)
Node/actor	A member of a network	Enterprise
Alter	Actor directly connected to an ego	Enterprises connected with the ego
Tie	Interconnections between actors	Enterprise to enterprise relation
Dyad	Pair of actors linked by a tie	To fulfil an activity

(Source: Author)

4.5.2.1 Egocentric network approach

An egocentric approach was appropriate for analysing actor network. According to Berrou and Combarnous (2012), an egocentric approach was relevant for analysing networks in informal setting that were composed of actors that often engaged in local

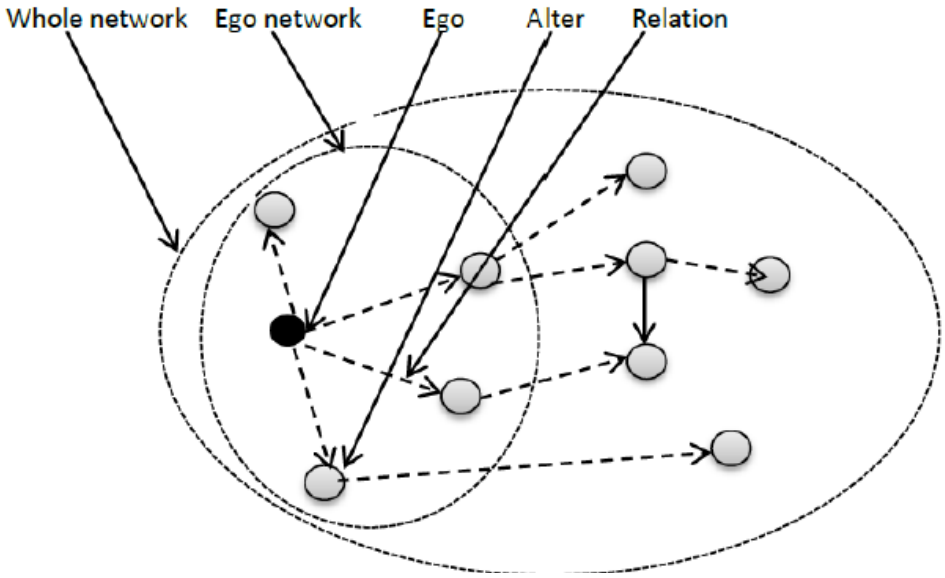
non-formal relations, such as kinship. They further indicated that this approach enabled the research to describe the network configurations by paying particular attention to network structure, actor attributes and the content of ties, such as strength and exchanged resources.

This study applied qualitative SNA to investigate the nature and characteristics of actor networks in rural South Africa. Qualitative driven SNA was exploratory and summative, therefore an egocentric approach to network analysis (Alexander, 2009) was used to measure partial network. It was appropriate for application at a dyad level, or ego alter relations. An egocentric approach was one of the methods in SNA (Crossley at al., 2015) as opposed to sociocentric approach. In this case, it can assist in examining the dynamics and qualitative aspects of the network, unlike a ‘sociocentric' approach (whole network analysis) that focused on the structural patterns of the network (Alexander, 2009; Leavy, 2011).

An egocentric approach referred to actor-centred analysis, also called an ego-net. An ego-net is a network that formed around a particular actor in a social space (Crossley et al., 2015). According to Alexander (2009), an egocentric approach presented a bottom-up perspective to studying networks at a dyad level. For this reason, the methods provided an appropriate framework to examine network activities and actor roles and functions in actor network. Ego network research focused on success as a function of an actors’ social ties. This looked at how network ties facilitate access to resources and support (Borgatti, Everett and Johnson, 2013). An ego network approach was often carried out at actor level and took the characteristics of actors into account and how they influenced the composition and structure of networks.

An egocentric approach enabled the exploration of the composition of actor networks (Rice and Yoshioka-Maxwell, 2015). Figure 4.4 shows the structure of an egocentric network. In this ego network, the ego, or focal actor is depicted by the black circle. The grey circles represent alters or actors that have a relation with the ego. The lines show the connection between ego and alters, forming dyads. Alters are not necessarily connected to each other, however, this study did not pay attention to alter-alter relations.

Figure 4.4: Ego network graphic presentation



(Source: Author)

4.6 Examining agro-processing innovation value chain

This section presents integration (cross-fertilisation) of SNA and RIAT for examining actor networks for innovative learning. The proposed framework sought to provide an insightful impression of individual actor (innovating enterprise) and an exploration of innovation and networks at different agro-processing stages of a particular enterprise. Following Lundvall (2009), the interactive aspects of innovation could be explored at different levels. The important task of a cross-fertilised framework was to explore enterprise level actor-network dynamics and innovation activities, as well as institutions. It provided an actor-oriented approach at the micro-level of SI. In essence, the application of the framework could illustrate factors that were influential for supporting inclusive rural innovation. The framework was grounded in an SI perspective and actor network theory. Actor networks were and have always been, necessary for innovation, whether radical innovation or incremental innovations (DeBresson, 1999). DeBresson noted that innovation networks are necessary for understanding all economic processes in different contexts. The latter explained why networks are the starting point in the proposed framework.

The compatibilities between the RIAT IVC dynamics framework and egocentric SNA is presented in Figure 4.3. Figure 4.5 shows that the agro-processing value chain

comprises three stages, from raw fruit supply and storage to end product; supply of primary commodities for processing; and production (processing process), distribution and usage. Under the primary commodities supply, the activities included sourcing fruits from the suppliers or harvesting the commodities if grown in the enterprise fields. The production stage activities included the washing and cutting of fruits for processing. The proposed framework combined supply chain (successive stages of creating value) of the innovating enterprise (ego), actor network analysis and IVC (innovation activities and types) and the environment (described by institutions). Value chain referred a set of activities that enterprises undertook to create or add value (Lazzarini, Chaddad and Cook, 2001). Sources of knowledge and resources, as well as coordination mechanisms, correspond to a particular stage of creating value (Lazzarini, Chaddad and Cook, 2001). In any form of network, there are unique characteristics. By failing to distinguish between network types, researchers have prevented themselves from capturing the complex variety of factors (Inkpen and Tsang, 2005).

The two approaches, RIAT and SNA, were analysed at the micro-level in the following ways: firstly, by isolating the focal actor (innovator) and then applying the IVC approach, the actor network aspects evaluation framework, and institutions to the three-stage agro-processing value chain. The assumption made in the framework was that each stage has distinct dynamics, such as the type of knowledge needed, networking support needs, as well as the difference in innovation activities. The assumption related to that made by Lazzarini, Chaddad and Cook (2001) in their net chain analysis framework. In this framework, the scholars integrated supply chain and network analysis to study complex inter-organisational relations.

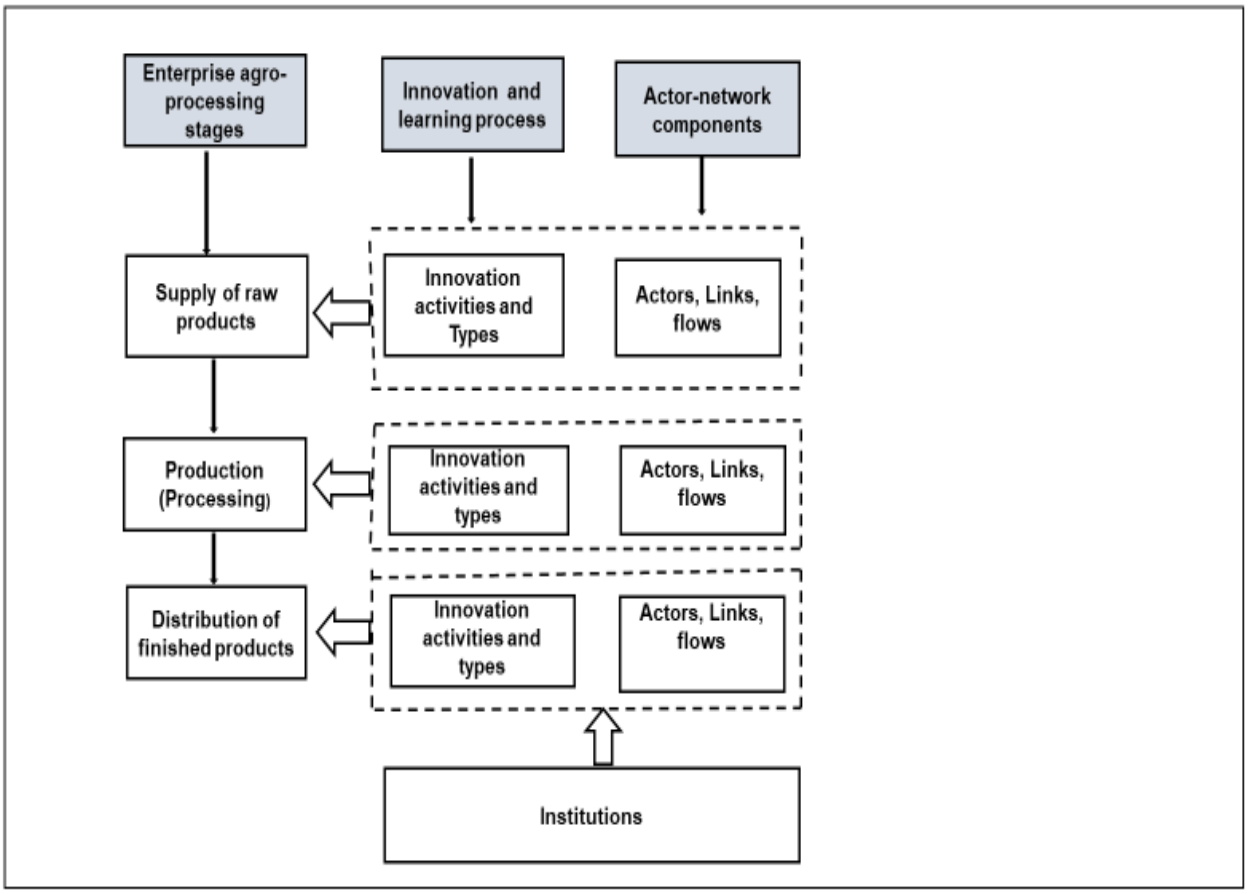
Secondly, some of the actors may not be relevant at some of the process stages. The application of this framework could provide insights into the inclusiveness and exclusiveness of some actors that may be relevant or irrelevant in rural innovation systems or network systems. Rural innovation processes, as pointed out in Figure 4.5, referred to the process by which actors invent, adopt, adapt and share novel ideas, processes, technologies, new ways of organisation, and new ways of communicating to improve their activities (Sanginga et al., 2004). The network

aspects following Conway and Steward (2001), included actors, actor characteristics, links between actors and flows (objects of exchange).

Figure 4.5 summarises the stages of agro-processing; supply of raw products; processing them into finished products and the distribution of those products, showing that there is an expectation of innovation activities at each stage of agro-processing and some form of networking. The institutions show that there is some form of rules or norms at each stage and they may differ across the processing chain.

In summary, RIAT and SNA were important approaches to investigating the nature and dynamics of innovation in rural contexts as they focus on the actors, their characteristics, links, flows, innovation activities, and institutions that influenced the process of innovation. The application of an integrated framework could highlight the dynamics of interdependencies (supply of raw products, production, and distribution) in the system. Thus, the approach explored the composition and interaction of actors across the three stages of enterprise involved in agro-processing activities.

Figure 4.5: Integrated framework depicting network agro-processing value chain



(Source: Author)

4.7 Data analysis

Qualitative data analysis was guided by the purpose of the research, connected to the research strategy (Sørensen, 2004). The data analysis approach remained open-ended, given the nature and complexity of innovation activities and actor networks and the limited research evidence available on innovation actor networks in rural areas of South Africa. With reference to Yin (2003), the research made use of various sources of data, namely secondary data collected by the HSRC, documents, published short articles, observations, and key informant face-face interviews. According to Yin (2003), the use of different data sources assists in addressing issues of validity.

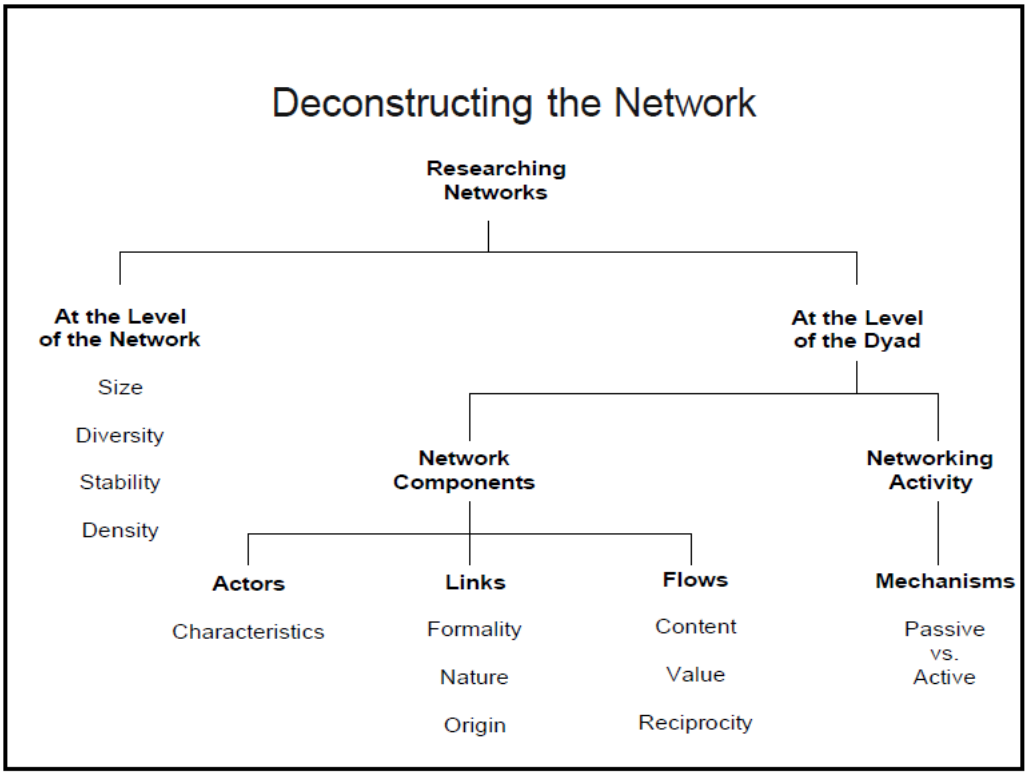
In qualitative data analysis, the first step was to provide a description of cases (Arthur, 2011), which is the starting point in this thesis. A description was developed

in each of the four cases. In each case it was focused on enterprise profiles, innovation activities, and ego networks. To address the research questions, the second step in the analysis was based on the elements of SNA. The analysis focused on actors' attributes linkages and flows and dhow they influenced learning and innovation.

Researching innovation networks could be done at different levels (Figure 4.6) (Conway and Steward, 2001). In this study, the analysis of networks was based at the individual network relations (dyads) level, in other words, the relation between the ego and alters. According to Conway and Steward (2001) in their work on "Realising the potential of network perspective in innovation studies", the focus of analysis at the dyad level was on network components, e.g. actors, links and flows and networking activity.

Network boundary was an important aspect of defining a network. According to Butts (2008), a misspecification of the network boundary could lead to inclusion or exclusion of relevant or irrelevant actors. In the current study, the network boundary was guided by the methods adopted and used to explore actor networks. The information studied was restricted to ego nets on alters, their attributes and the nature of their relationship. An egocentric approach helped in understanding the opportunities and constraints of the focal actors by being part of networks (Hanneman and Riddle, 2005). Thus, the egocentric network approach was useful for getting a picture of "local networks". As a result, it made it possible to get a grasp on the differences in actor places in social structures and to draw conclusions about how such places, or environment, influenced the behaviour of innovation actors (Butts, 2008).

Figure 4.6: Deconstructing the network



(Source: Conway and Steward, 2001)

4.7.1 Application of RIAT to mapping innovation

The analytical explanation of RIAT entailed documenting the narratives and innovation in each case. The innovation description commenced with an explanation of the procedure or practice of processing of the primary products and distribution to the market. In each case, the stage at which innovation activity was observed was highlighted and the interaction process explained. The innovation activities were explained in terms of invention, adoption, adaption, and diffusion of organisational ideas and products, goods and services. This was achieved by transferring survey data into narratives, using the key variables underlying the RIAT framework relevant to the present study.

4.7.2 Application of qualitative egocentric SNA

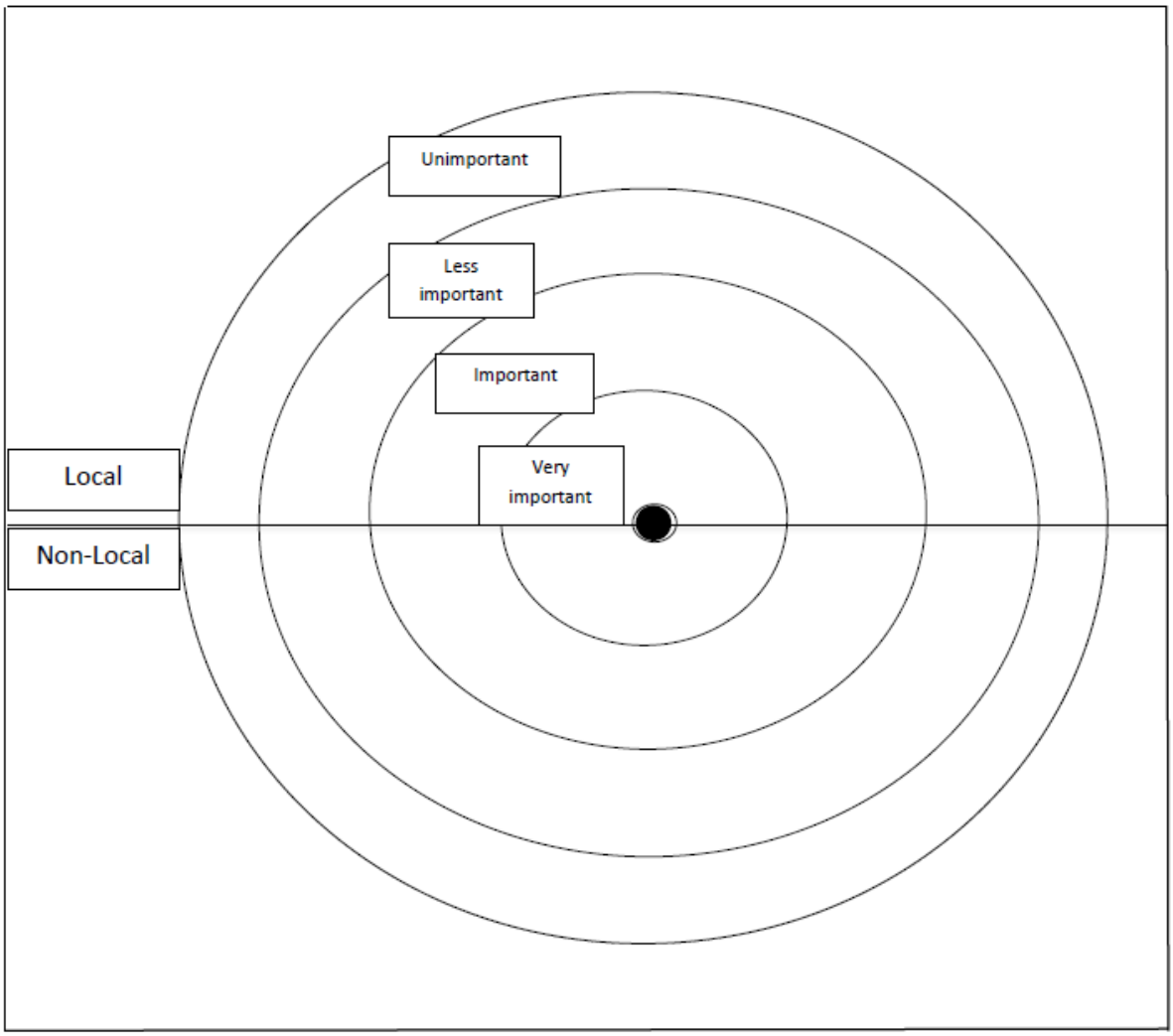
Qualitative egocentric SNA was applied to analyse data collected from the four cases that were involved in some form of innovation in the Mopani rural district. This approach focused on the view of actor network from the perspective of the focal

actor and indicated how many links the ego had with alters, the nature of the links or relationship, and the kind of information and resources they exchanged. For the purpose of this study and to answer the research questions, the emphasis was on actor network composition, concentrating on actor characteristics, ego alter relations (links) and the nature of flows. A cross-analysis of the four cases paid attention to network activity. This approach helped to understand the structure and composition of actor networks, the nature of interactions and learning patterns within networks, as well as items of exchange.

Information that characterises the ego and alters is presented in a table referred to as “the name interpreter grid”. The table sought to provide an easy understanding of the ego alter relationship. This grid contains information on actor attributes, nature of the tie, actor contribution, reciprocity, and relations. A network graphic depiction in SNA or network mapping tool was also applied in the study. According to Conway and Steward (1998), graphic depiction was designed to represent informal relations between individuals and also to represent relations between organisations in a factory setting. In the current study, the network graphic representation or network map was used to map actors that were closed to the ego in an ego network setting and to explore which of the alters were more important than others and also to check whether the links were reciprocated or not.

Figure 4.7 presents a network graphic depiction, or network map to analyse the level of importance of network partners (alters) and linkages. The actor variable (type of actor) and link variable (reciprocity) were used on the map. The four circles around the ego represent the level of importance from very important to unimportant. The closer to the ego, the more important the relation becomes. The line that cuts across the circle makes a distinction between local and non-local actors. The upper half depicts the local actors and the lower half depicts the non-local actors in the network with the ego. Reciprocity was measured to show the strength and weakness of the links. Unreciprocated links were considered weak.

Figure 4.7: Network map

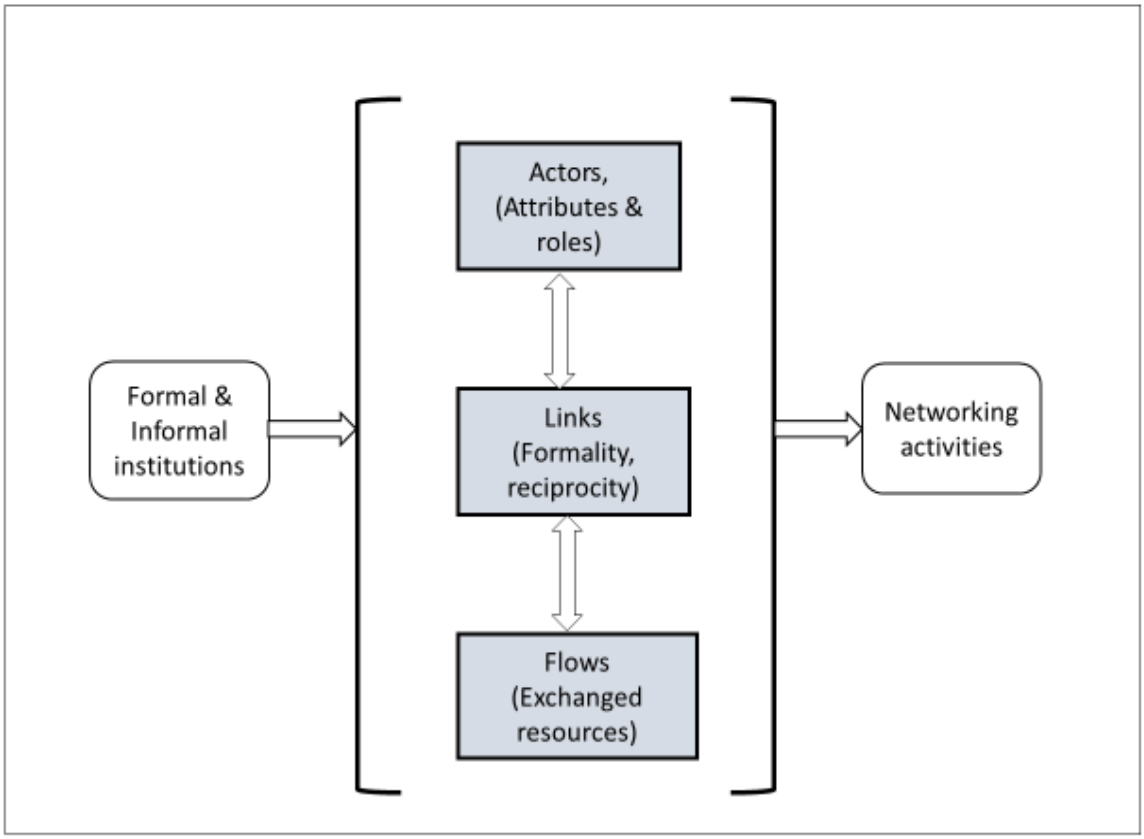


(Source: Adapted from Bilecen, 2013)

The egocentric approach in SNA was applied, which meant that the analysis was based on the focal actor (summarised in Figure 4.8). The composition of networks, network activities and the role and functions of heterogeneous groups of actors were examined and conclusions drawn about the success or failure of the cases in innovation. The composition of actor networks, activities and institutional contexts presented rich insights into the social dynamics of the innovation process in rural contexts. Figure 4.8 explores the characteristics of an ego network. Firstly, focal actors were profiled to understand the nature of the enterprise. The network aspects included actors, links, and flow. Actors refer to analysis that paid attention to actor attributes and roles. To understand the nature of the network, it was necessary to look at the formality and reciprocity of ego alter relations. Flows refer to the

exchanged resources. The resources have a huge impact on the strength and the nature of ego-alter relations.

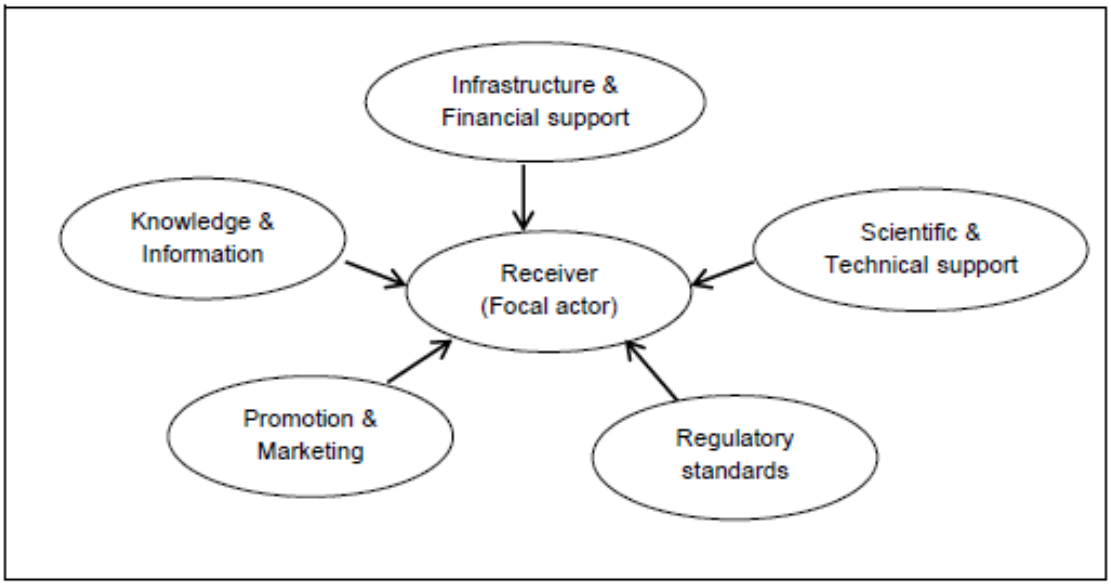
Figure 4.8: Actor-network components of an ego



(Source: Adapted from Berrou and Combernous, 2012)

A comparison or cross-analysis of the multiple cases and insights could be drawn at the ego network level. A high-level analysis of the interplay between the actor network and innovation was based on actor contribution and network activity. At the network level, the analysis was based on the structure and the network activities. The following network activities were selected in this study: knowledge creation, knowledge transfer, and resources transfer. Actor contribution is summarised in Figure 4.9. Multiple case study analysis allowed a comparison between case studies (ego networks).

Figure 4.9: Actor contributions



(Source: Author)

4.7.3 Multiple case study analysis

A multiple case-study design was used to examine four cases involved in networking and innovation. An analysis was done to draw similarities and differences between the four cases. The rationale for cross-case analysis was to replicate the findings (Baxter and Jack, 2008). A comparison between the cases revealed the challenges and opportunities faced by enterprises in rural contexts in South Africa. A cross-analysis was used to compare the composition of the four ego networks with a focus on actor diversity and size. The research also involved looking at network activity across the cases and exploring the extent to which each case introduced technological or organisational innovations. To understand the nature and character of interactive learning processes in rural contexts, a cross-analysis of interactive learning patterns, knowledge forms, and learning environment was done. The section on learning was extended by enterprise knowledge management.

4.8 Limitations

This study adopted purposive case study selection approach. It could be considered to suffer from selection bias and limitation with regard to generalisation of the research findings, but this is justified because of the depth, texture and nuance of insights that emerge from good case analyses. The researcher highlighted that the population of innovating enterprises is often hidden and undocumented in rural areas in Mopani, South Africa and other rural areas. Therefore, sampling purposively was necessary. Prior evidence of observed innovating enterprises was found from the data collected during an on-going study on rural innovation in local municipalities by the HSRC and the researcher was part of this project. The rationale of this study was to explore the social dynamics of innovation in a particular rural context and it does not aim to generalise the findings. Thus the study seeks to understand networking and learning trajectories in the context of the study.

In-depth case study researcher depends on the descriptive ability of the respondents. However, to overcome this issue, the interviews were conducted in the language the respondents were comfortable in speaking. Furthermore, data was collected from different sources, namely interviews, reports, observations during project visits and transcripts of workshops.

4.9 Ethical considerations

The study was undertaken in line with principles of ethical research involving participants. Special attention was paid to communicating the aims of the study, and the rights of participants in the research, written informed consent, and issues of confidentiality. Before conducting interviews, permission was requested from all the participants that were interviewed. It was explained that participation in the interviews was voluntary and they could withdraw at any time during the interview (Richie et al., 2013). Furthermore, issues of confidentiality were clearly communicated and assurances were given that confidentiality and anonymity of the data will be maintained at all times (Richie et al., 2013). Information was provided to participants through an introductory letter, followed by telephone calls and the setting up of appointments for interviews. On the interview day, the interviewer repeated the introductory information about the study. (Richie et al., 2013).

Following the research ethics guidelines by Richie and Lewis (2013), participants were informed about the purpose of the research and how the data would be used. Furthermore, all participants were requested to give informed consent for the interviews.

Interviews only continued after receiving confirmed consent from participants. They were provided with information on the on-going pilot research project on RIAT, and that the researcher conducting the interviews was part of the HSRC team. RIAT phase 3 was an on-going project that was implemented in 2015 following a successful completion of phase 1 and 2 between 2012 and 2014. Prior to implementation, the research project was assessed to see if it was in line with research ethical guidelines. The enterprises also took part in RIAT participatory, reflection and learning workshops on rural innovation. The subject of interest in this study was the element of networks captured in the RIAT project and the instrument was part of the high-impact innovation catalyst framework.

4.10 Conclusion

This chapter has elaborated on the methodology and research design, including the methods that formed the basis for data collection and analysis. It was argued that the interpretivist research paradigm was suitable for exploring the nature and dynamics of innovation processes in rural contexts by tracing the network relations of actors, learning activities, and institutions that condition their innovation behaviour. This study was developed, based on the core idea that innovation is a social process that occurs through a network of heterogeneous or diverse elements. Using exploratory qualitative approach, the purpose of this study was to explore how these networks were composed and how they explain interactive learning activities.

CHAPTER 5

CASE STUDIES' FINDINGS

5.1 Introduction

This chapter presents findings obtained from the analysis of selected case studies. It presents insights on the social dynamics of innovation among agro-processing enterprises in rural Mopani District. It provides the anatomy and profiles of the selected cases and evidence of existing innovation; It further provides descriptions of key themes i.e. actor networks, learning patterns and institutions that are central to innovation. It presents a cross case analysis to draw similarities and differences among the focal cases.

A qualitative egocentric social network analysis was applied to explore and map out actor networks of the innovating enterprises, and RIAT was applied to map out innovation value chains. The focus of analysis at the level of the dyad was on network components e.g. actors, links, flows, and networking activity (See Conway and Stewart, 2001). An egocentric approach allowed for an exploration of the networking and innovation activities of the ego (Everrett and Borgatti, 2005) and of the effects of networks on innovation activities. It is also important to state that this study was not concerned with individuals' perceptions on innovation processes but rather on exploring the nature and patterns of innovation processes of selected enterprises in relation to external actors for the purposes of networking and innovation.

5.2 Evidence of innovation

The cases of focus included; NBef Organics (NBef), Wolkberg Fruit Processors (WFP), Mpfuneko Rural Biogas (Mpfuneko) and Ledzee Estates (Ledzee). A key feature shared by all enterprises was their involvement in agro-processing. NBef and Ledzee were also involved in farming activities while WFP and Mpfuneko were only involved in processing activities and sourcing of raw materials from other enterprises in the local areas; WFP and Mpfuneko have received funding from various public agencies, while NBef and Ledzee were non-funded enterprises.

Innovation in the agro-food industry could take place at different stages of processing (Arthur, 2011). To carefully identify innovation activities and types, investigation was done at the three stages of agro-processing (supply stage, production stage and distribution). This approach was adopted to systematically map out innovation activities and other social practices that were involved during the process of innovation such as networking, learning and rules. The stages of processing refer to supply and storage of raw commodities, the actual production of product, and the packaging and sales of finished products.

5.2.1 NBef Organics

NBef was a female-owned enterprise that originated from Baraka Eco Farming, a primary cooperative established in 2006. This enterprise was involved in farming and agro-processing activities. NBef operated on state-owned land, leased from the Department of Rural Development and Land Reform (DRDLR). The farm was located outside Tzaneen, along Henley farms. The enterprise produced organic vegetables, herbs and moringa tree products (refer to Appendix 2, Pictures 1 and 2). NBef also offered training on organic food production and food safety standards (procedures to follow to acquire the right food safety standards) to local small-scale farmers.

The enterprise produced and sold organic cucumbers and tomatoes to Woolworths supermarket and other local buyers. The up-take relation with Woolworths was renewed annually, depending on the farm produce for that year. Woolworths supermarket was well known for selling organically produced agricultural products. Following a drought season in the area and low capacity irrigation water, the enterprise opted for more drought-resistant vegetable crops. Green beans and butternut were introduced, which did not require intensive irrigation. Other crops produced and distributed through the local market included lemon grass.

The enterprise representative indicated that through interaction with other farmers and observations they were exposed to moringa leaf processing, which was introduced following interaction with farmers and hearing the local buzz about the nutritional value of moringa leaf powder. Moringa trees were also used as a form of weed control by planting them between the vegetables crops, which was an added

advantage. Moringa also has another use, namely as an organic fertiliser. The leaves were soaked in water for a couple of days and then the liquid was sprayed onto the vegetables as a fertiliser. The enterprise also used some parts of the moringa tree as forage for livestock.

A key service of NBef was training provided to small-scale farmers, the majority of whom were local communal property associations (CPAs) and primary agricultural cooperatives. The main course was offered as a three-months training on sustainable farming systems. About 70 per cent of the training was experiential learning and 30 per cent theory. Other training courses offered included food safety standards, market-access requirements, business management, business governance and farm record keeping. NBef engaged in networking with local and non-local actors to build capabilities and improve their innovative performance. Full-time and seasonal workers are employed to work in the farm and also in the processing section.

5.2.1.1 Evidence of innovation at NBef Organics

NBef was a mixed farming enterprise that was also involved in moringa processing activities. Moringa leaf processing is not new and is practised in different parts of Africa and the world. In South Africa, moringa leaf processing took place at a small scale for local informal markets. Moringa trees were also planted at households across many villages in South Africa, which often harvest the leaves, dry them and use traditional methods to grind the leaves into powder for household consumption. NBef is one of the enterprises that planted moringa and harvested the leaves to process for commercial purposes. The leaves were harvested and left to dry. Once dry, the leaves were grinded into powder. Some of the moringa powder was sold in small packages, for instance, a 100g of moringa powder fetches between R80.00 and R120.00 (South African rand). The products were used for human consumption as food and nutrient supplements. According to one respondent, the powder could be added to smoothies, juice, soup, salads and other food products. The innovative idea of moringa leaves processing was learnt through interactions with external actors.

The moringa tree has been used by the human race for many purposes, ranging from consumption to domestic usage, animal forage, plant manure, bio pesticides

and as ornamental plants. The leaves from the moringa tree were used in many countries as a nutritional supplement in feeding programmes and as medicine for patients with a low immune system (such as HIV/AIDS patients). The enterprise processed moringa leaves into moringa powder and capsules and infrequently into tea. According to one of the respondents, moringa tea was offered to visitors for them to experience the taste of this natural beverage. Moringa leaf tea is even tastier when it was brewed with lemon grass, the respondent indicated. This activity could be interpreted as a type of marketing innovation, as the owner expected visitors to become aware of moringa products and consider coming back to purchase the product.

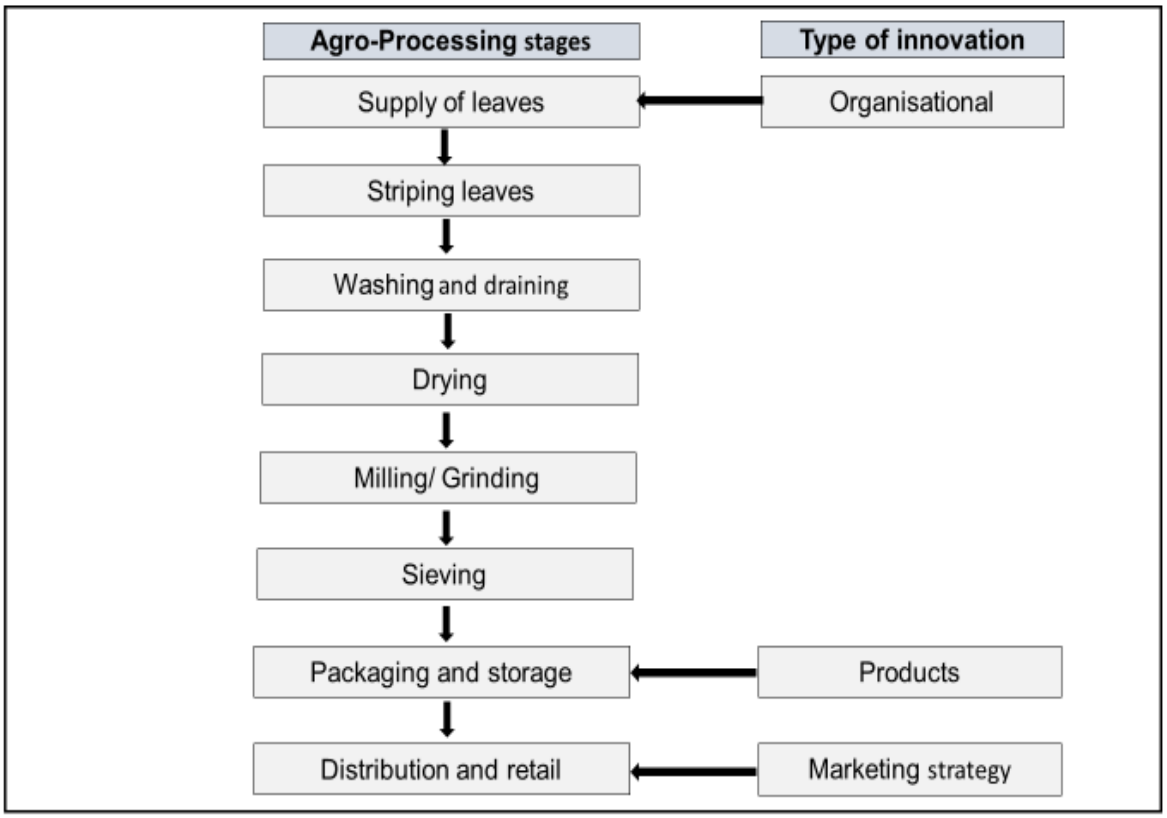
The arrows in Figure 5.1, an important illustration in this chapter, depicts the processing plant of NBef. It illustrates the stages at which innovations are introduced, from the supply of leaves, packaging, and distribution stages. At all these levels there was some form of networking, linked to the innovation activities. They show that actor networks are necessary for innovation with varying links, based on the type of knowledge and resources needed to fulfil an innovative act.

The researchers observed that at NBef, networking was necessary to increasing the supply of moringa leaves for processing. The enterprise also benefited from networking at a stage where they needed to acquire machinery to produce capsules and moringa tea bags. There was also evidence of networking at the level of distribution and retail.

At some stage, the managers realised that to increase production, it was necessary to increase the supply and storage of moringa leaves for processing into powder and capsules but they experienced a shortage of leaves. To increase the supply of moringa leaves for processing, the enterprise opted for an organisational innovation by organising a group of local small farmers who were trained on how to grow moringa trees organically. According to NBef, the farmers were provided with mentorship to start their planting as a way to encourage them to be actively involved in the growing and production of moringa trees. It was believed that this approach could lead to participation in the export market of moringa leaf powder. It was not difficult to access small-scale moringa farmers as some participated in the training programme that NBef offered to farmers in partnership with the Limpopo Department

of Agriculture (LDoA). This organisational arrangement has benefited the enterprise. The success of this effort has been ascribed to the involvement of the department, which assisted in many ways, including identifying the farmers and providing funding to acquire a leaf powder capsule packing machine, described lower down.

Figure 5.1: NBef moringa processing



(*Source: Author*)

The enterprise has built a database of local small-scale farmers who were involved in various agricultural activities. This has increased the capabilities of NBef to establish more innovation networks by bringing disintegrated small-scale moringa farmers together to increase the supply of dried leaves. This was interpreted as an organisational innovation.

The second stage was the production phase, where the processing activities involved the supply, storage, and drying of the leaves. At the production stage the enterprise introduced a moringa leaf powder capsules packing machine to transform the grinded moringa leaves powder into moringa capsules. This came about when

the company realised that customers preferred capsules to powder because it is easier to carry and swallow. In powder form, moringa was added in food products, such as yogurt.

The acquired machine was a standard one and did not require high technological skills from operators as it was fairly easy to use, as was shown during a demonstration. It added much value to the enterprise. To note, some of the processes were still done manually, such as sorting, drying, grinding of dried leaves, and sieving.

The introduction of the capsules making machine could be interpreted as a product innovation since it was adopted, embraced and used in the production process. Networking partners provided information, advice and know-how. The LDoA provided agricultural advisors to support and assist farmers through its extension service programmes. For example, an extension officer provided educational expertise on planting and processing of crops. Interacting with resourceful actors have enhanced the innovative capabilities of NBef.

At the distribution stage, when the packing of powder and capsules took place, there were evidence of marketing innovation. Moringa leaf powder and capsules was a fairly new product with an increasing awareness of its attributes among local communities. It was not yet widely known in other parts of the county but was trending upwards in the Limpopo Province. NBef implemented an innovative middleman approach by signing a memorandum of understanding with a retail company, Letsitele Moringa, which distributed and sold these products. Letsitele Moringa marketed the products through exhibitions and awareness campaigns across the region. NBef also intended to engage in group marketing and to start exporting the products together with other farmers and processors, which was linked to networking activities. The knowledge and information about exporting the product was linked to interactions with CBI, an institution based in the Netherlands that specialised in promoting trade from developing countries to Europe. NBef acknowledged the role played by external actors in their product and organisational innovations. The enterprise was not an inventive one but has been involved in the adoption and adaptation of organisational and processing innovations that brought change to its existing situation.

In this section, it has been shown that NBef has introduced innovations at the three stages of the value chain. The evidence underlined that the enterprise constantly sought information and knowledge to advance its processes, as was observed from the fact that the ego network evolved at different stages of processing. Based on the evidence, one could observe that innovation was a problem-solving act, intended to improve the existing situation. This was done by assessing the situation and pro-actively seeking network partners with relevant knowledge and resources, for example, establishing contact with the LDoA, which made available funding to access a moringa leaf powder capsule packing machine. Another example was the way in which the enterprise sought information on engaging in export marketing of moringa leaf powder. There were no radical innovations introduced in this enterprise, and as would have been expected, the organisational arrangements were prevalent and have benefited the enterprise in improving its innovative performance.

Evidence from the case highlighted that the innovations introduced were linked to the act of networking and interactive learning. Even though the networking patterns were relatively loose, the enterprise indicated that it had used formal and informal linkages, depending on the object of exchange. At NBef, there was evidence that even though enterprises in the local space were aware of what they needed, their innovative performance might be hampered by limited institutional support, relevant polices and intervention programmes, as well as funding. Nonetheless, the social dimensions of innovation have played a fundamental role in the processing of moringa leaves at NBef.

5.2.2 Wolkberg Fruit Processors

The WFP, originally known as the Nkowankowa demonstration centre, was an agro-processing facility that was initially funded by DST to support science and technology initiatives that brought about development in rural areas and served the needs of the local community. The factory specialised in mango processing into juice pulps and dried fruit. The WFP factory was located in the Nkowankowa Industrial Park, next to the Nkowankowa location in one of the impoverished rural district municipalities called Mopani in the Limpopo province.

Nkowankowa area and other surrounding rural villages were known for growing fruits such as mangoes, oranges, bananas. To produce juice pulp and mango dried fruit the enterprise sourced the mango fruit from local farmers and households that own mango trees in their back yards. These suppliers were selling in bulk to the enterprise, but there were also wheelbarrow and bakkie traders that sold mango fruit to the enterprise without pre-sale agreements (shown in Appendix 2, picture 4). The largest market for both dried fruit and juice pulp was in the local areas.

The WFP factory acquired unprocessed fruit from formal (e.g. commercial farmers) and informal economy suppliers (the community) as part of its input into the production process. WFP served as a market for ripe mangoes from all the segments of the local economy, such as households, individuals (including school-going children), small and big farmers within and outside Nkowankowa area. The inputs were delivered through a range of methods, some came in buckets brought in by young children, in wheelbarrows, as well as in bakkies, vans and trucks.

The enterprise has a high-end technology processing plant. The unit initially only focused on sorting fresh mangoes (shown in Appendix 2, Picture 5). Selected mangoes of good quality were then taken to the washer for cleaning. There was also a peeling section where workers only focused on peeling and cutting the fruit. An oven was used to dry the fruit. Once dried, another group of workers did the sorting of the fruit. When ready, the dried fruit were taken to the packing room, packed and sealed, and waiting to be distributed to buyers. Up-take agreements were made with potential bulk buyers. The Letsitele branch of QMS laboratories, a few kilometres outside the small town of Tzaneen, tested the products for quality and food safety standards.

The enterprise operated in a competitive environment with other mango-processing enterprises that process mango, for example Morokolotsi Archar that used green mangoes for their archar products. In many cases, commercial mango farmers opted for contracts with big commercial non-local enterprises that paid better fees for mangoes. This made it difficult for smaller enterprises to receive sufficient supplies of mangoes from commercial farmers. However, there were small-scale mango producers or farmers, scattered around the villages, that supplied micro and medium

enterprises, such as WFP. The enterprise employed seasonal workers during the mango-harvesting season.

5.2.2.1 Evidence of innovation at Wolkberg Fruit Processors

WFP was involved in the processing of mango fruit into juice pulp and dried fruit and was therefore exclusively involved in fruit processing. WFP owned a sophisticated and high-end technology processing plant. The plant, which was funded by DST, was motivated by the fact that the Nkowankowa rural area had an abundance of mango fruit that often went to waste. It was believed that processing of these fruits could present a market for small-scale producers, households and many other mango producers in the local area. A provision of a market for the primary agricultural products could boost the local economy and improve the living standards in the area. The processing stages included: sorting, cleaning, peeling and cutting of fruit, drying, packaging, and sealing. Fruit processing (pulping and drying of bulk supplies of fruit) involved the drying of mangoes and extracting of pulp from fresh mangoes.

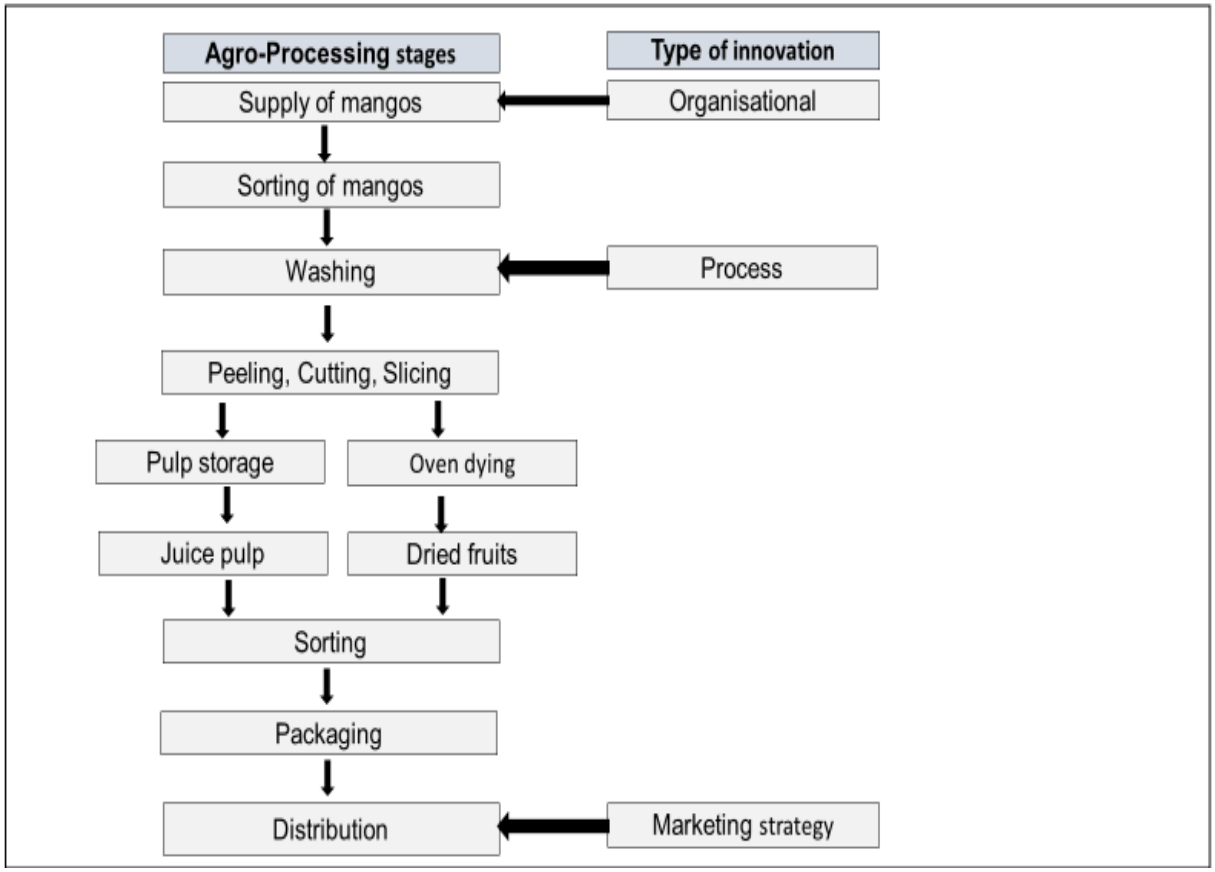
Figure 5.2 presents the processing stages at WFP. The double-lined arrows indicate the stages at which new and better ways of production were introduced. The enterprises established networking relations with suppliers of fruits through the introduction of organisational innovations to secure supply of fruits, which included concluding pre-sale contracts with buyers.

The processing of mangoes was at its peak during the mango season, which was from January to March/April of each year, when the enterprise increased their production of dried fruit and pulp juice. In the Nkowankowa area and surroundings there were several fruit processors which produced archar, dried fruits, juice pulp, jam, syrup, archar and so on. To curb challenges related to mango supply, WFP entered into pre-sale contracts with commercial mango suppliers and established informal relations with CPAs and households to supply mangoes to the factory during the supply and storage stage. The enterprise also entered into uptake agreements with potential buyers and concluded supplier agreements with locals, such as the CPAs farmers and households that could supply fruit to the factory. This, as well as the pre-sale contracts, were considered organisational innovations.

Mango fruit processing required a highly hygienic controlled environment. Collecting mangoes from small-scale producers might pose hygiene-related challenges as most of the small-scale producers did not pre-spray the fruits. To overcome this challenge, the enterprise introduced a chlorine solution in the pre-cleaning process before they were moved to the peeling and cutting section. This product innovation has led to an increased supply of mangoes to the enterprise. Knowledge of this process came from competitors through observation and adaptation of some of the practices. Previously, small-scale producers who did not pre-spray their mango fruit had limited access to agro-processing facilities in the area. Adding the additional step of washing mangoes with chlorine in the pre-processing of raw fruit has satisfied the Hazard Analysis and Critical Control Points requirements and allowed the procurement of direct inputs from the community. This was not the case with other mango juice and dried-fruit producers in the area, which mainly accepted pre-sprayed mangoes as input into their production process. The pre-cleaning innovation of mangoes differentiated WFP from its competitors and was regarded as innovative.

Participation in formal markets has always been a challenge to small-scale producers in local areas (Ramoroka, 2012). This was a highly-cited challenge in agricultural economics research that affected both farmers and agribusiness. In this case, WFP was faced with a challenge of securing profitable markets. At the time of the interview, participants highlighted that the mango production varied from season to season because of the fluctuating supply and quality of fruits during that season. As a result, the production output of dried fruits and juice pulp differed with each season. It was also indicated that previously, the enterprise had an opportunity to participate in short-term export markets through DST's assistance. Since then the marketing efforts have improved and currently WFP engages in pre-sale contract with retailers that provided them with surety of distribution of their products. Recently, the enterprise also established an occasional supplying of fruit to competitors in the area who were producing and supplying to bigger markets. According to the evidence, such relations were useful when the enterprise failed to secure a market at big supermarkets, such as Food Lovers markets and Spar.

Figure 5.2: Wolkberg Fruit Processing



(Source: Author)

It was observed that a combination of technical and social aspects of innovation improved the capability of an enterprise to innovate. Imitation was one of the most prevalent forms of learning and knowledge exchange between enterprises that were producing similar products. The opportunity-driven behaviour highlighted in this case showed that information and knowledge were not necessarily a public good. It could also be concluded that infrastructural support was not an end in itself. Enterprises lacked innovative capabilities to introduce different types of innovations, such as marketing strategies. Communication strategies were limited to creating pre-sale contracts between the producer and a retailer. There was no attempt to self-distribute, or any awareness creation of the products beyond the local areas. If enterprise productions are to be sustainable, firms should be able to participate in profitable markets at different levels (local, regional, national and international). Nonetheless, participation in markets was linked to many other challenges, such as product requirements, which might be difficult for resource-poor innovators to

achieve. All the innovations were introduced through purpose-built relations with careful assessment of current activities.

5.2.3 Mpfuneko Rural Biogas

The rural biogas enterprise was a locally based non-government and non-profit organisation that constructed and operated biogas digesters to produce ready-to-use biogas (refer to appendix 2, picture 7). The picture in Appendix 2 showed a stove connected to a digester. The enterprise was established in 2007 after receiving donor funding from a Dutch-based organisation to pilot test the use of ready-to-use biogas in rural areas. Its aim was to improve the standards of living in households by introducing the use of biogas for cooking in rural communities. These biogas-digesters enabled households to cook with biogas instead of wood for fuel, cut from the forests. The biogas enterprise was based in Gawula village and the first biogas digester was constructed and operationalised as an experimentation and demonstration site in Gawula area in the Mopani rural district municipality. Gawula is a small village with challenges, such as water shortages and poor rainfall. Following the piloting and awareness raising period, the enterprise adopted a business model to commercialise the biogas for sale to local households at a subsidised rate. The innovation came about following interactions with Netherlands-based enterprises and networks.

The biogas digester was an underground system made of bricks and concrete and a connection of pipes. Fresh cow dung was used to produce the gas. A gas pipe separated the methane gas from the cow dung and transported it to the connected stove in the house. However, to date there were still challenges with storing the gas. The biogas could not be stored for future use. It was produced and used immediately. The cow dung for filling the digesters was collected from cattle kraals, streets and veld. In some instances, the dung was also collected from neighbouring villages. As a practice, households owned cattle and kept them in kraals during the night, making cow dung available for collection in the morning. The digesters were filled with cow dung and water on a daily basis to enable the digester process. One of the challenges was cow dung availability because of cattle mortality during a drought seasons and another that some households still used cow dung for decoration of floors and walls of clay houses in their yards.

Prior to the introduction of biogas production in Gawula village where the experimental site was based, a survey was conducted to establish the willingness of households to use and purchase biogas. The survey results indicated a great interest in adopting and using biogas for cooking to replace fire wood for cooking. The reason mentioned by the key informants was that if ready-to-use cooking biogas expanded and became commercialised, it could replace fire wood, which would reduce the dangers of fire wood smoke inhalation. In addition, the women and children would spend less time collecting fire wood, and would reduce deforestation caused by a regular collection of fire wood. One of the reasons for commercialising the biogas was that households that did not own cattle, might not be able to access cow dung for collection or to make use of their own bio-digester for biogas production. Similarly, the bio-digester was relatively expensive to build and could be unaffordable. This enterprise has centralised the bio-digester and it serviced several households with an interest in adopting and making use of biogas for cooking and heating water.

The enterprise also started training local people, including local brick layers, on how to construct the digesters, how they worked and how they were connected to stoves for cooking purposes. They continued diffusing the knowledge by demonstrating their functioning and capabilities to other enterprises through experimental site visits. A thorough orientation and demonstration was provided to individuals and groups who visited the biogas site.

5.2.3.1 Evidence of innovation at Mpfuneko Rural Biogas

Mpfuneko was involved in renewable energy. The enterprise used fresh cow dung to produce ready-to-use biogas. Given the nature and lack of awareness of the use of biogas for cooking in and around the villages in Giyani, the enterprise operated as a non-profit enterprise which sought to promote the use of ready-to-use biogas for cooking purposes. The enterprise was faced with funding challenges to keep operating subsidised biogas digesters.

The initial idea of starting the biogas production in rural Giyani came from the manager, and while other stakeholders contributed to the implementation of the idea. The potential, capabilities, knowledge and previous experience were the key factors that influenced the introduction of ready-to-use biogas in Gawula village in rural

Mopani district in Limpopo province. This enterprise constructed underground concrete and cement biogas digesters to produce ready-to-use biogas. The construction of such biogas digesters was regarded as low-tech and training of local constructors to build the digesters was straightforward. The digester produced compost, which was collected and used as an organic fertilizer in local gardens. During the interviews it was learnt that the local people derived increased social benefits from this initiative, i.e. the elderly people found it difficult to collect wood in the veld for fire-wood for cooking and heating water.

The enterprise expanded the scale of introducing ready-to-use biogas for extending their operations to three more villages namely, Mniginisi, Shawela and Siyandana. The expansion to these villages was facilitated through the introduction of organisational arrangements with nationally-based institutions through special programmes for green energy production and also establishing relations with civil-society organisations in their respective villages. The implementation of the digesters in rural villages had its own challenges and opportunities. Working in poor rural areas in South Africa, in particular, required the establishment of social structures that would create a favourable environment for facilitating the introduction and implementation of innovations, while also creating trust and acceptance from the community. Community innovation activities relied extensively on social relations built on trust and close physical proximity. To address this, the enterprise initiated organisational innovations by establishing relations with tribal authorities, the Tivarixaka Disabled Enterprise, and cattle owners in Mniginisi village as partners. The tribal authorities assisted in giving the go-ahead to introduce and implement ready-to-use biogas in the village and to create awareness by calling meetings and introducing the enterprise and their work to the community. Community meetings have served as a key platform in the introduction of this product to villages.

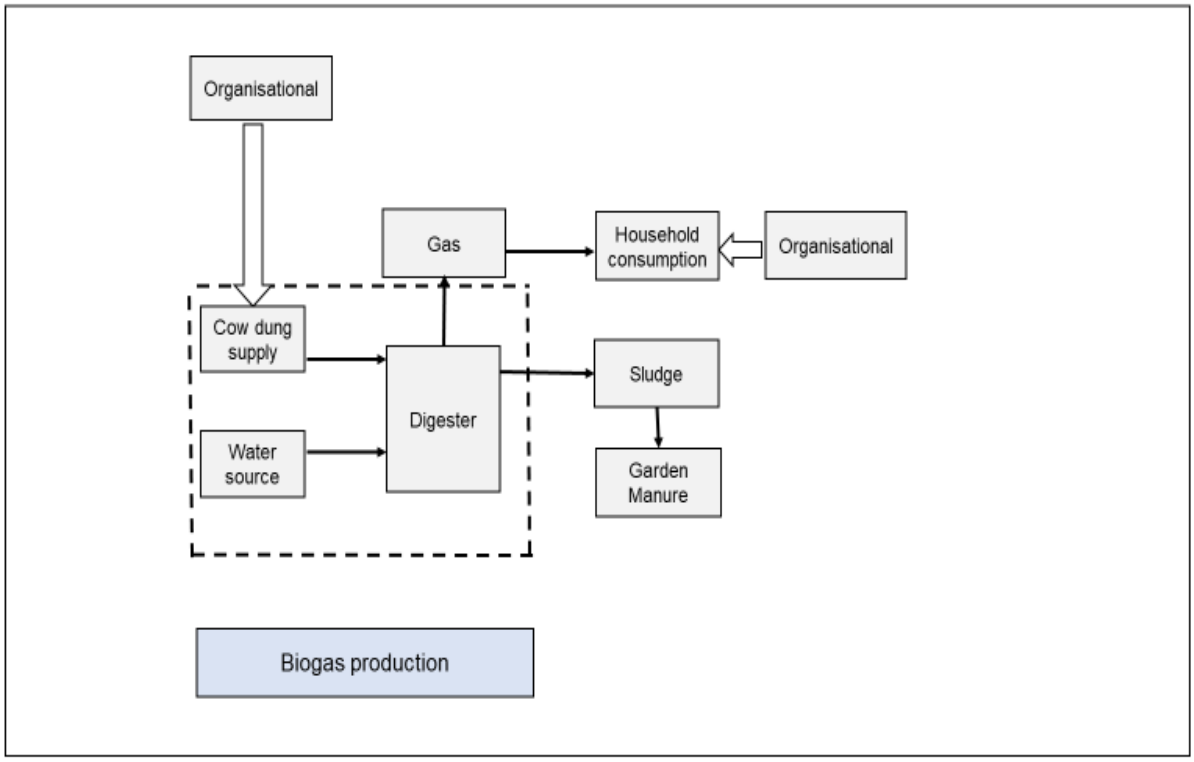
The Mpfuneko biogas enterprise adopted a model of establishing working agreements with local enterprises in the specific village to coordinate the implementation of biogas digesters. The Tivarixaka Disabled Enterprise entered into a relationship with Mpfuneko. Tivarixaka's role included mobilising local households and cattle owners to introduce biogas for cooking and for the maintenance and operation of bio-gas digesters, i.e. filling the digesters with fresh cow dung. During an interview with Tivarixaka participants indicated that there was increased

excitement among local households about the use of ready-to-use biogas for cooking. The evidence showed that these organisational arrangements were crucial for innovation and learning in the local and regional space. There was limited participation and support from the local government in the area. During the interviews it was highlighted that participation in local economic forums through the local government has not benefited the enterprise.

To come up with mechanisms to sustain the operation of digesters, the enterprise opted for operation and maintenance with local households. According to the contractual terms, households signed a fixed-term contract with the enterprise for a fixed fee and in return the organisation gave the assurance that the households would have sufficient gas for cooking at all times. The fee also covered the operation and maintenance of the bio-digesters.

Figure 5.3 provides a graphic representation of the activities that occurred in Mpfuneko. As indicated in the figure, cow dung supply and water were the key inputs in the biogas production process. These inputs were used to fill up the digesters to produce biogas and the sludge was used as organic fertilizers. The double-lined arrows show the point at which innovative activities were introduced. An overarching challenge was access to, and supply of cow dung. This has led to informal organisational arrangements with livestock owners outside of the villages but in close physical proximity. The enterprise networked with external actors to source fresh cow dung and the enterprise introduced organisational innovations to increase the number of households that adopt ready-to-use biogas as an energy source.

Figure 5.3: Mpfuneko biogas production



(Source: Author)

The fact that the enterprise relied extensively on social structures meant that the innovative activities were most particularly organisational with an element of seeking platforms to create awareness and promotion of the adoption and use of the ready-to-use biogas by local households. The enterprise was also in search of possible funders and network partners. There was an element of dependency on state funding. State funding was termed and whenever the funding was cut off, the innovator struggled to maintain and sustain the innovation activities. In terms of innovations, there was no evidence of the introduction of radical innovations. It was a business venture that could have had an impact if the upscaling and adoption of ready-to-use biogas could be achieved. The financial viability of this enterprise was arguable. To some extent innovations were introduced through well thought-out processes to identify relevant partners and enrol them into the network.

5.2.4 Ledzee Estates

Ledzee is a privately-operated farm on approximately 800 hectares of land along the road towards Lenyenye and other villages. The main operation of the farm was for

commercial purposes. The piece of land was accessed through the DRDLR's land programmes. Ledzee is a privately-funded enterprise and experiencing challenges, such as poor infrastructure (e.g. broken fences), lack of high-end technologies and lack of access to profitable markets for mango fruit. This enterprise was a mango-producing farm and the largest proportion of the mango fruit was sold to other local mango-processing enterprises. The farming and processing enterprise was among many other mango producers that experienced increased competition from mango buyers in the area.

Ledzee distributed mangoes to the local market and retailers within the district. The largest buyers of mangos for processing were WFP, Minute Maid and Kgogongwe Mango Depot. The manager/farmer at Ledzee shared his experiences in producing good quality mangoes and sugar mangoes by farmers that were good for fruit drying by local farmers through informal channels and structures. This enterprise spearheaded an organisational arrangement with other smallholder producers scattered around the villages to source markets for the fruits as a joint venture or group.

Even though the enterprise was involved in processing mangoes into archar, a larger proportion of the mangoes produced were sold to local markets. Another profitable niche market for Ledzee was the selling of livestock fodder, such as sweet grass cuttings and pelleting for resale. Sweet grass, which was suitable for livestock feeding, grew between mango trees and in the open land.

5.2.4.1 Evidence of innovation at Ledzee Estates

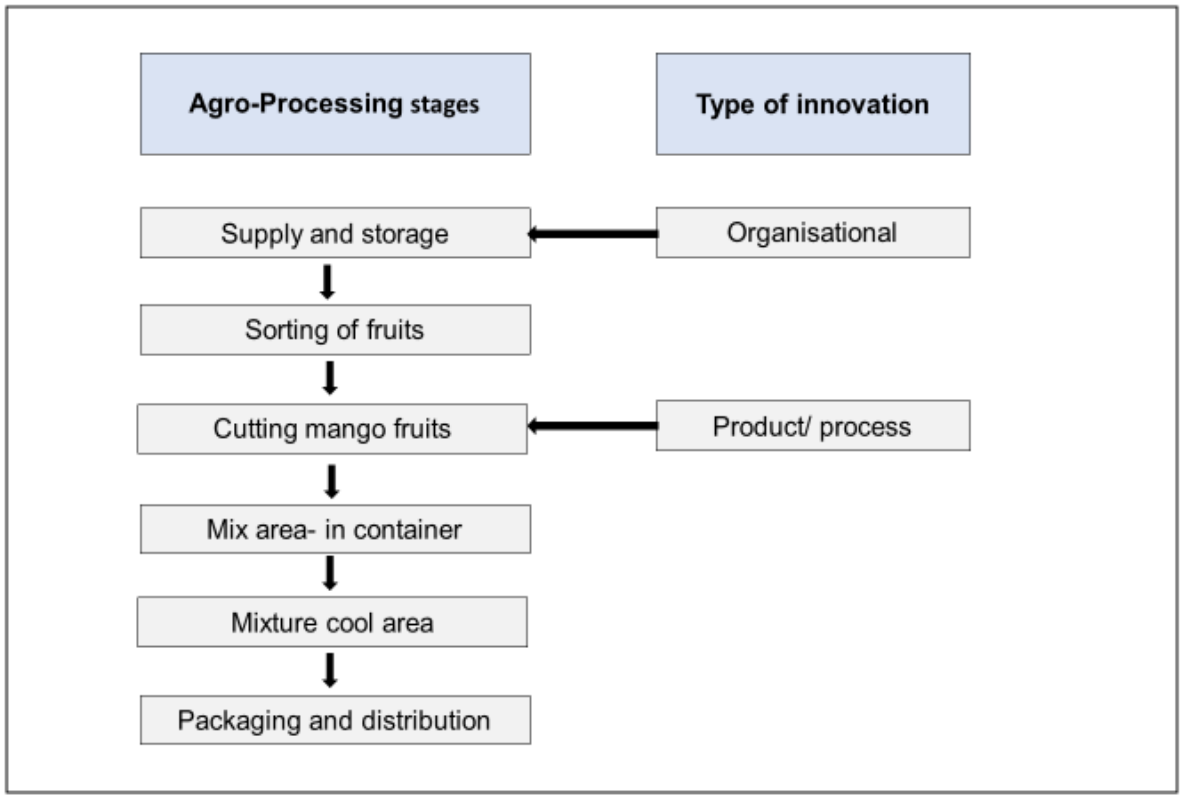
Ledzee was a farming enterprise involved in the production of mangoes, of which a large proportion was distributed as primary products to local markets for consumption and processing. With increased interactions and engaging with other enterprises or enterprise representatives, Ledzee realised an opportunity to engage in agro-processing activities. The enterprise established a mango-into-archar processing unit on the farm. Archar was made with different styles and some individuals or enterprises use fruits and vegetables in different areas across South Africa. In most parts of rural Limpopo, particularly in the Mopani region, mango archar was the most popular type of archar. Archar could be spicy or sweet. It was produced and consumed alongside bread, curries and other dishes. According to

one of the respondents, in poor households archar often replaced meat if the household could not afford to purchase meat on a daily basis. Archar is consumed in different forms and in various dishes all over South Africa.

Even though the study focussed on the processing of raw mangoes into archar, the enterprise was also involved in the distribution of livestock forage. The grass that grew between mango trees was cut, pelleted, and sold to local farmers as livestock feed. The biggest market and sales were achieved during the drought season, although some farmers purchased grass throughout the year. The farm received advice from extension services or agricultural support that the grass was suitable for cutting and for livestock fodder. This helped to expand operations on the farm and to increase profit margins. Informal relations with representatives from Agri SA also benefitted the enterprise. Agri SA provided problem-solving solutions and advice on request. The innovations observed in this enterprise were at a small-scale level. The enterprise also adopted a grass-cutting and packing/pelleting machine.

The analysis of innovation processes in Ledzee Estates is represented in Figure 5.4, showing the processing value chain. At the supply and storage stage of mangoes, the enterprise reported an organisational innovation that was introduced to address issues relating to shortages or surpluses of mangoes at the enterprise. Mango fruit were seasonal products and the amount of harvest differed each year depending on the level of rain during the season. This enterprise had to distribute surplus produce of mangoes and had to be able to source raw mangoes when production on the farm was low. A relationship was built with buyers of raw and ripe mangoes for processing and with one of the enterprises that operated in the form of a depot. Surplus mangoes were sold to other mango processing enterprises. To secure markets and avoid losses, the enterprise took up agreements or contracts with formal and informal buyers. The enterprise was part of a local forum of small producers. These producers supplemented each other in cases where an enterprise could not meet the demand for fruits.

Figure 5.4: Ledzee Estate archar processing



(*Source: Author)*

The manual method of cutting mangoes for archar processing was difficult and time consuming and the amount of archar produced was always lower than the demand. Production was dependent upon labourers who had to cut mangoes into small pieces for archar production. To speed up production, the enterprise adopted a green mango cutting machine with a sloping drain made of steel. The machine cuts the mangoes into smaller pieces, which are then mixed with oil and other ingredients to produce spicy archar. The machine could process up to 15 tons of archar in an hour. However, at the time of the research the machine was not utilised to its full productive capacity as it was installed recently and the enterprise had not secured profitable markets to which they could supply larger quantities of archar. Another factor was that the enterprise did not have a fully-equipped processing unit or plant. The machine did not require any formal training and was not highly scientific but operators needed some technical skills to be able to operate it. Through interactions with external actors, mango jam samples were produced in an attempt to start jam

production. These samples were taken to the Letsitele branch of QMS laboratories for quality testing of ingredients.

The innovation activities at Ledzee were embedded in loose, uncoordinated actor networks. There is an element of knowledge and information seeking through engaging in informal learning conversations with other local actors. There is no evidence of radical innovations but instead there are incremental innovations learnt through imitation. The evidence highlights the dominance of the adoption of new ideas that are aimed at improving production of the enterprise. Nevertheless, innovation cannot be isolated from interactive social practices. Institutional or organisational arrangements play a fundamental role in acquiring technical or machinery into the enterprise.

5.3 Networking, learning and institutions

This section presents an analysis of actor network structural features and activities, learning patterns and institutional contexts. It begins by, first, mapping out ego networks of focal enterprises, secondly examining reported learning processes and thirdly by investigating the institutions that influence their innovation behaviour.

Ego networks are comprised of actors involved in the innovation process of the ego (focal actor) at different stages of processing. With the use of name generator questions, enterprises provided a list of names of alters with whom they had some form of knowledge, information or resource exchange relationship that could aid the process of innovation. The use of name interpreter questions has helped in collecting information about the characteristics or attributes of alters (network partners) in the ego network, their roles and contributions, and the nature of links. The questions also took note of the object of exchange and how it affected the production and distribution stages. In the following section, the names of alters, their attributes and functions in the network and innovation process are presented.

The study used name interpreter grid and network maps to analyse the ego networks. Name interpreter grids of egos were presented in this section to understand the composition of ego networks and the ego alter relations in all of the four cases. The ego network components included actor characteristics, links and flows.

Actor network graphic depiction, or network maps were used to identify significant relations according to the information provided by the egos. The network maps have concentric circles with the degree of importance ranging from “very important” to “unimportant”. Actors that were regarded as very important have contributed significantly to the innovation activities of the egos. In the maps, there are lines that cut across the circles to distinguish between local and non-local actors. Actors were considered to be local actors if they were based within the boundaries of Mopani rural district municipality. Physical proximity might have had an effect on the level or degree of participation and contribution in the network. The legend of the maps contains information that shows the type of actors and the nature of ego alter link. The actors were distinguished as public, private, non-profit or non-government organisation.

5.3.1 NBef Organics

5.3.1.1 Networking

Enterprises established networking relations to access the necessary support for innovation. As presented in the previous section, NBef had introduced organisational and product innovations at different stages of processing of moringa leaves into powder and capsules, which resulted from the formation and interaction with external actors. Thus, NBef did not innovate in isolation but through interactive learning and exchange processes as reiterated in the innovation literature. In this section, a narrative and synthesis of the ego network of NBef is presented.

The analysis starts with a reference to Table 5.1, depicting NBef’s ego network, which was composed of public/ state agencies, private enterprises from both the formal and informal sectors, non-governmental organisations and associations. The state agencies included LDoA and DRDLR at the national level. The involvement of NBef with the two institutions was contractual. LDoA has contracted NBef to provide training to CPAs, establishing formal linkages. The department have contracted NBef to provide training for farmers in different practical and technical skills, including moringa production. NBef also interacted with extension service officers who offered agricultural advices as part of the mandate of the LDoA. The linkages with extension service officers presented an opportunity for NBef to learn about moringa and have access to information events and exhibition organised by the department. NBef’s

involvement with DRDLR was resource based. The enterprise leased land from the department. The linkages between the two enterprises were purpose built as NBef approached DRDLR to seek infrastructure support. The DRDLR has provided support by assisting this enterprise to access a moringa leaf powder capsule packaging machine. The packaging machine could be regarded as external knowledge as it was developed outside the locality and NBef adopted and used the machine in their on-going activities. By the time the machine was introduced the enterprise was already involved in moringa leaf processing for human consumption.

NBef had a relationship with two product associations, namely the Moringa Development Association of South Africa (MDASA) and the Cassava Growers Association (MORCASA), The linkages with Moringa and MORCASA was formal through a membership contract. NBef paid a membership fee to become a member of this association. MORCASA provided a platform where farming enterprises could exchange information and knowledge and also provided knowledge and information to members, particularly on moringa and cassava production. NBef established informal linkages with the MDASA and was a non-registered member of the association but did not acquired formal membership. MDASA was a local moringa association that intended to promote the use and production of moringa in South Africa through collaboration, research, training and information sharing. NBef interacted with MDASA members through a social media platform, namely a WhatsApp chat group, whereby members exchanged information and knowledge, and sought advice when facing production challenges.

The enterprise also exchanges information on moringa oil extraction with Knysna, a Cape Town based enterprise trading in moringa oil. The relation between the two enterprises was driven by the need for Knysna to purchase oil from NBef. The enterprise also engaged in promotion and market-driven relations with Letsitele Moringa. Letsitele Moringa was a local moringa distributing enterprise and a well-branded retail and distribution outlet that sold powder, tea and capsules. This enterprise actively participated in product exhibitions and road shows. NBef has put some of the processed moringa products on the shelves of Moringa Letsitele. NBef was involved in group marketing to meet demands of the farmers from the Communal Property Association on an ad hoc basis.

NBef received institutional and regulatory standard support from CBI, based in the Netherlands, and BCS, which was German-based. BCS was an organic production certifying body that conducted inspections and certifications of operators in countries of the third world. NBef received organic certification for moringa from BCS. The involvement with CBI, a centre that specialised in the promotion of imports from less-developed countries, was informal. CBI provided the enterprise with training on how to participate in export markets for moringa products. The LDoA assisted NBef to obtain a food safety standards certificate by providing information to the Hazard Analysis and Critical Control Points (HACCP).

Table 5.1 summarises NBef's ego network and contains information on the name interpreter of the enterprise. This is a representation of the attributes, relational ties, links (reciprocity) and flows gathered during in-depth interviews from the ego. NBef's ego network comprised a diverse set of actors. The links with alters were both formal and informal. NBef collaborated with actors from the public, private sectors and NGOs. The links between the ego and alters were reciprocated and non-reciprocated. The grid shows a sectoral similarity between the ego and some alters from the agricultural sector. The nature of the enterprise was found to be heterogeneous in the nature of ties at the dyadic level. The relations with public-sector enterprises were largely resource-based, for example, getting funding, rather than based on information or knowledge exchange and as such, relations tended to be less reciprocal. Relational interactions were through formal and informal structures and some were ad hoc while others were service-based interactions.

The network was expanding fast because of an increase in the market for moringa powder, especially at the supply and distribution stages. NBef produced moringa on a limited land area of less than 5ha. At all the stages of processing, the network consisted of diverse actors. The enterprise engaged with local, national and international actors and they included private, public, Non-Government Organisations (NGOs) and some international bodies responsible for organic certification. Regardless of the nature of the ties, links between the ego and alter were based on a need for particular knowledge, service or resources. The network consisted of both weak and strong ties and reciprocal and non-reciprocal relations. Links with non-local actors were often non-reciprocal compared to ties with locally-based actors.

It was also important to show the importance and relevance of relational ties between the alters and the ego (NBef) as revealed in Figure 5.1.

Table 5.1: NBef name interpreter grid

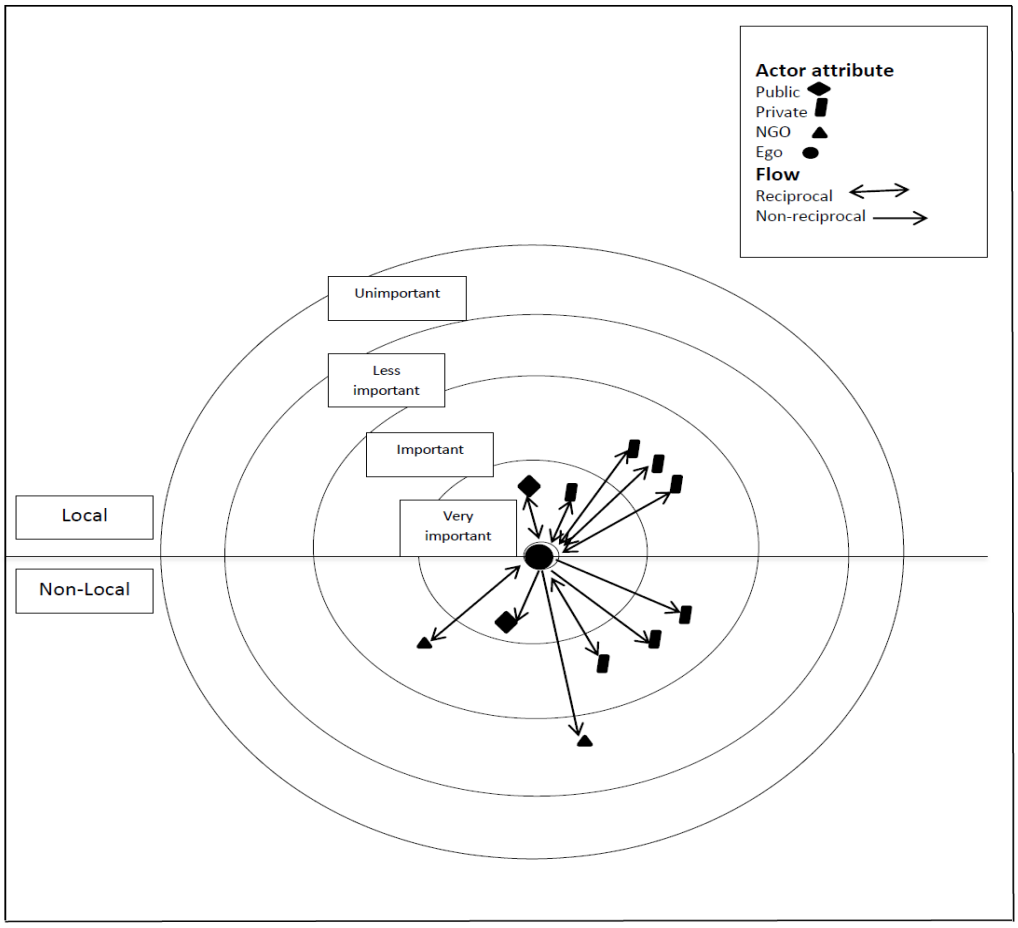
Alters	Attributes			Tie	Contribution	Reciprocity	Relation	
	Loca-tion	Enter-prise type	Sector	Nature of tie	Relational role	Ex-change relation	Interac-tion	flows
LDA	Local and pro-vincial	Public	Agricul-ture	Extension service/ farmer training contract	Knowledge/ product promotion	Both ego and alter benefit	On site visits/ exhibition	Know-ledge and informa-tion
Depart ment of Rural Develop-ment and Land Reform	Non-local/ na-tional	Public	Land	Land provision	Land	Ego operates on state provided land	Occasional ly submitting progress reports	Agricul-tural land
CPA farmers	Local	Private	Agricul-ture	Training	Alter attend training	Ego provides training	Through organised trainings	Know-ledge
Local moringa growers	Local	Private	Agricul-ture	Training	Informal conversa-tions	Share informa-tion	Informal face to face talks and social media	Know-ledge and informa-tion
MORCAS A	Non-local	NGOs /Associa-tion	Agricul-ture	Member	Member-ship in the associa-tion	Share informa-tion	Workshops and exhibitions	Know-ledge and informa-tion
MDASA	Non-local	NGO/ Associa-tion	Agricul-ture	Unregis-tered member	Unregis-tered member	Share informa-tion	Social media	Know-ledge and informatio n
KNYSNA	Non-local	Private	Buyer	Informal	Alliance	Provides oil extraction know-ledge	On site visit	Knowledg e and informatio n
Letsitele moringa	Local	Private	Distributo r	Collaborati ve	Joint venture	Product sales and distribu-tion	Planned meetings	Knowledg e and informa-tion
CBI based in the Netherlan ds	Non-local	Private	Food safety	Service based	Service provider	Regula-tory standards	Approval process	Approval
BCS German	Non-local	Private	Organic certificatio n	Service based	Service provider	Organic certifica-tion	Approval process	Organic certificatio n

Figure 5.5 illustrates some of the information presented in the name interpreter grid. The level of importance was self-declared by the innovating enterprise and was influenced by the object of exchange and nature of the linkage. As shown, a

distinction is made between public, private enterprises and NGOs. Even though actors played a key role in innovative capability building, the extent to which they were regarded as important by egos, differ. In this case, three actors were the closest to the ego, of which two were from the public sector and one from the private sector. There was no representation from NGOs in the “very important” circle of the network map. Actors in the “very important” circle were LDoA, Letsitele Moringa and DRDLR. The importance of these actors was explained by the resources the ego obtained from these actors. All the other actors (refer to the name interpreter grid) were important, except for a relation with MDASA, which was regarded as less important.

With reference to the evidence analysed in Figure 5.5, the actor network was limited. There were three actors that had been considered to be very important to the innovation activities by the ego.

Figure 5.5: NBef network map



(Source: Author)

NBef's ego network comprised public enterprises, formal and informal private enterprises and non-governmental organisations. This ego network was regarded as small with limited participation by state agencies: one at national and the other at provincial level, and an absence of local governmental agencies, such as local municipalities. A larger number of the actors in the ego networks came from outside the local area with two international bodies that provided food safety and organics certification. The two non-government organisations were product associations that focused more on sharing product knowledge and information than providing resources. There were also linkages with local small-scale farmers that received training from NBef. These linkages with small-scale farmers did not provide immediate benefit to the current processing innovation activities. A higher number of linkages with external or non-local actors showed that NBef had networking capabilities and constantly sought partners who had relevant information, knowledge and resources.

A distinct networking pattern emerged. Linkages were established to fulfil a particular purpose. The evidence showed that there were supply and infrastructure support, knowledge, information, and marketing and promotion linkages. These linkages were formed with both locally and non-locally based enterprises including private, public or state agencies, non-government organisations and local small-scale farmers. The linkages with different actors had varying levels of importance to the innovating enterprise. The two state agencies in the network were regarded as very important actors in the network because of the object of exchange. Institutional actors played an important role in the innovation of this enterprise. The enterprise preferred networks that shared relevant knowledge and resources for their innovation activities. More generally, most of the linkages that NBef had with external actors, were weak and less coordinated. Some of the links were problem-solving or promotion oriented. This was observed with actors that were not located in the rural sector. This could be explained because of the distance between the rural areas to the cities. Nonetheless, there were strong cooperation linkages in terms of knowledge sharing, resources and services.

5.3.1.2 Learning activities

Various learning mechanisms took place between actors in a network during the process of innovation. NBef engaged in different forms of interactive learning through

different structures and channels. It is evident that awareness of moringa leaf powder processing came through informal conversations with individuals who heard of the product or were engaged in the production. NBef adopted the idea and implemented it through increased interactions with external actors. Most of the learning was about how to produce moringa organically, and how to process and distribute the product in local, national and international markets. At NBef, the representative played a key role in sourcing knowledge and information. Following increased awareness and knowledge about the crop, the enterprise started developing routines of practicing producing the crop and sharing the knowledge with other external actors.

The initial information and knowledge about moringa production and processing was learnt informally through interactions with an LDoA extension officer, who had completed post-graduate studies in China on moringa production and processing. The learning process was entirely informal because the extension visit was done in relation to other vegetable crops that were produced on the farm. This learning pattern took place during farm extension visits. The pattern of learning has developed overtime, and NBef increasingly sourced more information about moringa leaf processing and possible distribution channels. Following this learning experience, the enterprise participated in moringa workshops and exhibition events spearheaded by LDoA. Moringa interactive workshops were participatory. The department was interested in the crop and started inviting NBef to different exhibitions and events.

From this point onwards, the enterprise engaged in experimental or experiential training whereby moringa was produced for consumption on a small scale. Exhibition participation and days were useful platforms for acquiring more knowledge on the technicalities of processing moringa leaves into powder and capsules. Interactive learning processes about moringa production had been expanded. The enterprises offered farm training to local small-scale farmers and those who intended to start the production and distribution of moringa leaf powder. The training was facilitated by the LDoA, which had strong contractual linkage with NBef.

Interactive learning in moringa processing at the production stage was limited to a few lessons about the operation of the capsule-making machine. There was no

learning reported to be linked to the grinding of dried moringa leaves into powder. This dynamic indicated the usefulness of the combination of local knowledge and external knowledge. Not only did the enterprise learn about capsule producing machines but it also provided a platform to interact with other actors and access information on possible infrastructure support. The evidence gained from NBef showed that learning took place in different ways and under different circumstances but the need for learning was influenced by the need to solve a particular challenge or take advantage of an existing opportunity. According to the owner of NBef the search for knowledge and resources networking partners began with the need for finding herbs that improved people's health. Local people consumed traditionally grown and produced herbs because they are affordable, healthier and in close proximity. The enterprise's need for learning was aligned with exploiting opportunities for health benefits products.

Most of the interactive learning processes on the technical properties and marketing of moringa took place through relations with the two moringa and cassava production associations. One of them is MDASA of which NBef was an unregistered member. Members of this association created an online chat group (WhatsApp) whereby members posted and shared the experiences and challenges they were experiencing in moringa production, processing and harvesting. They further used this platform to share information on new opportunities, for example by sharing experiences with other members of the association by telephone. Even though the linkages with the association did not contribute to obtaining physical resources, it was a useful platform for sharing past and present personal experiences. Another platform was through participation at information day or exhibition events. Even though this form of learning was useful, it was regarded as having less impact on innovation activities at NBef. This open learning mechanism gave the impression that local actors preferred face-to-face interaction that was focused on solving a particular challenge or provided an opportunity.

State or public enterprises played a key role in creating a conducive environment for interactive learning. State agencies have the capabilities to arrange events whereby a diverse set of actors could be invited to share their experiences. According to a representative from NBef, learning was only useful if it is relevant to the current activities within the enterprise. The enterprise was also eager to source new

knowledge to tackle existing challenges or to take advantage of possible business and innovation opportunities. Interactive learning involved formal patterns, such as project-based training activities, demonstrations, training seminars and informal patterns, such as peer-to-peer exchanges of experience among producers or informal direct consultations between producers. The observation was that this enterprise benefited more from purpose-built linkages than from voluntary and serendipitous linkages.

In the case of NBef, the most dominant learning pattern was through planned face-to-face interactions. Even though this learning process was not two-directional, this pattern of learning had an impact since it focused and addressed a particular challenge or opportunity. The case study also highlighted that a combination of local knowledge and external or foreign knowledge inspired their innovative activities. Any external knowledge complemented their local knowledge and assisted in the acceptance, absorption and application of new ideas into current activities. The identified learning patterns in the NBef case, showed that relevant knowledge and the resourcefulness of actors had a massive impact on the learning processes and its impact on innovation activities.

5.3.1.3 Institutions

NBef adhered to DRDLR's land lease agreement rules and regulations. The enterprise paid a lease fee and had to draft progress reports, which were submitted to the department. NBef received an organic certification for adhering to the standards of organic certification. These institutions had an influence on the innovation activities of this enterprise. Linkages with the LDoA was governed and influenced by the terms of the contract. All the informal linkages had been influenced by rules and routines that were organically developing within the network, for instance, on how network members should conduct themselves during site visits and training. In the case of NBef, two state agencies interacted with the enterprise, namely DRDLR and LDoA. The linkages were contractual and these institutions had mandates and objectives to achieve.

5.3.2 Wolkberg Fruit Processors

5.3.2.1 Networking

WFP processors engaged in innovation and interactive learning processes with a host of enterprises from different localities, but with limited sectoral variety. These actors included state agencies, farmers, processors, civil society and households. The factory received start-up funding from DST. The factory was involved with the Limpopo Economic Development Agency (LEDA), which leased a building to the factory at the industrial park in Nkowankowa area. The factory also engaged traditional authorities who provided support and assisted in getting buy-in from the community in the area. This relation was used to create awareness and encouraged small-scale farmers and households to grow more mangos and supply the factory for processing. The interaction with civil society was particularly important for social support and building more social structures to facilitate the supply of fruits to the factory. The factory hired labourers locally as a way of contributing to the local livelihoods. Such behaviour has strengthened the links and trust between these actors.

The factory had limited interaction with the local municipality to facilitate access to water and electricity. This relationship was not reciprocal as the enterprise only visited the municipality if it experienced problems with water and electricity supply. At the supply and storage stage of the processing, there was increasing interaction with local actors who produced mangoes. The linkages were reciprocal because the enterprise needed the supply of mangoes while alters or network partners were in search for markets which they can supply to. However, learning activities between these actors were limited. The linkages were established for fruit-supply purposes. The actors in the ego network that supplied mangoes to the factory included CPA farmers, commercial farmers, “bakkie traders”, and households that grew mangoes in their gardens and back yards. The factory had an informal relationship with most of these farmers, particularly the non-commercial farmers.

Contractual supply linkages were established with Ledzee Estate, a commercial mango grower that concluded contracts with the factory to supply mangoes. There was also evidence of knowledge and information exchange between WFP and Ledzee. Ledzee provided training on handling the fruit delivered to the enterprise

and project management. WFP had accessed services and product specifications for quality and consumption safety at the small Letsitele branch of QMS laboratories. The relation was service-based and not formalised. The factory paid a fee for the quality assessment services.

WFP also established linkages with three other mango processing enterprises located at the Nkowankowa industrial park. These linkages could be interpreted as competitor linkages, in part, as these enterprises competed for the supply of mango fruit for processing. However, the linkages with these enterprises were regarded as more beneficial as indicated by the manager, since these linkages also served as a market for their juice pulps and dried mango fruit. BNS purchases surplus dried fruits from WFP and both Bronpro and Granopasse bought its surplus juice pulp. BNS, Bronpro and Granopasse are private entities that were strict on HACCP regulations and did not acquire mangoes from informal traders, such as CPA farmers, “bakkie traders” and households.

A composition of WFP ego network is presented in Table 5.2. The “attributes” section of the table indicates diversity or heterogeneity in terms of the location, enterprise type and sector. Ego links with alters were formal or informal. Heterogeneity of alters may be providing the ego with more opportunities for knowledge, information and access to resources. The contribution column in the tables indicates the key role of each of the alters in the ego network. Reciprocity explains whether the linkages were two-way or one-way. The evidence showed that most of the linkages were not reciprocal, which implies that the linkages were weak.

Table 5.2: WFP name interpreter grid

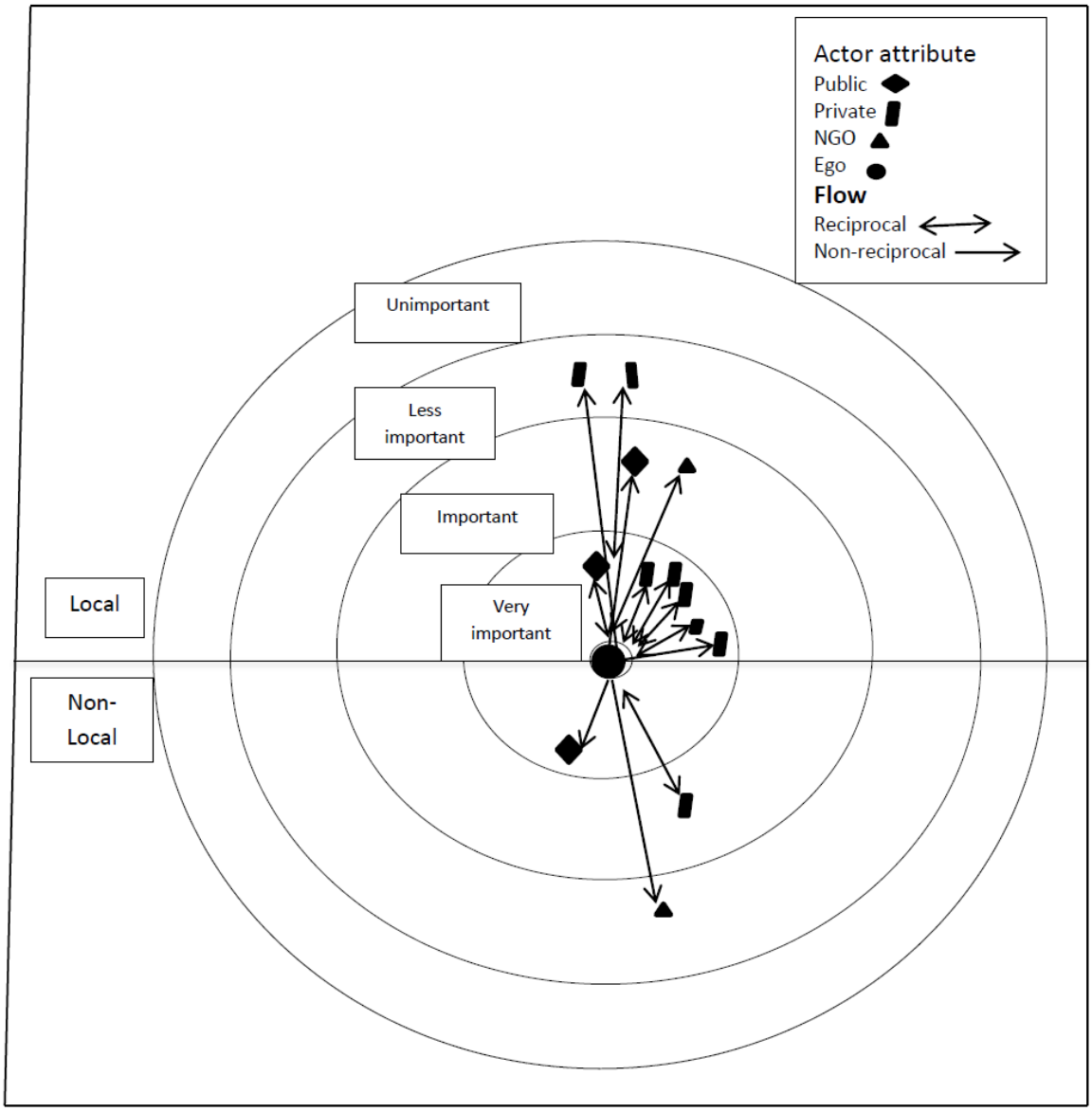
Alters	**Attributes**			**Tie**	**Contribution**	**Reciprocity**	**Relation**	
	Location	**Enterprise type**	**Sector**	**Nature of tie**	**Rela-tional role**	**Ex-change rela-tion**	**Interac-tion**	**flows**
DST	Non-local/ National	Public	Science and Techno-logy	Contractual	Funding	Ego receives	Monito-ring	Finan-cial resour-ces
Local muni-cipality	Local	Public	Social ser-vices	Informal	Water and electri-city	Ego recei-ves	Assis-ted with access	Water and electri-city
LEDA	Non-local/provi ncial	Public	Social services	Contractual	Building infra-structure	Ego lease building	Lease arrange ment	Infrastruct ural service
Traditiona	Local	NGO	Commu	Informal	Support	Alter	Commun	Support

l authority			nity services		and buy-in	provides support	ity gathering	
Households	Local	Private	Agriculture/ Backyard growers	Informal/ sales based	Supply of mangoes	Supply to the ego	On factory sales	Fruits
Bakkie traders	Local and non-local	Private	Agriculture	Informal/ sales based	Supply of mangoes	Supply to the ego	On factory sales	Fruits
Small farmers	Local and non-local	Private	Agriculture	Informal/ supply	Supply of mangoes	Supply to the ego	On factory sales	Fruits
Ledzee	Local	Private	Agro-processing	Formal/contractual	Supply of mangoes	Supply to the ego	On factory sales	Fruits
QMS Letsitele laboratory	Local	Private	Science lab	Informal/ Ad hoc service	Products quality tests	Alter provides service	On site visit	Service
Bronpro	Local	Private	Agro-processing	Buyer of juice pulp	Market	Both actors benefit	On factory sales	Market of juice pulp
Grannopasse	Local	Private	Agro-processing	Buyer of juice pulp	Market	Both actors benefit	On factory sales	Market of juice pulp
BNS	Local	Private	Agro-processing	Buyer of juice pulp	Market	Both actors benefit	On factory sales	Market of juice pulp

(Source: Author)

Figure 5.6 shows the relevance of alter relationships with WFP. The relationship with DST was considered as very important, because the department provided infrastructure and financial support. All the mango suppliers listed in the name interpreter grid were considered important because of the need for raw material/ mangoes for processing. Even though traditional authorities were part of the network, they were considered less important as they had less influence on innovative activities. Households seemingly supplied a smaller proportion of mangoes to the factory and as a result the linkages between them and the ego were considered less important by the ego.

Figure 5.6: WFP network map



(Source: Author)

Observations made show that WFP's ego network was dominated by locally-based actors operating in and around the areas where the WFP factory was based. Relying solely on local linkages, particularly at the distribution stage of processing, had negative implications as this affects the chances of participating in profitable markets. Civil society or traditional authorities in Nkowankowa provided social support and raised awareness to local mango growers of the operation of a mango processing enterprise. Apart from DST, the other two state agencies involved in the network were locally-based. The network was also dominated by actors that were involved in the production of mango fruit. Most of the links were weak. Weak and loose networks negatively affect the supply and distribution of final products. Thus,

weaker links with mango producers may lead to a shortage of mangoes available for processing. More generally, there was limited involvement of key national SI actors in the network systems. This made the network to be weaker and uncoordinated. Limited involvement of state actors was an indication of poor institutional arrangements in the area that are aimed to support and enhance the innovative capabilities of local innovators.

5.3.2.2 Learning activities

WFP is an agro-processing factory that specialises in mango fruit processing into juice pulp and dried fruit. It has a fully-equipped processing plant that was funded by DST. Mango processing operations are a highly-competitive industry as there is a scarcity of raw or green mangoes for archar and sugar mangoes for juice production. WFP established linkages with competitors as they were important actors that had relevant information and knowledge as they were operating in the same industry. Even though they interacted during several occasions, the learning patterns were individualist and opportunistic. They observed, imitated and adapted what they learn from competitors. This pattern of learning has led to the adoption and use of a chlorine solution in the pre-cleaning process of mango fruit before processing. The introduction of this process has seen the enterprise being able to accept supplies of mangoes from different producers including small scale farmers and back yard mango growers.

A more productive way of learning for innovation is observing how competitors or enterprises in the same industry operate. According to one of the interviewees at Wolkberg, enterprises that are involved in mango processing in the area are reluctant to share knowledge and information. The adoption and use of a chlorine solution was learnt from a competitor BNS in informal way. According to one of the interviewees, competitors have useful knowledge, but the knowledge is always hidden to reduce competition and avoid a situation whereby competitors start to progress more in their operation.

Another positive act from learning by observing was the introduction of pre-sale agreements with mango suppliers. There was also evidence between this enterprise and smallholder farmers, land reform beneficiaries and procuring from households that can supply fruit (e.g. mangoes) on mango sorting and handling as well as how to

grow sugar mangoes. WFP conducts in-house training to seasonal workers. This is hands-on and experimental training on how to cut, peel and wash mangos. Safety and hygiene training is conducted on a regular basis to constantly remind workers and other suppliers about the need to practice caution when processing mangoes.

Formal education is relatively absent in WFP's learning networks. Cooperation in learning is poorly developed and actors rarely engage in organised formal interactive learning activities. Interactive learning in mango processing in the production stage has been limited to observational learning. The learning occurred at the mango fruit preparation (washing). The chlorine solution use was learnt from competitors through interactions not necessarily aimed at learning the mango washing processes. There is an element of opportunistic behaviour, whereby the actors learn from competitors by observing and adapting what they have observed to suit their enterprises' activities.

Learning at the distribution stage was linked to finding possible channels of distributing processed products (juice pulp and dried mangoes). WFP engaged with other mango processors to explore marketing opportunities. Surplus produce is sold to the competitor that has secured a market. Seemingly, the type of learning between the competitors was informal and observational. The extent to which an actor shares knowledge to actors in the same sector or niche market is limited. There is an issue of trust that is linked to the fear of ideas been stolen and used by competitors. The dominant mechanism of learning highlighted in the synthesis is imitation through informal links with actors that are operating in the same sector.

5.3.2.3 Institutions

WFP operated in the hygiene requirement sector and adhered to safety and hygiene regulations. A chlorine solution that was adopted and used to wash mangoes prior to processing had to satisfy HACCP requirements. In the processing plant the manager had to supply workers with safety clothing. In the process of engaging with the community and civil society organisations, there were customs, rules and practices within the communities that had to be followed, for example, to arrange a meeting, the enterprise had to go via the chief or traditional authority to receive approval and had to be assisted by local leaders, such as ward counsellors, to reach households and small-scale mango fruit producers. Except for informal linkages with competitors

and other actors, contractual linkages were governed by the terms of the contract. In the case of WFP, DST played a key role in infrastructural support to the enterprise. Other key NSI players were absent in the network.

5.3.3 Mpfuneko Rural Biogas

5.3.3.1 Networking

Mpfuneko collaborated with different enterprises to bolster their operations. This enterprise joined into non-contractual relations with the municipal district office, the local municipality and the local department of agriculture. These linkages contributed to awareness of ready-to-use biogas in the local area. Furthermore, the enterprise interacted with the district municipality to access water to produce gas. The traditional authorities played a key role in offering land to Mpfuneko. Traditional authorities also created ease of entry and trust in the communities. Another form of partnership arrangement was between households and the enterprise. This was a contractual relationship whereby the households sign the ready-to-use contract. The households committed to paying a fixed fee on a monthly basis and the enterprise ensured the digesters were filled with cow dung and produced gas for cooking.

Mpfuneko also collaborated with funding institutions through special programmes. SANEDI provided funding for training of local people and subsidising the construction of biogas digesters in the households in Gawula. SANEDI has subsidised the construction of 55 biogas digesters in Gawula. Energy and Environmental Partnership Programme (EEPP) also provided funding for training of local people and subsidising the construction of biogas digesters in the households in Mniginisi and Siyandani. EEPP is a special programme jointly funded by international stakeholders. The key objective is to contribute to the reduction of poverty by promoting inclusive and job-creating green economy opportunities and by improving energy security in the Southern and East Africa regions while mitigating global climate change.

With an intension of making the biogas for cooking scalable, the enterprises formed an organisational arrangement with Tivarixaka disability project and cattle owners as partner organisations. The enterprise also interacted with a Cape Town-based biogas enterprise called Gender CC on ad hoc basis through workshops. Gender CC has demonstrated biogas digesters using plastic material than bricks and cement.

ZZ2 in mooketsi popularly known for producing tomatoes has an enterprise that concentrates on livestock production. ZZ2 has entered into a verbal agreement with the Mpfuneko to acquire cow dung. The relationship was entirely on access to cow dung to curb supply shortages in Giyani area. The relationship was fruitful during the drought season as many cattle died of hunger resulting in shortage of cow dung. Mpfuneko subsequently joined the Greater Giyani local economic development (LED) Forum.

The name interpreter grid (Table 5.3) helps us understand the composition of the Mpfuneko ego network. The table contain elements that illustrate differences and similarities of the ego and alters that explain the relevance of the relationships. In this case the ego tends to build relations mostly with local actors and non-local actors. This dynamic can be explained by the need for more local buy-in of the use of ready-to-use biogas. From the evidence, there was poor awareness of the gas in the area. The ego constantly presented and conducted demonstration workshops to train local people on how to use the gas to shift from cooking using fire wood.

Table 5.3: Mpfuneko name interpreter grid

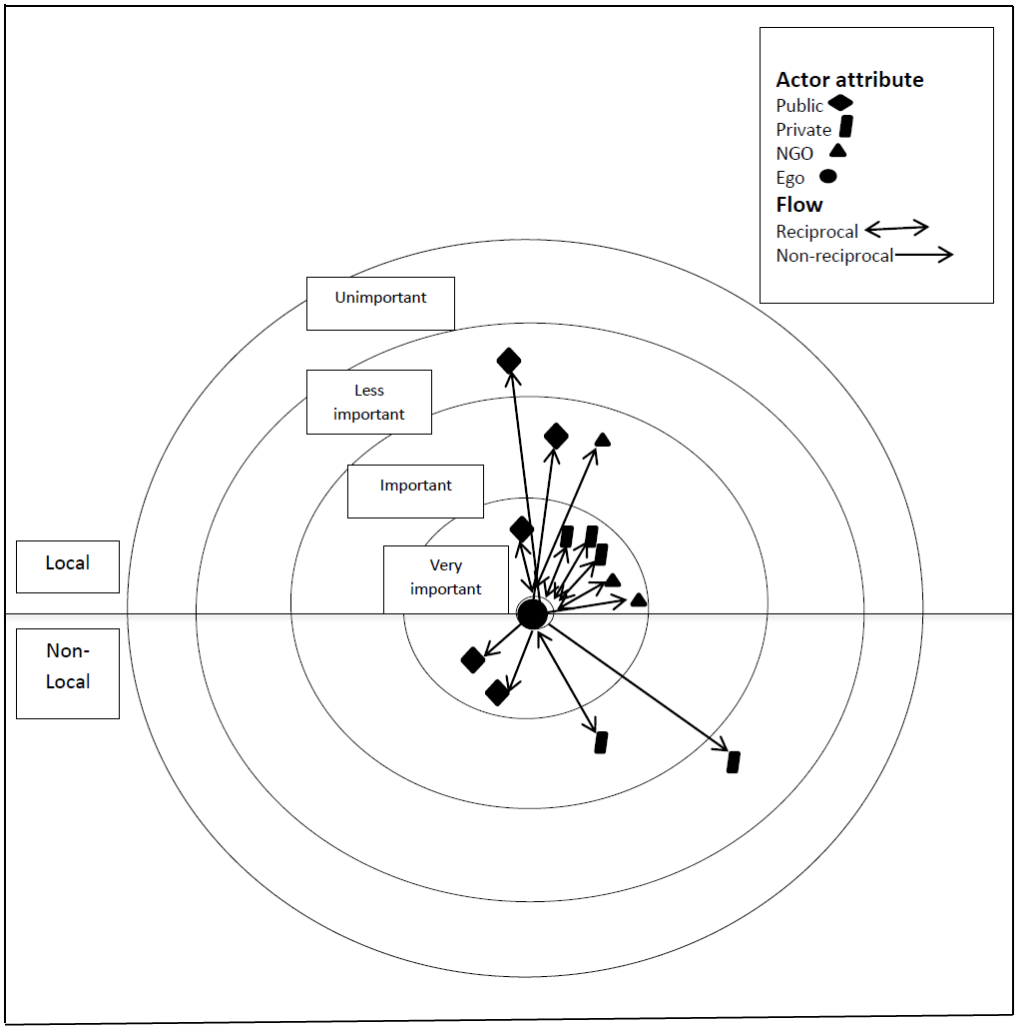
Alters	**Attributes**			**Tie**	**Contribu-tion**	**Recipro-city**	**Relation**	
	Loca-tion	**Enter-prise type**	**Sector**	**Nature of tie**	**Relational role**	**Exchange relation**	**Inter-action**	**Flows**
Municipal district office	Local	Public	Commu-nity service	Non-contractual	Service delivery i.e. water	Ego receives support	Ego visit the offices	Informa-tion
Local municipal-lity	Local	Public	Commu-nity service	Non-contractual	Service delivery i.e. electricity	Ego receives support	Ego visit the offices	Informa-tion
Depart-ment of Agricul-ture	Local	Public	Agricul-ture	informal	Extension service	Ego receives support	Ego visit the offices	Informa-tion
Giyani LED forum	Local	NGO	Commu-nity service	Participate in forum meetings	Information	Share informa-tion	Local LED meetings	Informa-tion and know-ledge
Tradition-al authori-ties	Local	NGO	Commu-nity service	Verbal agreement	Provision of land	Support to the ego	Commu-nity meetings	Informa-tion and support
House-holds	Local	Private	Community	Contrac-tual	Use ready-to-use biogas	Access gas from the ego	Workshops	Informa-tion and know-ledge
Cattle farmers	Local	Private	Agriculture	Informal agree-ments	Access to cow dung	Ego benefits through accessing cow dung	Community meetings	Access to cattle kraals
SANEDI	Non-local/	NGO	Energy	Contrac-tual	Funding	Ego receives	On site visit and	Informa-tion and

	national					funding	telephonic	funds
EEP	Non-local/ national	NGO	Energy	Contrac-tual	Funding	Ego receives funding	On site visit and telephonic	Informa-tion and funds
Tivarixa-ka	Local	NPO	Commu-nity social service	Partner organisa-tion	Implementa-tion of digesters	Knowledge and information sharing	On site visit and partner-ship gathe-rings	Know-ledge and informa-tion
Gender CC	Non-local	Private	Energy	Competi-tor	Knowledge	Knowledge and information sharing	Exhibi-tions and local work-shops	Know-ledge and informa-tion
ZZ2	Local	Private	Agriculture	Informal	Collection of cow dung	Ego collects dung from ZZ2	Ego visits ZZ2	Cow dung

(Source: Author)

With reference to the network graphic depiction we observe more local relations as being the most important from all the different enterprise types. The two key non-local actors from the public depicted in the closest circle to the ego are SANEDI and EEPP. Both of these actors provided financial support to implement ready-to-use biogas digesters in three more villages. The relationship with these actors was unreciprocated. The biogas enterprise received funding that came with a number of contractual conditions. Setting up a conducive environment for diffusing biogas digesters has proven to be important. In Figure 5.7 depicts the relationship with traditional authorities, partner organisations in respective villages, households and cattle farmers, which were regarded as very important to Mpfuneko.

Figure 5.7: Mpfuneko network map



(Source: Author)

The synthesis shows that the network consisted of a high number of local actors, particularly in the community social services sector and livestock farming. Their relations were useful in providing social support and creation of awareness and adoption of ready-for-use gas. The interactions were largely facilitated by the traditional authorities or civil society through the arrangement of community meeting whereby the rural biogas enterprise would present information on their operations and the usefulness of ready-to-use biogas. There were linkages with the renewable energy special programmes, aimed at promoting the use of renewable energy in the fight against climate change. Even in the case of the biogas enterprise most of the linkages were purposively built to fulfil a certain function.

5.3.3.2 Learning activities

Mpfuneko produces ready-to-use biogas in three rural villages. One of the key objectives of this enterprise is to promote awareness, adoption and use of ready-to-use biogas in the households. This encouraged the enterprise to engage in knowledge and resource networks locally and non-local. Interactions with SANEDI and the EEPP have influenced the introduction of organisational innovations. The learning was on developing possible ways to involve an increased number of local organisations and households in adopting renewable energy. The learning process was not reciprocal as SANEDI had set objectives to accomplish. The linkages between SANEDI and EEPP have facilitated and made possible a number of training and demonstration events to local individuals, groups and organisations on how to produce and use ready-to-use biogas from cow dung. Partner organisation also received training on the maintenance of digesters, collecting cow dung and implementing and managing the ready-to-use biogas contract.

The forms of learning included presentations, observations and hands-on training. Contracted households, as well as those that did not enter into a signed agreement to purchase the biogas, received training on how to construct biogas digesters, and operate and maintain them. The households were trained to be able to construct their own digesters in the future and produce biogas for cooking. This training was provided free-of-charge. The experimental site where the first pilot biogas digester was built is being used as a demonstration site for science learners from local schools and other people from outside the village as a way of diffusing skills. Youth were encouraged to work closely with the manager to learn how the project and the system operate. The manager highlighted that the aim was to have the local people accept biogas production for cooking and other purposes.

Strong linkages with civil society organisations have positively influenced the process of learning. Local people often responded positively to community meetings that were used as platforms to perform training sessions. In addition, during the interactive learning processes, Mfuneko Rural Biogas made partner organisations, traditional authorities and the community aware of the social responsibility linked to reducing the use of fire wood and preventing the cutting of trees. These actors also took up the responsibility of spreading the word and creating awareness of the use of ready-to-use biogas. This learning mechanism was reciprocal in the sense that the

biogas enterprise had an opportunity to learn how to interact and facilitate engagements with local residents and organisations.

The Mfuneko Rural Biogas enterprise and partner organisations played a key role in the biogas technical learning and awareness building, with support from the traditional authorities. This form of learning was completed by seminar and demonstration events. The traditional authorities adopted the technology and became the key source of knowledge on ready-to-use biogas. They understood the values and customs within which the targeted group of households operated, but also the cattle farmers who ought to have made fresh cow dung available for biogas production.

5.3.3.3 Institutions

Mpfuneko's local interactions were largely influenced by traditional rules and norms as the enterprise was located within rural communities that played a crucial role in the operations of this enterprise. Firstly, there was a need for consultation with the Office of Traditional Affairs before the implementation of biogas digesters in any village. Apparently, there were rules and norms concerning keeping livestock in these rural areas. Dung cannot be collected in other villages without consulting with the traditional authorities in that village. Middle-aged and pregnant women cannot enter the cattle kraal, which meant that women were not able to collect cow dung. The enterprise also had to adhere to the local water service's access rules and regulations. The enterprise had to pay service fees for water that was used in producing the gas. Ready-to-use biogas also had conditions - all the produced gas had to be utilised completely on a daily basis.

5.3.4 Ledzee Estates

5.3.4.1 Networking

Ledzee is a privately-owned entity that specialises in mango production, sales and processing. This enterprise has established close and loose ties with different enterprises within the local area and outside. Kgogongwe bricks and mango depot was one of the key network partners that interacted with Ledzee at the level of supply and storage of mango fruit. Kgogongwe specialises in buying green mangoes and selling them to big commercial archar producers in the area. When Ledzee experienced a shortage or a surplus of mangos, Kgogongwe assisted by supplying

mangoes. This linkage was a kingship tie, i.e. the owners of the enterprises had family ties with each other. Ledzee also had an annual renewal contractual agreement with WFP.

Ledzee also interacted informally with Morokolotsi Archar, which is one of the big commercial archar producers in the Tzaneen area in Mopani district. Ledzee exchanged knowledge and information using informal patterns with network partners. Morokolotsi Archar is also the biggest mango buyer. As part of the services offered to farmers, DRDLR interacted more frequently with Ledzee through extension service support as per the mandate of the department to assist local agribusinesses. Another extension services and support relation was with Agri SA.

At the time when Ledzee experimented with new mango products like jam and Minute Maid, the Letsitele branch of QMS laboratories played a key role in offering information and services at a fee. The mango jam samples were taken to the laboratory for quality and safety testing. Ledzee also had a relationship with small-scale mango farmers in the area. In cases where there was a need for more mango fruit supply at WFP, Ledzee mobilised local farmers to increase the supply to the factory. Ledzee also interacted with the DST through their involvement at WFP, which provided an opportunity to learn more about mango processing from DST-supported enterprises.

With reference to the name interpreter grid (Table 5.4) Ledzee's ego network consisted of local and non-local actors that were almost equal in number. Most alters were from the agricultural sector. The ego network was dominated by informal relationships with alters. The local municipal offices played a limited role in the network.

Table 5.4: Ledzee name interpreter grid

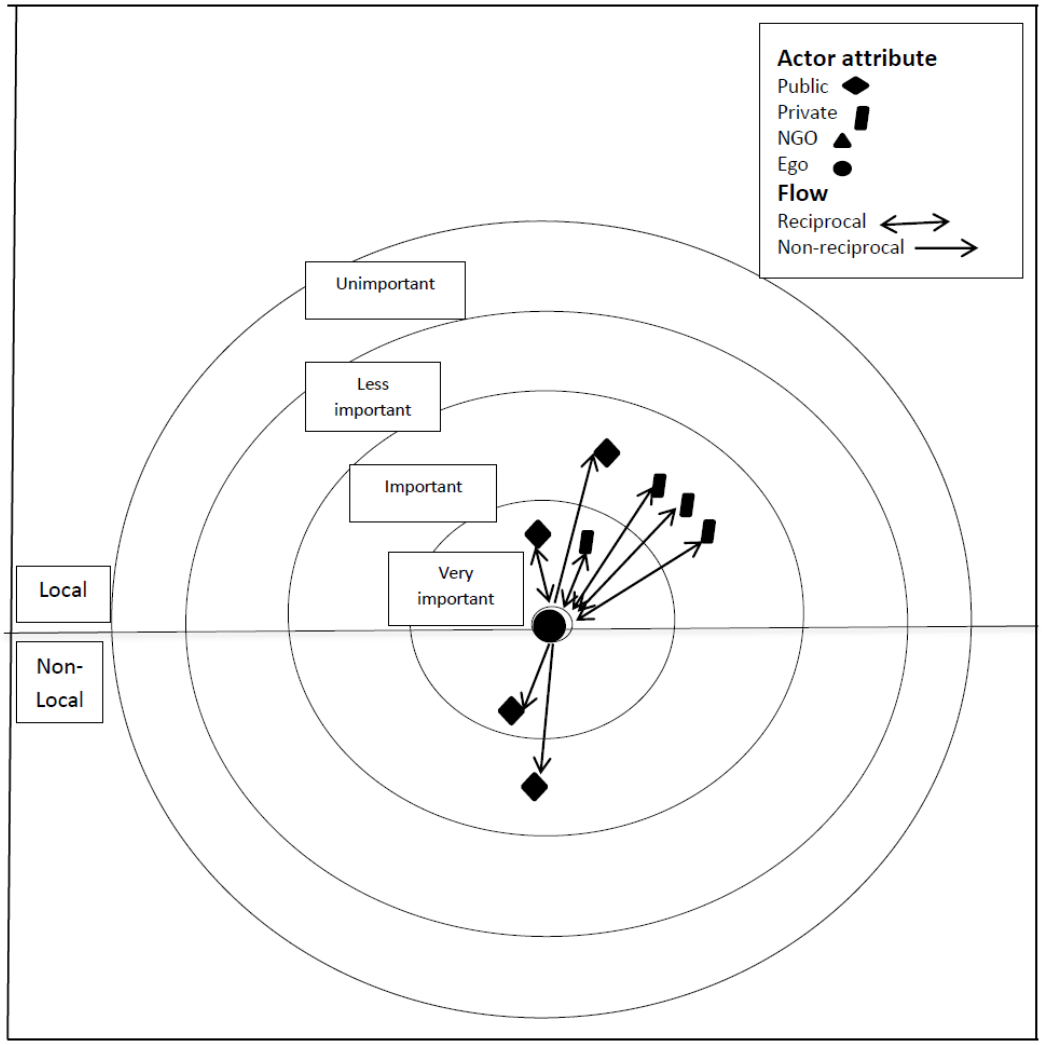
Alters	**Attributes**			**Tie**	**Contribu-tion**	**Recipro-city**	**Relation**	
	Loca-tion	**Enterprise type**	**Sector**	**Nature of tie**	**Relational role**	**Exchange relation**	**Interac-tion**	**Flows**
Depart-ment of Agricul-ture	Local	State	Agriculture	Informal	Knowledge and information	Extension service provided to the ego	Extension service visits	Knowled-ge and informa-tion
DRDLR	Non-local	State	Agriculture	Contractual	Access to agricultural land	Ego lease land	Ad hoc	Farming land

Kgok-gong-we bricks	Local	Private	Agriculture and construc-tion	Informal	Alter is mango depot	Fruit	Sales based in mango season	fruit
DST	Non-local	State	Science and techno-logy	Informal	Information	Information received by ego	Ad hoc	Informa-tion on agro-proces-sing
WFP	Local	NPO	Agro-proces-sing	Formal/ market based	Market for fruit	Alter purchase fruit	Sales-mostly in mango season	Fruit
Agri SA	Non-local	NPO	Agriculture	Informal/ friend to manager	Knowledge and information	Ego requests technical support	Ad hoc-on request	Knowled-ge and informa-tion
Morok-lotsi archar	Local	Private	Agro-proces-sing	Informal/ sales based	Market for mangos and archar production information	Ego and alter interacts	Alter buying mangos to produce archar	Resour-ces
Letsi-tele labo-ratory	Local	Private	Science lab	Informal	Labora-tory services	Ego visits the laboratory for tests	On request	Product quality testing

(Source: Author)

The network graphics or network map was used to visualise the closeness of alters to the ego (Ledzee) by examining the self-declared level of importance to the innovation activities. Figure 5.8 below shows that ego had a total of eight contacts, three of which were considered as very important network partners and the remaining was considered as important by the ego. Interestingly, the ego had reciprocated linkages with all the locally-based network partners.

Figure 5.8: Ledzee network map



(Source: Author)

The synthesis highlighted that Ledzee had a smaller ego network with linkages with small-scale mango producers from the local areas. There was also evidence of involvement with state enterprises. The enterprises reported three linkages as very important to their innovation activities. Ledzee's ego network was composed of weak and loose linkages with a limited number of strong linkages. Thus, loose and uncoordinated informal linkages were dominant in the network. There were voluntary linkages between Ledzee and other small-scale mango producers to share information on how to produce sweet mangoes that are good for producing mango juice pulp. Such linkages were not necessarily relevant to the immediate processing activities for the enterprise but they were necessary for social support.

5.3.4.2 Learning activities

There were several learning processes at the supply and storage of mango fruit regarding the production of sweet mangoes, the sorting of mangoes for juice pulp or fruit drying. Increased learning was observed between Ledzee and CPAs on producing sweet mangoes. CPAs partook in learning processes on producing good quality fruit in order to secure profitable markets.

Mango processing was influenced by interactions with other external actors. Prior to archar processing, Ledzee were one of the key suppliers of mango fruit to WFP. Thus, lessons on mango processing was learned from WFP through observation, informal chats and hands-on training. Archar processing skills were obtained through site visits and observation, reading, and informal conversations. The enterprise also received extension support from LDoA in Tzaneen. The officials visited the farms to assess conditions and offered basic agricultural information, such as dealing with weeds. Agri SA provided services on request to Ledzee. The learning was not reciprocal as the linkage was one-directional and weak. Ledzee contacted Agri SA if there was a crisis that affected the production and quality of mangoes. Ledzee also shared market information with other local small-scale mango farmers and briefed them about supply contracts and marketing. The learning process included ways of finding new sustainable and profitable market for mango fruit. Training was provided on the production of sugar mangoes.

5.3.4.3 Institutions

Ledzee took cognisance of safety and hygiene regulations in terms of producing good quality mangoes and archar, and rules pertaining to the drainage system of the archar production. According to the owner, the drainage system should be managed in such a way that it did not negatively affect the health of the local community. The relations with different actors were not affected by any rules and norms, except for the terms and conditions stipulated in contracts, for example, the supplying of fruit to WFP.

5.4 Cross-case analyses

The earlier sections in this chapter have concentrated on individual case analysis of the focal agro-processing enterprises in Mopani District. This section provides cross

case analysis with an aim of highlighting the differences and similarities observed in the focal cases. In this regard the dynamics of innovation and networking in rural contexts of Mopani are noted. The analysis focuses on innovation activities, networking, learning and institutions.

5.4.1 Innovation activities of rural enterprises

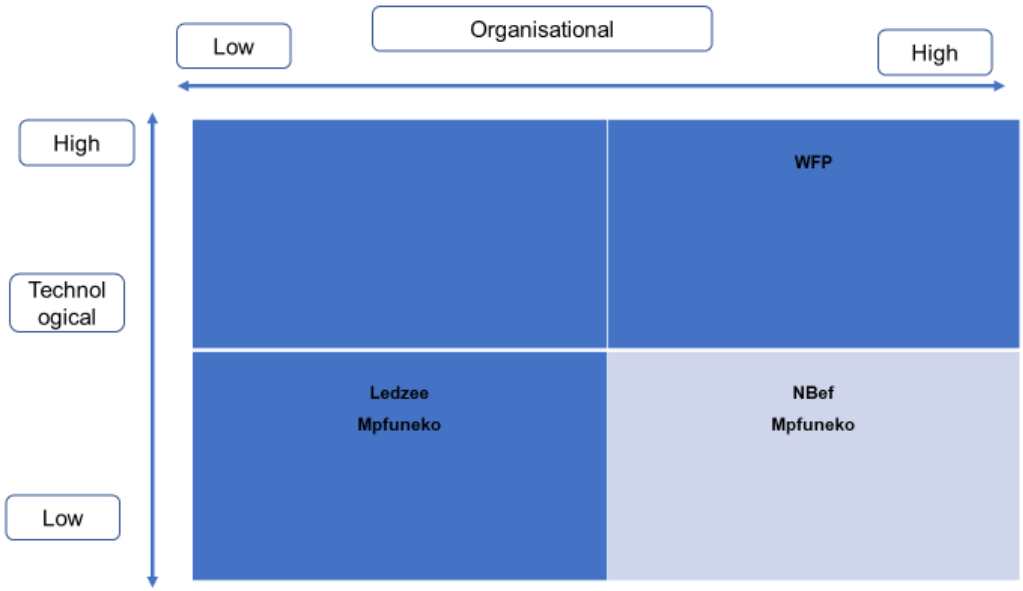
In this research study, four cases; NBef Organics, Wolkberg Fruit Processors, Mpfuneko Rural Biogas and Ledzee Estates were investigated. In relation to individual case analysis, some innovation types and activities were reported at different stages of agro-processing. The findings revealed that the four rural-based enterprises engaged in the adoption and adaptation of innovations, and none of them reported inventions. These enterprises rather adopted innovations from the external environment and applied them in their own enterprises to improve production and performance. There was no evidence of any new inventions and radical innovations in these case studies., Enterprises were engaging in specific types of innovation activities that led to the formation of specific types of relations with external actors. The findings also revealed compelling insights about the IVCs in rural contexts. The findings have highlighted that the combination of local knowledge and external knowledge relevant to the activities of the local innovators had a positive impact on their innovations. It is also shown that product innovations and organisational arrangements were interlinked. This dynamic has shown the need for increased institutional support as rural enterprises lack the resources and capabilities to generate and implement innovations that can be up-scaled to other regions and nations.

The evidence has indicated that the innovators engaged in low-end technology innovations. In all the cases, the innovations were incremental and not radical “novelties”. The innovators or actors indicated that they innovated to improve the existing situation in their enterprises and made an effort to envision opportunities, for example, that moringa products could be the next natural nutrient supplement, which opened up opportunities worldwide for processors. More importantly, it was indicated that the introduction of new ways of doing things better was a result of interactive processes, specifically with handpicked network partners. The innovators also

pointed out that they pre-assessed the existing situation and from there attempted to further improve on what already exists.

In this cross-case analysis it was found that the main sources of innovation in the four case studies were a low level of technological innovations and high organisational innovations (see Figure 5.9). The extent to which the enterprises adopted and used high tech innovations was influenced by the availability of resources and infrastructures. For example, WFP received funding from DST, which assisted the enterprise to erect a fully-equipped processing plant. Organisational innovations were most prevalent among rural enterprises as explained by the need to develop and build relations based on trust. Low levels of technological innovations among these cases can be explained by the disconnection between formal national innovation system actors and the rural innovation systems. These enterprises had no partnership with research and development actors and therefore low levels of research and development-driven innovations.

Figure 5.9: Innovation dynamic: technological vs. organisational



(Source: Author)

The findings from all the four focal enterprise revealed that networking and learning were the key sources of innovations that were introduced in their enterprises. Thus, the innovators sought to and create networking and learning opportunities that would

enhance innovation. The social practices, experiences, and efforts played a role in shaping their innovation landscape. To a larger extent, innovations had an element of addressing prevailing challenges in the communities. The case studies showed that innovation happened when there was intent and necessity. The innovators indicated that even though there was an element of commercial need, they innovated in order to solve problems encountered within the communities and to overcome the pressing problems within local communities. Moreover, their intentions to innovate were coupled with hope that the innovations can be up-scaled and could bring in economic benefits for the enterprise and for the local economy. It was observed during the interviews that the drivers of innovation could also be customers, family, network partners, anticipated opportunities and the innovation itself.

5.4.2 Rural innovation actor networks

Networking activities were instrumental at the introduction and implementation of new and improved ways of doing things in NBef, WFP, Mpfuneko, and Ledzee. Their networks assisted them in accessing new knowledge, information, resources and social support for innovation. The main structural features of ego networks of the four enterprises, that were observed were relatively small in size (about ten at most), were composed of a set of heterogeneous actors from different economic sectors and locations. These actors were dominated by local actors. The network partners had different attributes, and were composed of state actors, private actors, Non-Profit Organisations (NPOs) and NGOs. It was only in the case of Mpfuneko whereby collaboration with special programmes, such as EPP in the rural biogas case was reported. Among all the ego networks, there was limited participation of state agencies and the key NSI actors in the South African science policy context. Relations with state actors were noted in those cases where the innovator received funding or infrastructure support. Those relations were often project-based. Such relational characteristics were observed in the case of WFP and Mpfuneko. WFP and Mpfuneko were the only two enterprised that had received funding from state actors at the initial stages of the enterprise operations.

An observable dynamic among the networks was that the linkages were activity-driven. Table 5.5 below summarised the network activity or actor contributions that

could be translated as the determinants of network formation. The evidence presented in the table shows that the formation or engagement into networks was influenced by the need for infrastructures, such as buildings or land; financial support for innovation purposes; knowledge and information access; scientific support (such as laboratory services); promotion and marketing; and the enforcement and adherence to regulatory standards such as norms.

Table 5.5: Network activities

Ego	Infrastructure and Financial support	Knowledge and Information	Scientific and Technical support	Promotion and Marketing	Regulatory standards
WFP	✓	✓	✓	✓	✓
NBef	✓	✓	✓	✓	✓
Mfuneko	✓	✓	x	✓	✓
Ledzee	✓	✓	✓	✓	x

(Source: Author)

The network members in the four ego networks had varying resource and knowledge bases and contributions to the network activity and performance differed considerably. It was learnt that public enterprises often had predefined objectives to fulfil in rural areas, and this has had negative implications on their usefulness to the activities of the investigated enterprises. Enterprises adhered to contractual obligations that came with support from state agencies. The findings revealed that most of the knowledge and information received through public seminars were not always relevant to their current activities. Seemingly, special programmes are designed by state agencies and donors to perform a specific objective as well. This was shown in the case of the rural biogas in the Giyani area.

All the four ego networks were small, loose and dispersed and two types of linkages were observed among the four, and those are formal and informal linkages. Except for contractual linkages, the informal linkages were not necessarily managed but the routines and sense of trust and humility, as well as social empathy, had in some way

contributed to managing the network. The formal linkages were influenced by terms and conditions stipulated in the contracts, and they were often event-based. On the contrary there was limited participation of key NSI actors in these rural actor networks. But that did not prevent rural enterprises from engaging in innovation activities.

Two other types of linkages were observed among the four, and those are purpose-built and voluntary linkages. The purpose-built linkages were more beneficial to innovation activities than voluntary linkages. In this case, innovators engaged purposefully with a network member to access a particular resource that was of necessity to current activities. The network linkages were activity driven and such linkages were defined as “event-type ties” (Borgatti and Halgin, 2011). Event-type ties may include interactions (e.g. giving advice) and transactions (e.g. making a sale, signing a contract). The actor network types of the innovating enterprises are mapped out and explained below. They include infrastructure and funding; knowledge and information exchange; marketing and promotion; technical and scientific; and supply linkages.

Infrastructure and funding linkages or ties: These types of linkages were pre-dominant between the innovating enterprises and state or public agencies. Here network partners were instrumental in proving funding support and infrastructure to the enterprises which contributed to innovation processes. These forms of linkages were strong as they were facilitated through contracts and in some cases, they were project based, e.g. in the case of a special renewable energy promotion programme in Mfuneko Rural Biogas network; land and machinery funding that was received by NBef and the case of WFP and DST. Mpfuneko received funding from SANEDI to transfer knowledge of the use of ready-to-use biogas to household. These links have catalysed the introduction of some organisational innovations. i.e. Mpfuneko used these links to establish and facilitate partner organisations in rural villages that assisted in the transfer of ready-to-use biogas. The evidence showed that the interaction between Mpfuneko and SANEDI was limited to funding.

Rural enterprises declared that these types of network linkages were very important. Apart from access to resources, the findings suggested that, the interactive learning process taking place beyond the transactional activity, was limited. Thus, these types

of linkages did not necessarily promote or facilitate learning. In many instances, state agencies had pre-defined mandates and objectives to fulfil.

Knowledge exchange linkages or ties: These types of network linkages were either formal or informal. They could be interpreted as interaction linkages whereby actors shared, exchanged knowledge and information and in some instances, actors used these linkages to receive advice. It was found that some of the linkages were weak while others were strong. In addition, some of the linkages were reciprocal while others were not. Strong links were observed in contractual relations and in cases where shared knowledge was relevant to the immediate activities (solving a particular challenge or enhancing some of the existing activities). These links were useful for sharing knowledge and information in both tacit and explicit form and were often informal and unregulated relations. The patterns of knowledge sharing include face-to-face conversations, interactions with customers and competitors, experiential trainings and so on.

Based on the evidence received from all the cases some of the strength and importance of such links were influenced by the usefulness and relevance of the information to the current enterprise innovation activities. These links were dominated by interactions with local actors and limited with key national SI actors and non-local actors. Interactions with non-local actors were observed in cases whereby the non-local actor has a way to benefit. This is observed in the case of NBef and Knysna. Knysna was interacting with NBef organic with an intention to source moringa oil from NBef. Knowledge exchange links were also prevalent between local and non-locals in cases where the local enterprise requests information to address an existing challenge. For example, Ledzee often contacted Agri SA on needs for a particular knowledge to solve specific challenges. Knowledge exchange links can help to understand to whom, what and how knowledge was shared.

Marketing and promotion linkages or ties: These types of linkages were characterised by increased social interactions and pre-sale contracts. In some cases, actors who were distributing products produced by innovating enterprises, played intermediary roles. The links were reciprocal and strong. These links were dominated by NGOs, municipal offices and some private actors. Marketing and

promotional links were popular among the actors because they had to create product awareness that could increase profitability through wider distributions of their products. In the case of Mpfuneko and WFP, NGOs played a key role in creating awareness of ready-to-use biogas and putting out a call for household and small-scale farmers in nearby villages to supply the mango processing factory with mangos. Private-sector enterprises also collaborated with innovators with the aim of distributing the processed products into the market. For example, NBef collaborated with Letsitele Moringa for the purposes of distributing moringa products.

Technical and scientific linkages or ties: These types of linkages were exclusively transactional, unreciprocated and weak. In this case, innovating enterprises (WFP and Ledzee) had visited a small laboratory of QMS laboratories situated on the out skirts of the small town of Tzaneen in the Letsitele area to have their processed products tested for quality at a fee. There was no participation of a science council or universities in these networks. Thus, actor networks that involved specialised knowledge producers, such as research centres and science councils, were absent in poor rural areas. There was little sign of R&D innovations or of more advanced innovations (radical innovations) among the rural enterprises. There was evidence of learning when the laboratory service provider shared the results of the product assessment and provided the innovator the opportunity to learn more about the quality and contents of the products. The owner of Ledzee, for example, indicated that he had learnt a lot from interacting with the laboratory worker, although the information was high-end science or technical knowledge. Such linkages promoted interactive learning but they were limited platforms for technical and scientific learning structures in rural areas.

Supply linkages or ties: The enterprises opted for organisational arrangements with actors that were supplying them with raw products for further processing. These types of linkage were transactional and mostly characterised by contractual agreements, as was observed during the storage and supply stage of processing of the focal enterprises. The characteristics of network partners had a great influence on the strength and nature of these linkages. The linkages with commercial and big mango fruit suppliers were facilitated by pre-sale contracts, unlike with the small-scale suppliers such as the CPAs and households. Small-scale producers had weak

links with innovating enterprises compared to large-scale commercial producers. The links were developed on a needs basis for primary products for processing. These links were easy to establish and to terminate. For example, CPAs were always on the look-out for actors who were willing to collaborate. The ease of collaboration was aided by the desire of small-scale producers to find access to profitable markets. Supply links facilitated the introduction of organisational innovations. Interactive learning processes were limited to knowledge sharing about the quality of mango fruit and requirements, how to do group marketing, how to deal with an increase amount of fruit, and learning about planting good-quality products.

5.4.3 Interactive learning patterns

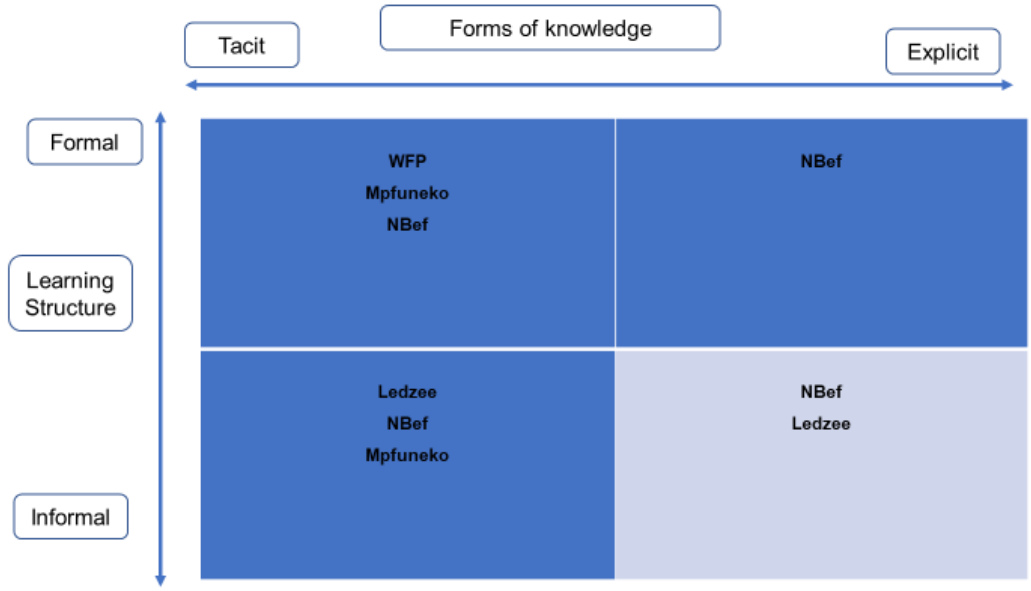
Interactive learning was regarded as a key contributing factor to innovation and capability building. In the early chapters of this study, an extensive literature review has emphasised that actor networks provide a locus for interactive learning. Still, learning among innovating actors in a network takes different forms and is often influenced by the quality of links and the need for new ideas to solve existing problems. The strength of linkages between actors influenced access to learning and resources (Semrau and Werner 2014). This section explores the nature and patterns of interactive learning activities observed in the ego networks of focal enterprises in Mopani District.

There were diverse learning forms across all the cases: voluntary or unplanned learning; mutual sharing (actors informally sharing technical knowledge); community grouping; as well as workshops and informal events. For example, NBef constantly used “informal ways”, organised by LDoA to gather the necessary knowledge and information on moringa processing and distribution opportunities. Such learning participants could ask questions during presentations and receive feedback. Informal learning structures included informal one-on-one exchanges of knowledge and experiences, consultations, collaboration, chat groups, and site visits. Formal learning structures included officially organised events, such as seminars, on-farm training, and arrangements for local community meetings. Enterprises could possess different forms of knowledge but some forms of knowledge could be dominant (Lam and Lundvall, 2007). Village community meetings were a fundamental platform for sharing knowledge and experiences. Knowledge shared by the actors in these cases

were in different forms. According to Lam and Lundvall (2007), knowledge can either be tacit or explicit. Tacit knowledge is knowledge rooted in practice and experience that was hard to articulate or communicate in codified form; it is implicit and wholly embodied in human individuals transmitted by apprenticeship and training (cf. Fleck, 1997; Lam 1998: 4). Codified knowledge is understood as explicit and can be stored and transferred as information (Johnson and Lundvall, 2001). Figure 5.10 presents a cross analysis of four cases looking at the types of knowledge and the patterns of learning used within actor networks.

The evidence showed that NBef shared formal (explicit) knowledge through formal learning structures. WFP shared experience and knowledge in both formal and informal learning structures. Among these enterprises, these innovators possessed and used tacit knowledge, compared to the extent to which they shared and used explicit knowledge. The findings disclosed that actors did not partake in formal education and training to gain innovation knowledge. Nonetheless, formal interactive learning did exist in the form of seminars and experiential training. Interactive learning largely occurred through informal channels and in many cases, it was not reciprocal. This pattern of learning took place between more powerful actors that came from outside the rural sector. Figure 5.10 revealed that the knowledge was not stored or consolidated in a readily-available form. It was only in the case of NBef that farming training was provided, using codified study material.

Figure 5.10: The patterns of learning and forms of knowledge



(Source: Author)

Different knowledge forms resided at individual or collective levels (Lam and Lundvall, 2007). The study attempted to understand the dynamics of knowledge coordination and management within the enterprises. Table 5.6 summarises the two forms of knowledge and the levels at which such knowledge resided within the enterprises. The findings showed that tacit knowledge was the most dominant form of knowledge. Even though the learning processes did not take place in a formal educational classroom, actors arranged formalised interactive learning structures such as seminars.

Table 5.6 indicates that all four enterprises shared action-orientated tacit knowledge and practical, or experiential knowledge. Interestingly, however, NBef shared some of the short, printed manuals of learning materials with network members. NBef also established a habit of standardising knowledge within the enterprise in the form of practical and on-farm routines. In Mpfuneko Rural Biogas, knowledge of the construction of biogas digesters was embedded within the enterprise (available to everyone in the enterprise), while embodied (carried by certain individuals) tacit knowledge was dominant in WFP. This enterprise employed seasonal workers who

were trained to perform a specific task and as such, internal knowledge transfer was individualised rather than collective. In Ledzee, the knowledge base was at an individual level. The owner had the capability to acquire knowledge through interactive processes and experimentation and was better able to provide problem-solving skills to external actors. The evidence summarised in Table 5.6 reveals considerable insight into interactive learning and knowledge. The knowledge and skills were largely held in tacit form within individuals (representatives, managers, workers) and they were not transformed into readily-available codified form. If individuals would leave an enterprise, they would leave with their embedded knowledge and skills.

Table 5.6: Knowledge management

Enterprise	Tacit knowledge		Explicit Knowledge	
	Embodied	**Embedded**	**Embrained**	**Encoded**
NBef	✓	✓	X	✓
WFP	✓	X	X	X
Mpfuneko	X	✓	X	X
Ledzee	✓	X	X	X

(Source: Author)

5.4.4 Institutions

There was a difference in how formal and informal institutional context influenced networking and learning among the four focal enterprises. In Mfuneko, the informal institutions played a key role in providing an entry point in implementing biogas use for cooking in different villages. Formal rules in the form of contractual terms and conditions played a role in influencing the social and economic practices of the innovating enterprises and how the related to their network partners. As agro-processing forms part of the food sector, the enterprises had to adhere to the hygiene and safety regulations.

Of all the case studies, informal and formal institutions influenced their behaviour based on the type of innovation the enterprise introduced. In cases where the community or use of local resources was involved, the informal rules such as norms

played a much greater role. For an innovator to reach local communities for the purposes of diffusing innovation know-how, such an innovator had to go through the traditional authority offices i.e. in the cases of Mpfuneko and WFP. Formal institutions were observed in cases were focal enterprises engaged in contractual linkages and in occasions whereby the enterprises distributed their products in the formal markets. Perhaps more generally, all the enterprises had to deal with a mix of formal and informal institutions during the process of innovation.

5.5 Conclusion

The study used both secondary and primary data sources. Using a combination of RIAT and SNA data approach, both individual case and cross case analysis were presented. An egocentric network approach was adopted to explore actor network components, interactive learning patterns and institutional context of rural based enterprises in South Africa. The investigation focused on NBef Organics, Wolkberg Fruit Processors, Mpfuneko Rural Biogas and Ledzee Estates.

The observations made revealed no evidence of inventions and radical innovations, instead there was evidence of incremental innovations. It was further found that actor networks were complex and often fragmented. It was also observed that the strength of the linkages between actors was influenced by knowledge and exchanged resources. In positioning the rural sector in the SANSI, it was observed that key institutions such as science councils and universities seldom took part in rural network systems. On exploring how networks relates to interactive mechanisms, it was found that actor attributes, linkages and the nature of innovation know-how exchanged, influenced interactive learning. Tacit knowledge was pre-dominant within these networks and was shared in various ways such as community meetings. Informal rules such as norms and formal rules such as contractual terms and conditions played crucial role in networking and learning processes. The detailed discussions of the findings are provided in the following chapter (Chapter 6).

CHAPTER 6

GENERAL DISCUSSION

6.1 Introduction

It has emerged that innovation arises from a dynamic network of actors embedded in a particular institutional context. In addition, innovation occurs through an on-going process of learning and research. The aspiration of this study was to explore the social dynamics linked to the process of innovation and networking in the rural context of Mopani District. Grounded on the SI, AIS and ANT, actor and process-oriented approaches to analyse the self-organising practices and activities of rural based enterprises were adopted.

Innovation in rural contexts, entails a network of interactions that are embedded in social connections (Spielman et al., 2009; QUNO, 2015). However, there is a paucity of literature on the complex social aspects of innovation in rural contexts. The reality that this study had to contend with was how resource-poor actors in rural areas engage in innovation. In addressing this, it was imperative to define: Who are the actors; What are their attributes and roles; What is the nature of their networks; what is the framework of their linkages; and What are the interactive learning processes used to disseminate innovation? In exploring this, the complexity of the social dynamics of innovation emerged.

6.2 Dynamics of innovation in rural context

Innovation value chain analysis through RIAT, revealed that the adoption and adaptation of new ideas do exist in rural areas. Enterprises adopted existing products, practices and procedures from external markets that were new to their enterprises. These new ideas were either applied as they are, or were adapted to suit the current enterprise's activities. Innovation was largely a process of change intended for both social and commercial benefit and the innovations were dominated by non-R&D processes.

Based on the observations made, innovative know-how is adopted from local and non-local network members. These network members are operating from both the formal and informal economic sectors. Thus, the process of innovation in rural contexts is about the use and adaptation of modern knowledge and practices and integrating them with local know-how (QUNO, 2015). Organisational and process innovations were found to be predominant among the studied rural-based enterprises. There was also evidence of the introduction of new marketing strategies among these enterprises. Nonetheless, it was observed that improvements and adaptation of existing activities had significant changes on innovation output along the agro-processing value chains. Therefore, there is evidence of incremental innovations in rural contexts. Observations made show that rural-based enterprises can drive innovation.

Rural localities have a relatively high content of natural resources and indigenous knowledge but lack quite a significant proportion of modern knowledge and resources (Murdoch, 2000; Wu and Pretty, 2004; Doloreux and Dionne, 2008). Rural-based enterprises function in a midst of challenges such as limited access to R&D facilities and infrastructure support (Murdoch, 2000). These challenges have seen rural enterprises opting for the establishment of knowledge, information and resource linkages with external actors that provide a milieu for innovation. Thus, actors constantly search for new ways of doing things. As a counterfactual, like many other studies (e.g. Sumberg, 2005; Spielman et al. 2009; Mugwagwa et al., 2010; Klerkx et al., 2012), this study argues against equating rural innovation to technology transfer. Instead, at the forefront of the innovation processes are actor networks for innovative learning as in the evidence presented of the researched case studies.

It is evident that the rural innovation landscape is changing. Observations made reveal that new actors, linkages and institutional arrangements are emerging, and they influence the innovative performance of rural enterprises. Actors are not merely consumers of innovations. They initiate processes of seeking potential actors to enrol in innovation networks. In this context, different actors played different roles in networks. As the process of innovation was unfolding, network partners contributed by sharing knowledge and resources with innovators. It is noted in the findings that, civil society actors among others, not only play a fundamental role in networking, but seek to improve innovative capability and empower rural communities. Woodson and

Williamson (2012) and QUNO (2015), note the presence of civil society actors in local systems of innovation. The trend shown in this study emphasises that diverse actors at different levels of the society has unique roles to play in the innovation process.

Rural enterprises in Mopani, acknowledged low access to scientific knowledge in their areas but they also highlighted that not all types of technologies and knowledge through top-down approaches are relevant to their activities. It was found that innovative changes are a result of efforts made by actors as they seek relevant information and resources to do new things in different ways. Thus, local and external know-how adopted and incorporated in the current activities were carefully assessed for its relevance and importance.

Innovations in rural contexts are initiated through a bottom-up approach suited to the conditions of enterprises. These innovations add economic value, and contribute to solving localised challenges. Innovations were found to be mostly on a small scale, as enterprises are confronted with a shortage of capabilities for upscaling such innovations. Nevertheless, actors still reaped the benefits from such innovations. Social and economic value was realised from the innovations. Smith, Fressoli and Thomas (2013), pointed out that rural innovations are excluded in state-intervention programmes, for example in innovation hubs, a condition that could be explained by the fact that SI-inspired interventions are likely to emphasise aggregate outcomes (Roling, 2016), that are often top-down (Bitzer and Bijman, 2015). As a result, the micro- level innovation activities remain on the periphery. Network composition, interactive learning and institutional context emerge as critical aspects of innovation in rural contexts. Thus, actor networks for innovative learning drives innovation among resource poor enterprises.

6.3 Characterising actor networks

The fundamental consideration of this study was, the nature and composition of actor networks for innovative learning. To respond to the research question about the structural characteristics of rural actor networks, the study gave special attention to: actor attributes (provided an indication of the actors involved in rural network

systems); links (provided an indication of the formality of relations and the strength of the relations); and flows (provided insight on the resource or object of exchange).

Evidence in the case studies illustrated the diverse characteristics of rural actor networks for innovation. Different actors from both local and non-local localities were identified in the ego networks of the focal enterprises. The actors included state agencies, NGOs, civil society, consultants, private enterprises, product/ producer associations and special programmes. These actors played different roles in the networks. Public agencies largely provided focal actors with information and resources that were pre-determined in a top-down approach. This finding concurred with observations made by Asres et al. (2012), who noted that public sector agencies were able to provide smallholder farmers with information, inputs and credit but were unable to assist smallholders to have access to the profitable markets. Private sector actors played a peripheral role in the ego networks, while civil society actors had a relatively strong intermediary role in establishment of networks.

Observations made illustrate the diverse network contributions and the roles and functions of heterogeneous actors. Actors undertook various activities to influence innovation and innovation processes. These roles were categorised as i) access to resources and knowledge; ii) business development and network mobilisation; iii) capacity building; and iv) supporting and enforcing institutional change. It is observed that enterprise-level innovation, particularly in peripheral contexts, require more than just scientific knowledge and technology diffusion to fulfil innovation activities (Kilelu et al., 2011; Rodríguez-Pose and Wilkie, 2016). Innovating actors require different kinds of support, including technical, financial, infrastructure, and social support. In the same vein, Sotarauta (2017), using the concept of agency, emphasised the need to understand micro-level dynamics and how they link to institutions. The institutional contexts facilitating innovation are not uniform, and they influence systems of innovation in different ways. In the context of this study, Institutional actors played a limited role fostering integration and interaction within rural actor networks.

Of all the studied networks it was found that the size of the ego networks was small. And these networks were composed of a small number of non-local actors. Focal enterprises depended on a few key actors for resources and innovation know-how. The actors who contributed most resources were regarded as the most important

network members in all the case studies. This trend concurred with Spielman et al. (2011), who noted that small holders relied on a limited number of actors for production inputs, credit and information. It was also observed that, the type, nature and relevance of actors to current innovation activities mattered more than a high number of actors in a network. Huber and Fitjar (2016), for instance, proclaimed that local network linkages are often not very useful in the promotion and upscaling of innovation, as opposed to non-local network linkages. The latter makes case for the need of co-innovation between local and non-local actors.

Observations made further reveal that actor interactions are mostly driven by a need for relevant knowledge, resources and access to markets. Fitjar and Rodrigues-Pose (2017), referred to such linkages as purpose-built relations. According to Fitjar and Rodrigues-Pose (2017), these linkages result from an assessment of needs and possible opportunities. In these cases, purpose-built linkages were found between local and non-local actors. Nonetheless, voluntary linkages play a key role in accessing knowledge, and could still lead to innovation.

Purpose-built linkages are established on the basis of a need for resources and knowledge. These resources determine the strength of the linkages. Thus, flows (object of exchange) influence how the receiving actor perceives the partner in a network. Enterprise representatives perceived resourceful actors, such as government departments, as the most important. Moreover, the object of exchange had to be relevant to the conditions of the innovator. This indicates that knowledge and resource structure are important for innovators in poor areas. Along the same thinking, Grillitsch and Nilsson (2015), argued that regional knowledge infrastructures were necessary for small firms with low internal competencies.

The evidence illustrates that rural actor networks are composed of both formal and informal linkages. However, these networks are dominated by informal linkages with local actors and fewer formal linkages with external actors. Formal network linkages are observed in alliances, event based/ projects, contracts and cooperative arrangements. Formal network arrangements were detected in infrastructure and finance, market, and supply-driven networks, particularly in the linkages between local enterprises and funding government departments and through special programmes. Other forms of networks that had been detected included: experience-

based relations; short-term collaborations to accomplish a task; project-based strategic alliances; and gate-keeping relations.

Informal linkages are predominant, however, such linkages are involuntary and unplanned. Unregulated or informal linkages have no clear boundaries. Actors interact on an ad hoc basis. In informal linkages, rules and routines gradually develop and guide the activities and behaviour of enterprises. Formal linkages are contractual and purposely established to address a specific challenge or opportunity (Musiolik, 2012). Contractual arrangements are often temporary and project-related. A dynamic observed within the networks is that cooperation and coordination are not well developed. Network actors rarely take joint decisions. This dynamic concurred with the evidence in a study of a wild silk enterprise conducted in the North-West province in South Africa (Ramoroka et al., 2014). The study found that, the network was characterised by bilateral and infrequent engagements. Within this study, some network actors undertook broker roles. In the presence of poorly-developed cooperation and coordination, common rules and norms in networks are not completely non-existent, but develop gradually.

The study found existence of several kinds of innovative network linkages among different rural-based agro-processing enterprises, namely:

i. Infrastructure and funding links that were dominated by state/public enterprise and special programmes.

ii. Formal knowledge exchange links that were aimed at sharing both tacit and explicit knowledge.

iii. Marketing and promotion links that were characterised by increased social interactions and pre-sale contracts, while in other cases some actors played intermediary roles by distributing products produced by the innovating enterprises.

iv. Service-based technical and scientific links that were often unreciprocated.

v. Supply links, dominated by commercial and small-scale farmers, were present at the supply and storage part of the processing chain.

It was observed that the practices that characterised rural realities are directly linked to the process of innovation. Overall, innovation in rural contexts is a social act embedded in socio-economic structures. These social structures are dynamic and complex, and they influence the direction of innovation processes. It was also observed that, certain social aspects had an influence on learning and innovation, namely the type of an actor; the nature of linkages; and the exchange of content as follows:

Type of actor: actor attributes and features, roles and agency could hinder or enhance learning and innovation, for example, support institutions were often embedded in cooperative relations as part of their mandate and service provision.

Nature of linkages: formal linkages were often contractual and therefore represented a restrictive, one-way power relationship, for example, funding institutions and rural innovators.

Flows: the object of exchange, value addition and relevance influenced learning and innovation.

In cases where there was institutional support, there was an outward movement of know-how from big formal enterprises to local actors. Participation of external actors was characterised by a limited number of these actors, the linkages were disjointed, and the practices were often top-down, while other local linkages were characterised by locked-in but free movements to search for new knowledge. Table 6.1 shows the characteristics of rural actor networks, distinguishing between local and external linkages.

Table 6.1: Characterisation of rural actor networks

Linkages with external actors	**Linkages with local actors**
- Small number of actors	- Increased number of actors
- Fragmented	- Closed, based on trust
- Large external organisations that were isolated from micro-enterprises	- Disintegrated micro-enterprises
- Limited learning opportunities	- Continual search for knowledge and resources
- Top-down/ one dimensional linkages	- Bottom-up, reciprocal
- High dependency relations on support	- Establish routines, norms and

institutions, contractual	common practices
- Event based	- Continuity over time

(Source: Author)

6.4 Interactive learning patterns within networks

According to Brunori et al. (2013), actor networks present a diversity of sources of innovation know-how, while interactive learning assists enterprises acquire innovative capabilities (Fu et al., 2013). The findings in this study support these basic observations, that the nature of actor networks influences the direction and success of learning and innovation in a manner that is discussed further below.

In exploring interactive learning mechanisms, two key features of interactive learning among rural enterprises were given attention. Firstly, interactive learning was incremental in nature for the existing activities. There was no evidence of enterprises engaging in learning during the process of novelty generation. Enterprises sought solutions for their existing problems (Maskell and Malmberg, 1995; Fitjar and Rodríguez-Pose, 2017). Secondly, interactive learning was not an automatic process, instead, it was an intentional act by actors and a highly needs-driven efforts to discover new ways of doing things differently. A recent study by Fitjar and Rodríguez-Pose (2017) noted that learning does not occur by chance. Instead, it occurs through actor networks for innovative learning.

The scope of learning covered varying forms of interaction between heterogeneous actors involved in an innovative know-how exchange process. The evidence revealed that, enterprises use various formal and informal channels of learning. Some actors opt for face-to-face channels such as workshops or non-face-to-face channels such as telephonic conversations to exchange knowledge and information. The formal learning channels identified in the studied cases include field demonstrations, training seminars, community and project meetings and informal patterns, such as peer-to-peer exchange of experience among producers, or informal direct consultations between producers as well as copying and imitation. Copying and imitation were deemed to be one of the important forms of learning. It is observed that, in some instances actors do not freely reveal and share their knowledge with competitors. The use of modern communication technologies is

evident in rural contexts. Communication technologies, such as cell phones and emails were used to exchange knowledge, information and setting up appointments. However, the most used form of communication technology is private cell phones.

Observations made revealed that interactive learning mechanisms vary greatly across different innovative milieu. During the survey, egos were asked to indicate the actors with whom they exchange knowledge, and the type of knowledge and the channels through which knowledge and information was being shared. Among these enterprises, knowledge and resource exchanges occurred within local milieu, with limited national and internal participation. Actor network components influence the extent and value provided by learning process to enterprise innovation activities. In exploring the relationship between network composition and interactive learning, the following aspects emerged:

1. *Locality of actors:* The study findings challenged the pre-assumption that proximity or localised learning was dominant in learning for innovation. This assumption is usually linked to the importance of implicit knowledge. enterprises engage in interactive learning processes with local and distant actors based on the relevance of the information and resources possessed by network members. in this context, interactive learning was found to be more efficient in small networks, which required a small number of actors who cooperated in solving a common problem with know-how and practical skills. The latter challenged the predominant theoretical assumption that the larger the size of a network, the greater the chances of generating innovations. However, the implication might be different outside the contexts of this research study.

2. *Object of exchange:* in rural context, observations made show that the relevance and usefulness of innovative know-how is a key determinant of the success of a learning process. According to Malberg and Maskell (2006), it is important to find a network partner with relevant knowledge and capabilities to local conditions. “Who you know and what who you know have to offer” had become critical in the learning process. Knowledge that was deemed relevant enhanced the innovative capabilities of innovating actors. The classic assumption made by the proponents of ANT on the effects of non-human or actants in a network process are evident in the study. Even though materials may not be regarded as actors

as such, they did have an influence on interactions and the need to engage in learning activities.

3. *Attributes of network partners:* How focal enterprises engaged in interactive learning differed with different types of actors. Different types of actors identified were state agencies, local private sector enterprises, competitors and NPOs. It was observed that interactions with state agencies were predominantly formal and the learning processes occurred through formal structures, such as seminars and information days. Such learning was often pre-determined through special state programmes, such as information days. It was doubtful whether shared knowledge was relevant to the immediate activities of innovators. During interviews it was learnt that enterprises in rural contexts sometimes had no choice of what knowledge and resources sector departments and other government agencies provided them with. Seyfeng and Smith (2007) asserted that, government agencies had their own mandate and objective to achieve, whether it was relevant or not to the innovation activities of rural enterprises. The implication is that such information events seldom contribute towards the existing innovation practices of enterprises. Thus, the learning with state actors is not necessarily complimentary.

   The compelling insights are revealed. There is a notable presence of exclusion in the learning process. Actors that operate in the same sector tend to hide knowledge from some actors. Martin (2013:1419) alluded that, innovation know-how is transferred and exchanged in a selective and uneven way. However, this trend is observed between actors that produce similar products. Copying and imitating are detected between competitors. The implication is that, learning can occur without direct exchange of know-how. Private sector actors, which are competitors, are useful for learning and gathering information on how to enter profitable product markets, implying that the competences of innovation actors operating in a value chain, are complementary (Pietrobelli and Rabellotti, 2011). The need to constantly seek innovative knowledge for improving capabilities is inspired by the desire by rural communities, individuals and enterprises to enter the mainstream economy (Seyfeng and Smith, 2007).

Interactive learning among small-scale, locally based enterprises is characterised by what Fu et al. (2013) termed “paying back favours”. “Paying back favours” presents a reciprocal type of learning relations. It is mutual learning that locally-based actors adopted. Similar learning mechanisms are also observed between local and non-local private actors. Pietrobelli and Rabellotti (2011), drew attention to the fact that interactive learning can only be mutual when actors have competencies that are complementary. Power relationships are particularly absent in these learning patterns. Actors tend to fulfil a need to provide resources and information to actors who had assisted them previously. According to Fu et al. (2013), such acts strengthen the interaction between actors and trust and loyalty develop gradually. This form of learning promotes the exclusion of others in the learning networks.

An interesting learning dynamic emerged between focal actors and NGOs. The learning patterns are often patchy and not necessarily comprehensive (Davis et al., 2004). This study has shown that in cases where the innovators interacted with NGOs, the interaction was project-based with an end period. Even though such learning interaction is short term, it provides valuable innovation know-how. Civil society actors, such as traditional authorities, play a crucial role in the introduction and promotion of institutional or organisational innovations.

The observations made in this research reveal that, the complexity of network linkages had an immense impact on the behaviour of actors and the outcome of the interactions. The findings reiterate that the strength of linkages explained by reciprocity and the object of exchange define the effectiveness of learning activity. This implies that strong and intentionally-built linkages enhance innovative capabilities of enterprises. Actors establish trust and loyalty as a function of co-location. However, they are not acknowledged as very important with regard to enhancing and finding new ways of doing things better. Small-scale and poorer enterprises tend to be loyal to successful local enterprises and accept ideas and information shared by these powerful enterprises.

Local conditions have an influence on interactive learning processes (Malmberg and Maskell, 2006), and the forms of knowledge have pre-defined mechanisms of transfer (Perry, 2014). Martin (2013), in his study on differentiated knowledge bases

and the nature of networks, found that not all forms of knowledge relevant to innovation are accessible through local networks. The trend shows that, the composition of actor networks influences the nature and usefulness of network activities. The actors' characteristics, the nature of linkages, and the content and value of the objects of exchange have an impact on interactive learning mechanisms. The process of learning is embedded in the cultural, political and institutional environment. The study findings also revealed that institutions play a key role. The social environment influences the makeup of interactive learning activities. Smith et al. (2013), noted that, new knowledge is context specific and is acquired through networks.

Observations made in this regard illustrate that tacit knowledge, experiential learning and observation are crucial elements of learning. There is paucity of exchange of tacit and codified knowledge. However, the exchange of tacit knowledge is pre-dominant in rural contexts. The challenge that came with codified knowledge was linked with the interpretation, absorption and use of such knowledge. Nonetheless, there is little evidence that actors opted for codified knowledge, except for an acknowledgement that some made limited use of the Google search facility to seek specific information related to possible marketing channels. An awareness and use of such platforms resulted from interaction with other actors. Tacit knowledge was easier to adopt and use, including knowledge of the machinery used in the production process. Frequent personal interactions fostered learning by observation, imitating and correcting others. According to Perry (2014), actors would visit co-partners frequently to promote personal interactions. Innovators indicated that they had learnt from other enterprises by observing, adapting and imitating what their arrivals are doing.

Even though the focus was on learning with external actors, it became clear that information and knowledge learnt from outside was diffused internally among the staff, who then implemented innovative activities. An interestingly amount of learning occurred within these enterprises between managers and owners with external actors. In the same vein, enterprises developed routines and practical procedures which were eventually used to transfer the ideas to other enterprises. Thus, tacit knowledge is embedded and embodied among these enterprises but it was not consolidated into a readily available form. In such cases, a specific individual within

an enterprise was the only one who could share that knowledge. The evidence shows that hands-on learning and experiential learning with limited theory provides innovative solutions and actors are able to absorb the knowledge and apply it in their own enterprises. Technical/ practical and communication skills are fundamental for innovation in rural contexts. This relates to Perry's (2014) ideas on enterprise visits that promoted the exploration of new ideas. Informal learning patterns also take place, such as peer-to-peer learning and exchange, and direct consultations to solve persisting challenges within the enterprise. Notable learning patterns are observed in market-driven networks, where producers or buyers offered knowledge and information, based on product requirements and specifications.

6.5 Institutional contexts among rural enterprises

Institutions, as one of the elements of the SI framework, influence the quality and nature of innovation process (Berdegué, 2005). Institutions include formal and informal rules that influence actor behaviour and mechanisms or practices. In this study, the dynamics of innovation processes in rural contexts were influenced by recognised and unrecognised political, cultural and economic institutions (Berdegué, 2005).

There is no doubt that there is no "one size fits all" innovation, development and policy framework. Observations made revealed that the innovators were influenced by different factors and needed varying support for innovation. The so-called rural network systems were sorely left out of the formal national innovation system in the South African context. The evidence showed that public enterprises and NGOs have a fundamental role in transforming the rural innovation landscape. These public-sector actors should look beyond their own desired goals to achieve against those desired by actors. The limited involvement of the formal NIS had been highlighted by scholars such as Muchie (2013) and QUNO (2015). A lack of focus on actor-network compositions and interactive learning and how they link with institutions was a weakness in the SI approach.

There is a considerable variation of innovative and networking capacity among the different innovators. This could be explained by the disparity between local innovation activities and the high-level national policies and infrastructures, as well as the level of knowledge. The innovative capacity of enterprises or innovators also

depend on the quality and strength of relations, the support received, and the size and nature of enterprises (Asres et al., 2012). The links between key SI actors need to be strengthened (Muchie, 2013). The evidence revealed that there is limited institutional links with local-level activities. Local communities have knowledge and experience of their environment and they need knowledge and resources (Seyfeng and Smith, 2007), therefore they should form part of the preparation of development and sustainability interventions, which would lessen the extent to which intervention programmes seldom achieve intended goals. These insights also highlight gaps in the earlier framework of the conventional NSI, adopted in the 1996 white paper DACST (1996). It hardly acknowledges, defines or addresses the specificity of the reality of the dynamics of innovation in the rural setting.

Rules, regulations and norms in the explored actor networks were weak or completely non-existent, however, they were gradually developing in collective interactions among enterprises. Observations made show that there is limited joint decision making but exceptions are made in cases where there is a contractual relationship. In formal network relations through contractual agreements, actors' behaviour is influenced by rules and regulation stipulated in the contract. While in informal network relations, there is little or no involvement of actors in decision-making processes, some of the rules and norms emerge organically and influence the ways in which actors interact in a network. Therefore, there is a need for that pays more attention to the social dynamics of innovation value chains in different SIs.

With the current interventions by state agencies no evidence could be found that positioned locals as key innovators in their own context. With this said, institutional development could become difficult if the compositional dynamics of the current actor network systems are not defined and addressed. The challenges found in the evidence relating to institutions, translated to the challenges picked up in the said white paper (DACST, 1996). There were weak linkages between state agencies, private sector, universities, and science councils, as well as between NGOs and civil society. It is evident that the so-called rural innovation or actor network systems remain excluded from the mainstream SIs.

State actors have a significant role to play at all levels of SI (macro, meso and micro). They have the capabilities of promoting access to resources and information to small-scale innovating enterprises. However, the extent to which these actors contribute to the innovative activities remain marginal and limited. It was observed in the cases that, where state agencies contributed, it was often a once off effort. Nonetheless, the state contribution in promotion and awareness raising, socio-economic development through innovation was notable.

Rural innovation ecosystems are largely governed by rules and norms that have been formalised by traditional authorities. These rules and regulations create coherence. Thus, civil society actors such as traditional leadership play a key role as institutional actors in creating an enabling environment for the transfer of innovation know-how and they also act as gate keepers. The gatekeeper role entails providing easy access into villages and mobilise local communities to attend information and knowledge sharing meeting. But the gatekeeper role also entails limited access to intruders into the villages.

In most rural areas the institutional environment is made up of structures and organisations, such as NGOs and CSOs, which were self-governing legal entities. The study indicated that they are a critical part of actor networks in local areas, and often generate and transfer knowledge to rural enterprises. They also facilitate engagement between local actors and non-local actors. CSOs form part of the marginalised actors in SANSI. Nonetheless, local CSOs have strong links with rural enterprises. As a result, they are critical actors and relevant to creating stronger and coordinated SI.

6.6 Innovation process and network effects

The insights gained in this study contributed to the understanding of innovation in rural contexts. The study, revealed that innovations are demand-driven and incremental in nature, with no evidence of radical innovations and separate from formal R&D activities. Another observable characteristic is that process and organisational innovations are predominant in rural areas.

Enterprises involved in agro-processing in Mopani district attested to the fact that, they use a wide variety of innovation know-how through actor networks for innovative

learning, and the importance of local and non-local actors, including competitors is evident in rural actor networks. Innovators constantly sought knowledge, information and resources to address existing challenges in their enterprises.

It is notable that rural based enterprises drive their own innovations. They make an effort to form networks for innovative learning. The implication for this is that, co-innovation between local and non-local actors can be an entry point for radical innovations. On the contrary, actor networks are poorly integrated, and improved participation of state actors could enhance integration of this network systems. Daniels (2014) highlighted that, policy support for grassroots innovation in Nigeria was weak. In South Africa, innovation support and development are largely focussed on the formal sector and urban areas (Mhula Links et al., 2014).

Limited resources in rural contexts, presents an opportunity for key NSI actors to collaborate, and develop innovations that are relevant to the actors and the needs of the local communities. The government could make a provision for innovative initiatives that address local challenges. The strengths and weaknesses of the rural-actor network systems should be taken cognisance of. The findings revealed compelling insights about limited participation of key knowledge actors in the rural actor network systems such as universities and science councils. One of the challenges facing rural enterprises is finding actors that are endowed with relevant knowledge and resources to the innovative activities.

Actors in rural contexts depend on networking and interactive learning to build innovative capabilities. Mhula Links et al. (2014) noted, experiential learning as a popular form of learning among rural enterprises. Innovators use formal and informal network relations to source new knowledge and resources in their innovation activities. In essence, actors (particularly among non-funded enterprises) conduct innovation activities with limited support from key NSI actors in South Africa. Two key factors are observed: Firstly, innovation activities mostly occur between local actors from across various sectors; and secondly, innovation processes are influenced by resources and know-how available locally to actors.

It is also evident that external knowledge and resource support have an influence on networking, learning and innovation performance. From the investigation, it was observed that innovation and networking tends to be connected to funded activities

and relations, particularly in enterprises that pursue socially-driven initiatives and projects. This also is often facilitated through special programmes, which in reality might cripple the innovativeness of enterprises as the activities are project-based with conditions and restrictions stipulated in the contracts. In some cases, innovation or knowledge diffusion occurs through pre-determined contracts to transfer particular skills or train local community and enterprises. Irrespective of increased challenges faced by rural-based enterprises, these enterprises still make an effort to make improvements in their operations. In this regard, both local and external linkages are critical for innovation. The usefulness of external interactions is also highlighted in a study by Booyens and Rogerson (2015) on innovation and networking among tourism firms in the Western Cape province in South Africa. They found that tourism firms used external and non-local knowledge to boost novel innovations.

Observations made also show that financial support is crucial for start-up enterprises to engage in innovation know-how generation and production. However, external funding does not guarantee the sustainability of innovative activities and types. In many instances, when funding is cut, the enterprises struggle to sustain capital intensive initiatives, which could be explained by the fact that there is limited mentoring and hands-on training. The more private-type enterprises pursueinnovation for commercial purposes, the less they depend entirely on external and public funding for innovation and operations. Other forms of support, such as institutional support, promotion and awareness, and even the local social environment to mention but a few, were crucial for innovation and learning.

6.7 Actor networks for innovative learning

This study proposed an actor and process-oriented approach to learning and innovation that went beyond the systemic nature of innovation process. Neumeier (2016), pointed out that an actor-oriented approach allowed for the exploration of self-organised activities of actors. In this process, the interrelations between actors and institutions that facilitated the process of innovation, were considered crucial in understanding innovation (Markard and Truffer, 2010). The idea of actor networks for innovative learning (ANIL), grounded in SI and ANT, brought together the two strands of thinking, namely actor networks for innovation and interactive learning. Extant literature, most particular on localised learning, underestimated the effects of

the compositional dynamics of actor networks on interactive learning patterns. A basic proposition made in this study was that the compositional dynamics of actor networks influenced interactive learning mechanisms in the process of doing new things or doing old things better (innovation).

The idea of ANIL is an extension of the interest in the social dynamics and IVCs within rural innovation systems. This idea arose in the context of revealing the distinctive characteristics and aspects that hinder or enhance innovation among rural enterprises. It also shed light on how innovation process occurs in more peripheral areas. ANIL is also a methodological extension of RIAT, reinforcing the idea of assessing innovation as a process in low tech settings, and considering the social dimension of innovation value chains. It was evident that note should be taken of the IVCs (innovation activities) and the micro-behaviour (networking and interactive learning) to provide nuanced insights into the dynamic nature of innovation process in rural areas with poorly-formed SI.

A key argument is that ANIL illustrates how networking dynamics and local interactive learning mechanisms define the conditions, capabilities and the contexts in which innovation is taking place. The imperative to operate in ANIL made networking and learning capabilities important to improve innovation processes and outcomes. As a result, the accepted idea was that without ANIL, rural innovations lack an incubating milieu. At the forefront of this proposed lens is actor network compositional dynamics and knowledge creation and diffusion that facilitate IVCs.

6.8 Actor network compositional dynamics

The findings from the four enterprises in agro-processing illustrate the diverse characteristics of actor networks in rural contexts. It is observed that the structure and form of the network is influenced by actor attributes, nature of links and object of exchange as well as rules governing actors' interactions. Actor networks are not given structures, instead they are influenced by content and context (Buzelin, 2005). Arguing in support of the latter, rural actor networks are not static, as the evidence showed, but take different forms, as it was observed along the agro-processing value chain.

Actor networks in rural contexts are complex by nature. Actors face tremendous challenges to build innovation capabilities. They were composed of different types of actors, who were mostly based locally and resource poor. Close ties with family members and relatives, as well as ties with other small-scale producers, kept the networks going. For example, family support and cooperation were very important. Family members not only provided moral support in private entities, but they also take up positions in the enterprises and contributed to the operation and introduction of innovations. From the evidence, family members were not regarded as network partners as the focus of this study was on enterprises. However, the findings of the study revealed that family ties contributed moderately through word-of-mouth product marketing and sharing information.

Based on the research findings, NGOs and CSOs are critical contributors to organisational and institutional arrangements. Even though state actors' level of participation in the networks was found to be low, they contributed greatly to the operation of rural enterprises. The investigation showed that both state agencies and traditional office support are fundamental in resource deprived areas. The introduction of innovation in villages required organisational and social support from traditional authorities, i.e. from the chief or headman, and also to access land to operate on. Initiatives and projects that are introduced through local state agencies often receive buy-in, and accepted by local people. In this regard, CSOs are best positioned to mobilise local communities and arrange meeting for presentations on new opportunities and demonstrations.

We have learned from the research findings that rural actor networks are dominated by informal linkages. Actors tend to engage in ad hoc and non-formal relations. Actor networks are less coordinated and the position of actors was rarely defined in the network, but in cases where actors have resources and knowledge to offer to the innovators, the relationship appeared to be stronger. Elements of power in these networks were observed in infrastructure and finance relations, and they were considered very important actors for innovation. Thus, the innovation process is influenced by the most powerful actors in the systems. For instance, government agencies that implemented intervention programmes already had pre-defined initiatives to be operationalised in rural areas, and in these cases the rural innovators' roles as innovating enterprises are neglected. They are expected to

accept what has been offered to them. Such a dynamic had a great influence onthe direction of innovation and the outcome of innovation, and in some cases hampered innovation growth.

6.9 Knowledge creation and diffusion through networks

In the discussion, we reasoned that interactive learning for innovation occurred in an incremental problem-solving manner through purpose-built linkages. Particular attention was paid to actor characteristics, linkages and objects of exchange. Implicit in this emphasis on actor network composition was the proposition made in the literature that co-location and agglomeration would make tacit knowledge more freely available and accessible (Fitjar and Rodríguez-Pose, 2017).

Observations made indicate that innovative learning takes varying forms. In addition, learning for innovation often rests on the personal capabilities, previous experience and tacit knowledge of managers and owners. The observable features of learning in network included:

- Providing patterns for creating and sharing tacit knowledge.
- Providing access to a broad range of knowledge and a variety of knowledge sources.
- Actor networks that are not stable but somewhat flexible

Interactive learning through networks is characterised by formality and informality of knowledge exchange platforms; the absence of science of science councils and universities; and the dominance of the tacit dimension of learning. The findings revealed poor integration and interaction among actors and broad public-private sector interactions and development programmes were absent. The actor network systems were characterised by structural holes. According to Asres et al. (2012), public-sector enterprises took part in SI with an aim of fulfilling national targets through programmes designed to be implemented in local areas. A similar innovation dynamic was revealed in the current study.

Knowledge and learning patterns within actor networks of enterprises that constituted the local IS or network system were affected by many factors. It was observed that competence and capability building were dominated by tacit knowledge forms. Enterprises engaged in tacit knowledge exchange and enterprises

had the capabilities to acquire and diffuse tacit knowledge through interactive learning in both formal and informal network systems. The tacit knowledge had not been consolidated into a readily available form. In some cases, as a way of producing and keeping the knowledge, actors often created routines.

The value of formal educational systems and practical social practices were recognised, but there was a wide disparity between the two. This was evident in Mpfuneko Rural Biogas, WFP and Ledzee Estates. Even though there was some need for formal education qualifications at NBef Organics, tacit knowledge forms were still dominant. Different actors had a role to play and in one way or another, and they influenced learning patterns within the networks.

Interactive learning processes connected to the networks can be strengthened and integrated in many ways in rural contexts. The process of creating and diffusing know-how is also influenced by the nature, content and purpose of innovation in question. Moreover, the success of learning is affected by the attributes of actors and their ability of receiving actors to absorb the knowledge they were exposed to. Knowledge exchange could be successful when carried out with the purpose of solving a particular problem, or when the actor uses the knowledge to improve existing activities. Not-for-profit enterprises that can be considered as local champions, seek to empower local communities.

6.10 Conclusion

To reiterate, little research has focused on the social dimension of the innovation process. Innovation in rural contexts has remained concealed. And rural actors have been viewed as peripheral actors in innovation. However, this study explored the social dynamics of innovation, giving attention to the components of actor networks, interactive learning and institutional environment in rural settings. To this end, we can learn of the predominance of adoption and adaptation existing innovative ideas by rural enterprises. Therefore, it is observed that innovation is a process of change and the innovations are largely incremental in nature. Thus, innovations emerge through the contributions of dynamic relations. This indicates that rural innovation is embedded in anenvironment defined by the social dynamics of innovation. The research revealed that rural actor networks are diverse and small in size. They are

composed of heterogeneous actors from different sectors. It further is revealed that network components influence interactive learning processes.

CHAPTER 7

CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

In recent decades, rural innovation has been undeniably fruitful. However, very little research has focused on innovation by rural-based actors. Innovation in rural contexts is hidden and little is known about the social dynamics of the process of innovation. This study has illuminated the social dynamics of innovation value chains by analysing networks of four cases; Nbef Organics, Wolkberg Fruit Processors, Mpfuneko Rural Biogas and Ledzee Estates. Evidence of innovation in these case shows the importance of change processes made in different kinds of non-R&D innovations. It also unearths the social trait of the innovation process that is hidden and difficult to observe in mainstream innovation (R&D). Innovation by rural based enterprises' is concealed from mainstream research and policy agendas. Thus, rural-based enterprises and third sector organisations (NGOs, associations, civil society) are neglected innovation actors. A whole set of actors belonging in the third sector play a fundamental role in innovation and they may be considered as co-producers of innovations. Unfortunately, they are often considered as peripheral support actors, but this study highlights their role as innovators in rural context.

7.2 Research approach, questions and empirical findings

To address the research questions and open the black box of the social dynamics of innovation in a rural context of Mopani district, an exploratory case study approach was adopted. Secondary and primary data sources was employed. And a combination of RIAT – to identify and map innovation activities and types – and egocentric SNA- to map networks, were applied. The empirical tools applied in this study helped to better capture the social aspects of the innovation process, the network components (including actors and their characteristics, nature of links and knowledge and resources flows) and the patterns of interactive learning among rural enterprises. Egocentric SNA provided a lens through which innovation activities of

the focal actors were observed and exposed the manner in which such actors sourced innovations, resources, knowledge and information.

The outcome of this research shows that innovations by agro-processing enterprises namely NBef, WFP, Mpfuneko and Ledzee are based on the adoption and adaptation of existing ideas from external environment. This phenomenon suggests that rural-based enterprises engage in on-going processes of learning and search for solutions and opportunities to improve their practices. A critical look at the most common innovation activities of adoption and adaption suggests that they are not exclusively specific to rural contexts but can also be observed in urban centres.

The analysis revealed how network aspects of enterprises in Mopani district influenced the innovative performance of the focal actors. Discussion in line with research questions follows:

Research question 1: *What characterises actor networks for innovative learning among enterprises in South African rural contexts?*

The findings of the investigation on ego networks of enterprises based in rural contexts of Mopani district revealed various compositional dynamics that characterise rural actor networks for innovative learning. The outcome of the investigation presents a dynamic and complex character of rural actor networks. They are diverse and loose, characterised by inequalities and weak institutions. And they are disjoint from regional and national network systems. As observed in the investigation, rural actor networks are composed of different actors namely; state agencies, private actors (formal and informal sector), NGOs/ Civil society and special programmes. These actors are based both in local and non-local areas. Rural actor networks are often small in size. In this context, focal enterprises exploited relations with few key resourceful actors for new ideas and knowledge. A similar trend was observed in a study by Spielman et al. (2011) who found that small holders relied on a limited number of actors for production inputs, credit and information. On the basis of the evidence in Mopani district, the type, nature and relevance of actors' inputs to the current innovation activities influence innovation performance of rural-based enterprises. Non-local network linkages are useful for accessing modern knowledge and resources necessary for strengthening innovation activities.

Rural-based enterprises are utilising both formal and informal network arrangements. In this context, formal network arrangements were present in infrastructure and finance, market, and supply-driven networks, particularly in the linkages between local enterprises and key NSI institutions. In the ego networks, informal linkages were predominant. However, such linkages were neither involuntary nor unplanned, but purpose-built to access particular information and resources. Unregulated or informal linkages had no clear boundaries. Actors interacted and collaborated on an ad hoc basis. Rural actor networks are also characterised by bilateral and infrequent engagements particularly with local actors with low innovative competencies.

In the investigation it is notable that purposely built relations between actors are deemed important irrespective of their formality or informality. And the strength of ties is largely dependent on the resources exchanged in its relevance. The implication for this was that some of the one-dimensional relations that provide access to resources such as relations with state agencies are important for innovation. Moreover, the object of exchange had to be relevant to the conditions of the innovator. Rural actor networks seek to create know-how infrastructures where small firms and enterprises with poor internal competencies can engage to enhance their innovative capabilities.

Research question 2: *What are the roles and functions of different actors within actor networks?*

Findings in relation to this research question illustrate that different actors played varying roles in the network. The actors included state agencies, NGOs, civil society, consultants, private enterprises, product/ producer associations and special programmes. These roles were categorised as i) access to resources and knowledge; ii) business development and network mobilisation; iii) capacity building; and iv) supporting and enforcing institutional change. The findings suggest that actors are aware that different types of actors from across sectors provide varying innovation know-how that creates a local innovation ecosystem.

We observed that public agencies played a supporting role of providing information and resources. However, these actors adopted a more top-down approach. The challenge experienced by rural enterprises was that some of the state agencies'

intervention side-lined their own interests and intentions. For instance, civil society actors had relatively strong relations with egos. Civil society actors play a fundamental intermediary role in innovative networks, while private sector actors are sources of immediate relevant ideas to existing local activities. It was learnt that interacting with private sector actors in the same industry provides an opportunity for learning by imitation and observation. The frequency of interaction between the focal enterprises and different actors varied along the agro-processing value chain.

Research question 3: *What kind of actors and linkages facilitate interactive learning and innovation among rural enterprises?*

Rural-based enterprises that engage in innovation activities exploit various local and external knowledge and learning relations. This trend was observed as actors fostered interactive learning networks with actors that were located in the rural areas and those that were located outside the rural settings. Such external learning relations took place between focal actors and formal enterprises that operated in the formal economic sector.

In rural contexts, interactive learning takes place through varying communication structures and channels. The outcome of this research shows that interactive learning of enterprises in Mopani district occurred through local training seminars that were informal, project-based exchanges of knowledge and experiences; consultations, collaboration, chat groups, site visits; and on-farm training. In some instances, interactive learning takes place through formal structures, including project-based training activities on biogas production and experiential training. Face-to-face interactions through meetings, chatting, seminars and events, as well as site visits, were popular forms of interactions documented in this study. Thus, actors rely on face-to-face interactions but over time, the knowledge exchange takes place through modern technologies, such as telephonic discussions. Enterprise free-rider behaviour was revealed among competitors. Enterprises tend to copy and imitate other enterprises in the same sector.

Knowledge seeking behaviour for problem solving as seen in this study is a critical innovative capability of rural enterprises to maintain a competitive edge. It is often hypothesised that co-location facilitates learning that in turn promote innovation.

However, in line with (Fitjar and Rodríguez-Pose, 2017), this study argues that learning doesn't happen by chance, it is an intended effort by actors seeking solutions for their challenges. The actors' characteristics, the nature of linkages, and the content and value of the objects of exchange had an impact on interactive learning mechanisms.

Research question 4: *What types of institutions facilitate or hamper innovation processes in South African rural contexts?*

The institutional context in a rural setting is tightly aligned with informal rules and traditional rules that govern day-to-day community engagement and interactions. But they are also influenced by national policies. The evidence of enterprises in Mopani indicates an innovative behaviour that is influenced by both formal and informal rules at varying levels across the agro-processing value chain. This social dynamic trend can help theorise how innovation in rural context differs from innovation in urban areas.

Innovating rural-based actors are cognisant of traditional rules and norms in deep rural villages. Bypassing community and traditional authorities may hinder any chance of establishing relations and operating in villages. In some of these cases consultation with traditional authorities, councillors and community representative was noticeable.

One of the key highlights from the findings was that rural actors are influenced by privilege institutional frameworks that are locally-generated/contextually-relevant rather than those that are more remotely framed at the country level, such as SANSI. In this study, three forms of institutional arrangements were identified that directly influenced innovation activities in the rural Mopani district:

- Contractual terms and conditions and government actor mandates;
- Local rules and norms; and
- Rules and norms that emerged organically and influenced how actors in a network linkage interacted (could be internal enterprise operational rules).

7.3 Theoretical implications

The social dynamics of innovation, linked to networking and learning patterns and the diverse characteristics of the rural innovation landscape, are typically not at the forefront in innovation research. Furthermore, rural-based innovators are considered as weak and lacking the capabilities (QUNO, 2015). These insights are especially relevant to suggestions by scholars such as Muchie (2016), who has argued for an SI for integrated development that considered a combination of social, economic and environmental factors, as well as knowledge, learning, innovation and capability building. Poor interaction among system components or incoherent SI are among the reasons why the desired innovation development goals had seldom been achieved (Bitzer and Bijman, 2015; Soumonni, 2016).

This study argued that a lack of focus on the social dynamics of innovation presents a limitation in achieving a nuanced understanding of rural innovation. An actor and process-oriented approach was adopted to study the nature of innovation in rural contexts. In this sense, an overlay of systems of innovation, agricultural innovation systems and actor network theory was applied. By overlaying these theories, an ANIL lens was proposed and applied in this context. ANIL considers the self-organising practices of enterprises as a step to understanding the diversity and complexity of challenges faced by enterprises in rural settings. Assumptions under the ANIL approach following the outcome of this investigation emerged; Rural enterprises are not merely adopters and consumers but they are innovators in their own right; innovation is a process of change; innovations by rural enterprises are not specific to rural areas, but they can also be observed in urban areas. Innovation is also the result of a combination of the use of both traditional knowledge and modern knowledge adopted from external contexts. Individual enterprise interests and intentions influence the direction and use of innovation as well as the formation of networks. Micro-level heterogeneity explained the dynamic nature of rural contexts and encouraged integration and collaboration efforts that were relevant to local innovation systems of rural-based enterprises. The socio-economic characteristics of small-scale enterprises, or actors, should take priority in STI and development (Soumonni, 2016; Mavhunga, 2017; Daniels, 2017).

7.4 Policy implications in the context of South Africa

South Africa has adopted NSI as a policy framework that promotes science, technology and innovation (DACST, 1996). The application and implementation of the NSI has gaps that are linked to limited recognition of the rural innovation landscape (DST, 2012; Hart et al., 2015). Generally, innovation occurs when individuals and groups engage in the process of learning. The process is complex and it does not occur in a vacuum. In this regard, this investigation called for an understanding of the social dynamics of innovation processes and of the micro-level of the systems of innovation. It is held up in this research that an insight of the social aspects of innovation can guide and strengthen the formulation of an inclusive innovation policy that promotes a progressive rural innovation ecosystem. Thus, co-innovation depends on affective actor networks and partnerships at local, regional, national and international levels.

The investigation has revealed that rural enterprises have inadequate means to upscale their innovations as they operate in a more or less unfavourable policy environment. One of the key drivers of rural innovation would be institutional support and strong incentives to innovate. Poor integration among the system's actors were linked to questions of the agency and priorities of actors. The study's findings showed that pre-defined priorities of institutions promote power over micro-enterprises, with the result that the learning process became lop-sided. Actors in the rural innovation network systems were not interconnected. It was observed that rural networks are disjoined from regional and national systems. Interactive learning patterns of rural based enterprises has been revealed. A combination of different types of knowledge was crucial for innovation processes (Sotarauta, 2017), to which the study attested to, by revealing that the local actors used both local and external knowledge sources. However, communication capabilities seem to be lacking in rural contexts.

Rural innovation policies and strategies should consider the complexity and of the rural settings as there is a need for contextual appropriateness. Development intervention should fit particular social and economic conditions (Berdegué 2005). The social dynamics of actor networks and innovation processes have demonstrated the resilience and capabilities to seek new knowledge to solve existing challenges

while taking advantage of emerging opportunities. In an effort to promote and improve rural innovation, policies and strategies should consider the following:

- Recognise and promote innovation processes at the enterprise level;
- Create an innovation or network system that embraces the diversity and complexity of actors;
- Provide initiatives and incentives that promote co-innovation
- Establish effective local institutions to overcome red tape in the formal systems of innovation,
- Increase connectivity through promoting the intensification of the role of rural network systems to regional and nation innovation systems
- Promote interactive learning by also improving the learning, networking and absorptive capabilities of local actors;
- Provide relevant incentives to rural-based enterprises or actors;
- Link STI actors with rural based enterprises; and
- Promote a more targeted approach i.e. cluster or regional policies
- Provide entrepreneurial and communication training
- Establish communities of practice in rural areas
- Create innovation incubation centres in rural areas
- Link social and innovation strategies and policies

7.5 Limitations and area for future research

This exploratory qualitative research is not without its limitations, and more research is needed in some areas. The current study explored the different characteristics pertaining to the components of actor networks and how they relate to interactive learning and to innovation in rural contexts. The author acknowledges the inherent limitations of case study-based research in terms of whether the findings could be generalised to a wider context. However, the limitations do not in any way invalidate the findings of this study for several reasons: firstly, case study research has been acknowledged for its ability to provide a nuanced picture of phenomena; secondly, empirical research on innovation in rural contexts is still young in the literature; thirdly, the study also helps explore the rich yet unexploited potential of innovation led by rural-based enterprises.

Overall, this investigation serves as a prelude to future research on the social dimensions of the innovation process. This is an avenue for the further exploration of the untapped innovative potential of rural based enterprises. RIAT's notion of the social dynamics of IVCs proposes a need to study innovation as a process. Rural innovations are often small scale, and therefore, there is a need for research on how such innovations can be up-scaled.

The concept of the social dynamics of innovation emphasised the importance of understanding the micro-level of a SI. This requires further in-depth research into the design of useful tools for policy interventions that consider contextual socio-economic differences aimed at promoting STI-driven development in rural contexts. At a broader scale, this study opens up paths for the work of Muchie (2016) and colleagues on the notion of a "unified theory of Pan-African innovation systems and integrated development", which could lead to the re-articulation of alternatives to existing development approaches that integrate development economics with SI and directly address the challenges of underdevelopment (Muchie, 2016).

7.6 Concluding remarks

As indicated in the study, innovators in rural contexts are characteristically pervasive. Rural innovation continues to provide alternative livelihoods to millions of communities. In recent times, the role and contribution of continued production of social and economic value through rural innovation have been acknowledged. Scholars have started giving attention to innovation in less formal sectors. But, the mechanics of the process of innovation in rural contexts remain unknown. In the face of the emergence of this growing field of research, this study has shed light on the social dynamics of actor networks and innovation in rural South Africa. The social dynamics of innovation captures practices and procedures that have an influence on the process of innovation.

This study has distinguished enterprise networks as actor networks for innovative learning. Such networks are established for accessing knowledge and resources that are relevant to immediate operational activities that lead to innovative changes. The rural network systems are also characterised by a broad range of actors from across the economic sectors. A notable trend is a limited participation of key NSI actors

such as universities and science centres in these networks. Thus, the rural innovation system is fragmented and incoherent. In rural contexts, institutional support for innovation is lacking, and in some cases, non-existent. A consideration of the social dynamics can help develop policies that are fit for rural conditions.

Appendix 1: Qualitative enterprise interview protocol

Extracted from High-Impact Innovation Catalyst instrument (RIAT)

Enterprise-level survey (Open ended)

A. General information

Let's start by talking about your background and experiences in this enterprise.

a) How would you characterize the enterprise in your own words?

B. Innovations

1**.** Can you briefly tell me about the innovation your enterprise engaged in?

a) Why was it introduced?
b) How was it introduced or changes made? What is the source of the know-how?
c) What have the results been of the new things and improvements (various innovations) that have been made?

C. Features of the Actor network

1. Can you briefly tell me about your enterprise working relations with external enterprises?

a) Is the enterprise part of cooperation or ties with other enterprises or is it an individual enterprise?
b) What other enterprises are in the relation (ties) with your enterprise?
c) Where are they located?
d) What influences enterprises to form ties with other enterprises?
e) How would you describe the nature of the ties with other enterprises (e.g. weak; strong; formal; informal)?
f) What role does each member of the relation play?

D. Innovation and networking

1. Let's discuss how your collaborations and networks contribute to the operation of your enterprise to your enterprise innovation?

a) What relations are most important generally (local or non-local)?
b) Which relations (local/non-local) are preferable and why?
c) Has the enterprise been sharing resources/technologies with other enterprises in the relation?
d) Which resources are those?
e) How do such resources influence the operation and nature of the relations?

E. Actor networks and learning

1. Can you briefly tell me about how your enterprise interacts with other individuals and enterprise and the reasons for your interactions?

a) How does the enterprise receive knowledge and information from other enterprises in the relations (e.g. experimentation; workshops; email; telephone etc.)? What type of knowledge (qualitative information or codified information)? Is it local or non-local?
b) Which enterprises do you receive such information from (Name and location)?
c) What is the nature of the relations your enterprise has with these enterprises (long term or short term; including a contract/formal or informal?
d) What are the challenges and obstacles you have in receiving information and knowledge for innovation?
e) What are the specific types of relations that influence learning for innovation?
f) Does learning depend on the specific type of relation with the enterprise, or on whether the information is general or specific for innovation?
g) How does your enterprise interact with research and development institutions; higher education institutions and public institutions?
h) Is it of importance to interact with them and why?

INTERVIEWER NOTES AND COMMENTS

Thank you

Appendix 2: Pictures



Picture 1: NBef Organics' moringa plantation



Picture 2: NBef Organics' moringa leaf products



Picture 3: WFP's poster requesting the public for mango supplies



Picture 4: Two vehicles transporting mango supplies to Wolkberg Fruit Processors (WPF)



Picture 5: WFP's mango sorting room



Picture 6: WPF's mango fruit drying room



Picture 7: A concrete underground biogas digester in Gawula



Picture 8: Ready-to-use biogas demonstration stove

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