Mapping the Innovation Landscape of the Karoo Region with Local Innovation Advancement Tools

Consolidated final report

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Table of Contents

List of Tables ii
List of Figures iii
Executive summary 1
1 Introduction 8
1.1 Background of the project 8
1.2 Defining innovation 9
1.3 Objectives of the project 13
2 Research approach 14
2.1 Selection of districts 14
2.2 Innovation orientation assessment 16
2.2.1 Document analysis 19
2.2.2 Local Economic Development Innovation Orientation (LEDIO) Index 21
2.2.3 Weighting and aggregation of document analysis and index scores 23
2.3 Innovation value chain (IVC) instrument updates and customisation 24
2.4 Data collection process and sampling 26
2.5 Geospatial and statistical data analysis 27
2.6 Facilitation of PERL workshops 28
3 Demographic and socio-economic profile of the selected Karoo districts 32
3.1 Demographic profile of the selected Karoo districts 32
3.2 Socio-economic indicators and trends of the Karoo Region 37
4 Availability of innovation infrastructure 42
4.1 Innovation infrastructure availability in the Namakwa district 43
4.2 Innovation infrastructure availability in the Pixley ka Seme district 46
4.3 Innovation infrastructure availability in the Central Karoo district 48
4.4 Innovation infrastructure availability in the Sarah Baartman district 50
5 Innovation orientation results 53
5.1 Innovation orientation level of the Central Karoo district 53

5.2 Innovation orientation level of the Pixley ka Seme district 56
5.3 Innovation orientation level of the Namakwa district 58
5.4 Innovation orientation level of the Sarah Baartman district 61
5.5 Inter-district comparisons of innovation orientation levels 64
6 Enterprise survey results 66
6.1 Distribution and profile of the innovative enterprises 66
6.2 Innovation types and activities 97
6.3 Internal enterprise environment and access to resources for innovation 111
6.4 External enterprise environment for innovation 117
6.5 Networking for innovation 127
6.6 Institutional support for innovation 133
7 Insights from PERL Workshops 140
7.1 Participants' understanding and awareness of innovations 141
7.2 Developing a vision for innovation driven local development 143
7.3 Evaluation of the PERL workshops by participants 148
8 Conclusions 151
References 153
Annexures 155
Annexure A. Analytical framework for assessing STI-content of strategic documents 155
Annexure B. Local Economic Development Innovation Orientation (LEDIO) instrument 157

List of Tables

Table 1. Selected Phase 1 districts and local municipalities 16
Table 2. Innovation orientation levels for document analysis 20

Table 3. Innovation orientation levels for index scores 22
Table 4. Demographic characteristics of the selected districts in the Karoo region, 2017 37
Table 5. Socio-economic characteristics of selected districts in the Karoo region, 2017 38
Table 6. Innovation orientation (IO) levels, Central Karoo district 54
Table 7. Innovation orientation (IO) levels, Pixley ka Seme district 56
Table 8. Innovation orientation levels, Namakwa district 59
Table 9. Innovation orientation levels, Sarah Baartman 62
Table 10. Weighted innovation orientation (OI) levels for selected districts 64
Table 11. Enterprises visited and profiled per district municipality in the Karoo region 66
Table 12. Proportion of innovators sampled based on local municipalities in the Karoo 68
Table 13. Enterprise types and registration status in the four Karoo districts 84
Table 14. Economic sector, type and employment levels of the innovators in the four Karoo districts 87
Table 15. Maturity levels and head office location of the innovative enterprises 92
Table 16. PERL workshop attendance, local actor diversity and participation level ... 140

List of Figures

Figure 1. Karoo STR/ RED Initiative Boundary 15
Figure 2. Innovation value chain 26
Figure 3. Local municipality and main towns in the Central Karoo District Municipality 33
Figure 4. Local municipalities and main towns in the Namakwa district 34
Figure 5. Local municipalities and main towns in the Pixley Ka Seme district 35
Figure 6. Local municipalities and main towns in the Sarah Baartman district 36

Figure 7. Trends in formal employment by sectors in the selected districts, 2000 - 2017 40
Figure 8. Trends in informal employment by sectors in the selected districts, 2000 – 2017 41
Figure 9. Trends in gross valued added by main economic sectors, 2000 – 2017..... 42
Figure 10. Innovation infrastructure of the Namakwa district- Map 1 44
Figure 11. Innovation infrastructure of the Namakwa district- Map 2 45
Figure 12. Innovation infrastructure of the Pixley Ka Seme district- Map 1..... 47
Figure 13. Innovation infrastructure of the Pixley Ka Seme district- Map 2..... 48
Figure 14. Innovation infrastructure of the Central Karoo district- Map 1 49
Figure 15. Innovation infrastructure of the Central Karoo district- Map 2 50
Figure 16. Innovation infrastructure of the Sarah Baartman district- Map 1 51
Figure 17. Innovation infrastructure of the Sarah Baartman district- Map 2 52
Figure 18. Average scores per LEDIO item for municipalities in the Central Karoo district 55
Figure 19. Average scores per LEDIO item for the selected municipalities in the Pixley ka Seme district 58
Figure 20. Average scores per LEDIO item for the municipalities in the Namakwa district 61
Figure 21. Average scores per LEDIO item for the municipalities in the Sarah Baartman district 63
Figure 22. LEDIO scores per selected item for district municipalities 65
Figure 23. Relative contribution of towns to sampled innovators per selected district.. 71
Figure 24. Innovators and infrastructure profiled in the Namakwa district..... 72
Figure 25. Innovators and infrastructure profiled in the Pixley ka Seme district 73
Figure 26. Innovators and infrastructure profiled in the Central Karoo district 73
Figure 27. Innovators and infrastructure profiled in the Sarah Baartman district..... 74
Figure 28. Distance of innovators from the main hub in the Namakwa district..... 75
Figure 29. Distance of innovators from the main hub in the Pixley ka Seme district 76

Figure 30. Distance of innovators from the main hub in the Central Karoo district..... 77
Figure 31. Distance of innovators from the main hub in the Sarah Baartman district... 78
Figure 32. Shortest routes map for innovators in the Namakwa district..... 80
Figure 33. Shortest routes map for innovators in the Pixley ka Seme district 80
Figure 34. Shortest routes map for innovators in Central Karoo district..... 81
Figure 35. Shortest routes map for innovators in the Sarah Baartman district..... 82
Figure 36. Enterprises size categories in the four Karoo districts 90
Figure 37. Enterprise markets for goods and services 94
Figure 38. Main markets where goods or services are sold or freely distributed..... 96
Figure 39. Innovation types in the selected Karoo districts..... 98
Figure 40. Innovation types location in Namakwa district 99
Figure 41. Innovation types location in Pixley district 100
Figure 42. Innovation types location in Central Karoo district..... 101
Figure 43. Innovation types location in Sarah Baartman district 102
Figure 44. Innovation activities in the selected Karoo districts..... 103
Figure 45. Innovation activities location in the Namakwa district 105
Figure 46. Innovation activities location in the Pixley district 106
Figure 47. Innovation activities location in the Central Karoo district 107
Figure 48. Innovation activities location in the Sarah Baartman district 108
Figure 49. Newness of the innovations to the enterprise or sector 109
Figure 50. Registration of inventions as intellectual property..... 110
Figure 51. Adoption of high-tech or low-tech innovations 111
Figure 52. Main place for innovation activities..... 112
Figure 53. Access to innovation enhancing infrastructure 113
Figure 54. Investments in innovation activities 114
Figure 55. Required research by another organisation for innovation 116
Figure 56. Availability of resources required for innovation 117
Figure 57.Use of private or public energy/electricity sources..... 118
Figure 58. Use of private or public water sources 119

Figure 59. Use of public or private Higher Education & Training institutions 120
Figure 60. Use of private or public Research Agencies 120
Figure 61. Use of private or public ICT and available devices 121
Figure 62. Use of private or public security and policing for innovations 122
Figure 63. Sources of information or awareness of innovations 124
Figure 64. Organisations that advised enterprises on innovation activities 126
Figure 65. Innovation activities depend on interactions with others 127
Figure 66. Networking/interactions for innovation based on formal agreements 128
Figure 67. Formal linkages for innovation among enterprises in the four Karoo districts 129
Figure 68. Informal linkages for innovation among enterprises in the four Karoo districts 130
Figure 69. Joint innovation activities based on non-formal agreements 131
Figure 70. Effectiveness and efficiency of networking with positive outcomes 132
Figure 71. Improvements or adaptions of enterprise's innovations by recipients 133
Figure 72. Awareness of the laws, policies, regulations and agencies that control innovation activities in their sectors 134
Figure 73. Enterprise view of the legal policy and standards regulatory environment as supportive to its innovation activities 135
Figure 74. Understanding of STI policies, awareness, and access to government support for innovation 137
Figure 75. Grant or subsidy received from a Government department or agency for innovation activities 138
Figure 76. Sphere of government where most support is received 139

Executive summary

The aim of this report is to describe the innovation activities, the nature and patterns of interaction among innovation actors as well as the extent of the availability of infrastructure that supports innovation in four districts (Namakwa, Pixley ka Seme, Sarah Baartman and Central Karoo) in the Karoo region. This study was commissioned by the Department of Science and Innovation to inform the development of an innovation strategy for the region. The aim is to support the Small Town Regeneration and Regional Economic Development (STR/ RED) initiative, a flagship programme of the South African Local Government Association (SALGA), which was launched in 2013 across the country. The STR/ RED initiative, while targeting the revival of small towns in the region, adopts a regional economic approach, focusing on the optimal use of available resource to exploit identified regional opportunities to stimulate economic growth, job creation and spatial transformation in the region. The DSI seeks to centralise innovation as a key pillar of the STR/ RED initiative.

This report presents key demographics and socio-economic characteristics of the selected districts to provide the context for understanding the innovation ecosystem. The report indicates that all the four districts are geographically vast, sparsely populated, and highly urbanised, with at least 90% of their inhabitants located in urban areas. Even though there have been minor improvements over the years, the four districts are characterised by high levels of poverty, unemployment and inequality. The key economic sectors are community services, trade, finance and agriculture, contributing significantly towards gross value added and employment (formal and informal). Over the years, there has been structural transformation of the economy in these districts, with agriculture's contribution to the district economies declining from an average of 44% in 2000 to just

21% in 2017, while the role of sectors such as trade, finance and manufacturing has increased significantly in the same period. Also crucial is the role of informal sector employment, particularly in the trade sector, which contributed more than 40% of the informal employment on average for the four districts in 2017. Sectors such as renewable energy (solar and wind), transport and the knowledge economy have potential to grow and play a key role in the revival of the region's economy.

Infrastructure analysis indicated that the four districts have moderate access to basic and innovation infrastructure such as roads, communication or knowledge infrastructure. While there are major roads in good condition that cut through all these districts, most of the regional roads are gravel roads, which are difficult to drive on using low ground clearance vehicles. Internet connectivity is limited in most of the small towns, with stronger networks only found in major towns, often the district capitals and economic hubs. While there are many schools across the four districts, there are not many institutions of higher education in these districts. There exists big sciences projects located in some of these areas (e.g., SKA, Observatory, etc.). However, these remain islands of science excellence, which have not led to noticeable growth in the contribution of science, technology and innovation in the regional economy. The schools have limited computer infrastructure, or access to the internet. The books found in the many libraries scattered across the districts are old and mostly not related to contemporary science.

Relying on document analysis and interviews with municipal officials, the study assessed the level of innovation orientation of the municipalities, using a Local Economic Development Innovation Orientation (LEDIO) Index. Innovation orientation describes the learning philosophy, strategic direction, and trans-functional beliefs within an organisation that define and direct the organisational strategies and actions toward specific innovation enabling competencies and processes. The study found low levels of

innovation orientation among the municipalities in the Karoo region. While there were variations between results from the two analytical approaches used, as well as among local municipalities within a district, and among the four districts, most municipalities were at Level 1 of innovation orientation. This orientation level suggest that there is awareness of innovation and its importance; however, there is little or no prioritisation of innovation when allocating resources. This implies that most of the municipalities are currently paying lip service when it comes to innovation, emphasising in the documents and strategies its importance, without investing adequately in harnessing innovation to improve the internal and external municipal operations. In particular, further analysis showed low levels of physical, financial and human resource allocation for innovation, as well as lack of incentives for officials to engage in innovation activities.

A survey of innovative enterprises in each of the municipality was conducted. The term 'enterprise' was used in a flexible way to include the public sector, households (or members of households), non-profit organisations, and the informal sector that dominates the rural areas. An enterprise was considered innovative if it implemented a new or significantly improved product, process, organisational or marketing method during the past three years (2017 – 2019). A database of 1,038 enterprises was constructed across the four districts. Since no sampling frame existed, this enterprise sample was constructed using a snowballing approach, which was based on referrals by local stakeholders, experts and peers. Out of the initial database of 1,038 enterprises, 436 enterprises (42%) met the initial screening criteria to be considered potential innovators. A team of researchers visited the 436 potential innovators, and 64% of them (279 enterprises) met the further screening criteria, and were thus considered innovators. Overall, the 279 innovative enterprises represented 27% of the 1038 enterprises in our database. These survey results indicates that there is a relatively moderate level of innovation activity occurring in the Karoo region. However, this figure should be

interpreted with caution, as the database might not be representative of selected districts. A total of 168 innovative enterprises were profiled using the innovation value chain approach.

The innovative enterprises were mostly located in the urban nodes, and near major roads, highlighting the importance of infrastructure and market potential in stimulating innovation activity. There were however a few that were located far from urban centres, focusing on mainly farming using the latest artificial intelligence and robotics techniques to improve precision in farming operations. Most of the profiled 168 innovative enterprises in the four selected districts were private enterprises (86%), operating in the formal sector, with few of the enterprises (18%) not registered with any authority or not paying business taxes. Despite being a small proportion, the number of unregistered innovative enterprises suggests that there is also innovation that takes place amongst the informal enterprises who operate in the parallel economy. It is therefore important that innovations operating within informal settings be acknowledged and harnessed for inclusive outcomes.

Production process innovations were the most popular innovation type, reported by 78% of the innovative enterprises. The second most popular innovation type was product innovation, which was reported by 40% of the enterprises. The least reported innovation types were organisational and marketing innovations, each practiced by 10% of the enterprises in the region. While about two thirds of the innovative enterprise were involved in one innovation type, 32% of the enterprises engaged in at least two innovation types. Adoption (85%) was by far the most dominant innovation activity among innovative enterprises, followed at a distance by adaption (29%). Very few enterprises (16%) reported any invention activity, while about a quarter of the enterprises (24%) reported that they share or diffuse the innovations with others. A significant

proportion of the enterprises (38%) were engaged in more than one innovation activity. These results suggest that a significant proportion of the innovators are making improvements to production technologies by adopting cutting-edge technologies from others, sometimes making changes to these technologies to suit their specific needs and local circumstances. Additionally, the tendency among a significant proportion of innovative enterprise is to engage in more than one innovation type or activity.

The survey results indicated that the innovators faced challenges in terms of accessing resources they required for innovation. For example, only 27% of the innovators indicated that they had access to resources they require for innovation locally (within a radius of 50 km), while a quarter of them (26%) accessed the required resources in other municipalities within their province. The majority (72%) of the innovators indicated that they accessed the resources in other provinces outside of their own provinces. Some innovators (11%) acquired necessary resources internationally.

The innovative enterprises considered interactions with other actors in the innovation space crucial. More than half (52%) of the innovative enterprises reported that their innovation activities were dependent on their interactions or interlinkages with other enterprises or agencies. Interestingly, the strength of interactions or networking did not necessarily depend on formal agreements with formal contracts, as even those based on informal agreements were also reported to be strong. The informal networks were denser than the formal, indicating that informal networks are the most prevalent among the innovators.

The respondents reported that the networking activities produced significant and positive outcomes, with the majority of the innovators indicating that their networks were effective (72%) and efficient (64%). Overall, the results indicated low levels of local networking

(both formal and informal), with most of the enterprises networking with actors located outside their districts, often in the two cities of Cape Town and Johannesburg. The results also indicated that informal networks such as peers and colleagues (58%) were the main sources of information on innovations; followed by management or specialist departments within enterprises (55%) and suppliers of inputs and buyers of products (48%). Service providers for government were the least contributors (12%) in increasing the enterprises' awareness of innovations, while formal networks (32%) also played an important role as sources of crucial information.

The innovative enterprises demonstrated low levels of awareness of laws, policies, regulations and agencies that control innovation activities in their sectors. Consequently, a significant proportion of the innovators in the region (47%) felt that the legal, policy and standards regulatory environment was not supportive to its innovation activities, while 26% felt that the environment was marginally supportive. Only 27% of the innovators were of the view that the legal, policy and regulatory environment was supportive of innovation. What is of concern, however, is that only 29% of those enterprises who were aware had applied for support. These results suggest that it will be important for the relevant institutions and agencies to implement awareness or publicity campaigns to improve the exposure of the innovators to their services. Additionally, there is a need for policy makers to revise the policies and regulations to create an environment that is conducive and supportive of innovation, and then empower the innovators so that they benefit from government interventions.

The participatory workshops indicated that the local actors have high dreams and ambitious visions for the future of innovation and economic development. While accepting that the current landscape has failed to address the key challenges facing the region, the workshop participants identified the key challenges they think should be

addressed to unleash the potential of innovation in stimulating the local economies. In particular, they emphasised the need for inclusivity, which implies the need to empower local actors to use their agency to work themselves into prosperity. This goes beyond focusing on the local elites, or the few local stars, but ensuring the involvement of especially the marginalised in key aspects of the local innovation and production system.

1 Introduction

1.1 Background of the project

Achieving the globally agreed Sustainable Development Goals (SDGs), and South Africa's National Development Plan (NDP) agenda, require that new and improved ways of doing things be pursued and implemented. The triple challenges of poverty, inequality and unemployment, have been unrelenting and rising unabated over the years in South Africa. These cannot be addressed using yesterday's approaches. To meet these challenges, and several other societal, economic, environmental and technological targets, there is a need to harness the innovative capabilities of individuals and enterprises of all types, sizes, and in all locations. In particular, achieving inclusive outcomes through innovation is such that the enterprises located in the periphery can no longer be ignored. Unfortunately, not much is currently known about the innovation activities of these enterprises, as they are often ignored by the large innovation surveys, which tend to focus on large formal innovators located in and around large towns.

This study was commissioned by the Department of Science and Innovation (DSI), and it seeks to map the innovation infrastructure, actors and networks of the Karoo region, as an important step in developing an innovation strategy for the region. The aim is to support the Small Town Regeneration and Regional Economic Development (STR/ RED) initiative, a flagship programme of the South African Local Government Association (SALGA), which was launched in 2013 across the country (SALGA, 2018). The STR/ RED initiative encourages municipalities to target small towns as entry points to harness and make optimum use of available services and resources to stimulate economic growth, job creation and spatial transformation. Further, the initiative adopts a

regional economic approach to guide and identify regional trends, threats and opportunities that individual municipalities need to respond to jointly. The DSI seeks to centralise innovation, which is about improved or new ways of leveraging the sectors that the region has competitive and comparative advantage, as a key pillar of the STR/ RED initiative. While a regional innovation strategy should take cognisance of global and national innovation trends, it should remain anchored in the local context, tied to the region's unique opportunities and constraints.

It is against this background that this report seeks to investigate: (a) the extent of the availability of infrastructure that supports innovation in the Karoo region; (b) the key innovation actors in the region; and (c) the nature and patterns of interaction among innovation actors in the region. These form an important basis for tailoring the innovation strategy to the local context, ensuring that the strategy is grounded on relevant contextual realities and is geared towards producing inclusive outcomes. Given the diverse and often times conflicting meanings different actors attach to innovation, the next subsection discusses and operationalises the innovation concept for this project.

1.2 Defining innovation

While innovation has been defined in various ways in different contexts, the Oslo manual, which also provides guidelines on measuring innovation in the business sector, provides the widely accepted definition of innovation (OECD/ Eurostat, 2005, 2018).

The 3rd Edition of the Oslo manual (OECD/ Eurostat, 2005) defined an innovation as: '*the implementation of a new or significantly improved product (good or service), or process, a new marketing method, or a new organisational method in business practices,*

workplace organization or external relations'. In addition, the Oslo Manual 3rd Edition highlighted that '*a new or improved product is implemented when it is introduced on the market. New processes, marketing methods or organisational methods are implemented when they are brought into actual use in the firm's operations*.'

The above definition expanded the meaning and measurement of innovation beyond the technological innovation focus (i.e., product and process innovations), which had been the case prior, to also include non-technological innovations (i.e., marketing and organisation innovations). However, the focus was on formal businesses in the private sector, and innovation aimed at the market, restricting the applicability of the measurement guidelines to other potential innovative players operating in the public, household, non-profit or informal sectors.

The new White Paper on Science, Technology and Innovation adopts this Olso definition (DSI, 2019). The Local Innovation Assessment Toolkit (LIAT[1]) framework relied heavily on the above definition, and developed conceptual and measurement frameworks that adapted the existing guidelines to be applicable in the rural and/or informal contexts. A key aspect was the flexible use of the term enterprises to include the public sector, households (or members of households), non-profit organisations, and the informal sector that dominates the rural areas. This was in line with proposals being made by researchers. For example, Gault (2012) had highlighted the need to change 'introduced

[1] The LIAT is a set of information and decision tools that was developed by the Human Sciences Research Council and was funded by the Department of Science and Innovation. It was previously known as the Rural Innovation Assessment Toolbox (RIAT).

on the market' for product innovation in the Oslo Manual 3rd Edition to 'made available to potential users', so that is also applicable to the non-business sector.

The latest (4th) edition of the Olso manual has expanded the definition so that it is applicable to both private and public entities across all economic sectors (Gault, 2018; OECD/ Eurostat, 2018). According to the Oslo Manual 4th edition (OECD/ Eurostat, 2018: 20), '*an innovation is a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*

In the latest Oslo Manual definition, the generic term "unit" is used to describe the actor responsible for innovations broadly, so that it is applicable to any institutional unit in any sector, including households and their individual members, public entities, and non-profit institutions. Additionally, process was expanded to include three components; production and delivery, organisational change, and market/communication development, reducing the complexity in the definition. The revised definition also makes an attempt on defining 'significantly improved' by highlighting the need for a product or process to be differ significantly to the unit's previous products or processes. The phrases such as 'used by a firm' or 'introduced in the market' have been replaced by more flexible phrases to allow for general application.

In line with this general definition, the four types of innovation are as follows (see Gault, 2018):

Product innovation: is a product (good or service), made available to potential users, that is new or significantly changed with respect to its characteristics or intended uses.

Production process innovation: A production or delivery innovation is the implementation of a new or significantly changed production or delivery process. This

includes significant changes in inputs, infrastructure within the institutional unit, and techniques.

Organisational innovation: An organisational innovation is the implementation of a new or significantly changed organisational method in the business practice, workplace organisation or external relations of the institutional unit.

Marketing innovation: A marketing/communication innovation is the implementation of a new or significantly changed method of promoting products of the institutional unit.

It is important to highlight that, in the context of developing countries, 'innovation is best understood as the process by which the actors master and implement the design and production of goods and services which are new to them, irrespective of whether they are new to their competitors' (Egbetokun et al., 2016: 161). The LIAT framework broadly defines innovation to include processes of adoption and adaptations or modification of products, technologies, organisation arrangements and marketing functions that have been developed elsewhere.

In the LIAT framework, innovation activities are defined to include invention, adoption, adaption/adjustment and diffusion of both economic and socially beneficial innovations.

Invention: designing and implementing a new idea/ products/ practice for social or economic gain. It should be something completely new to the world.

Adoption: implementing an already existing idea/strategy/process originally designed by another enterprise/individual.

Adaptation: improving an already existing idea/ strategy/ process to suit own purpose or circumstances.

Diffusion: Distributing/sharing of innovations (new ideas, products, practices) through market or non-market channels to consumers, countries, organisations, markets, sectors.

1.3 Objectives of the project

The primary purpose of this research project was to construct a reliable evidence-base of the Karoo innovation landscape to inform the development of an innovation strategy for the region. The innovation strategy seeks to support the development, implementation and evaluation of a STR/ RED Strategy for the Karoo region. Mapping evidence about innovation is an essential step towards overcoming the knowledge gap on Science Technology and Innovation (STI) in the Karoo and giving strategic support for innovation-driven economic and social development on a regional scale.

Towards this end, project specific objectives were to:

- Conduct STI-content appraisals of local municipality socio-economic strategic frameworks, IDPs and LED strategies;
- Construct an evidence base about the STI-landscape in the Karoo region and map this information to support innovation-driven economic and social development in the region;
- Incorporate the evidence about the innovation landscape into the Karoo STR/ RED strategy using methods and techniques that empower local actors, particularly local municipalities involved in the STR/ RED Strategy;

- Facilitate participatory, evaluative and reflection learning (PERL) workshops to boost local innovative performance, which includes the exploration of innovation-driven actor networks or prototypes of communities of practice.

2 Research approach

The study adopted a mixed-methods approach, purposefully blending techniques from different qualitative and quantitative methods of information collection and analysis. The study is based on insights from the principles of geospatial analysis, participatory action and observation methods, key informant interviews, a survey questionnaire and transformative participatory workshops.

2.1 Selection of districts

Given that the Karoo region is vast, covering about 78 local municipalities in 16 districts across four provinces (Northern Cape, Western Cape, Eastern Cape and Free State), the research effort was divided into two phases. Figure 1 is a map showing the areas that are at the core and periphery of the Karoo region.

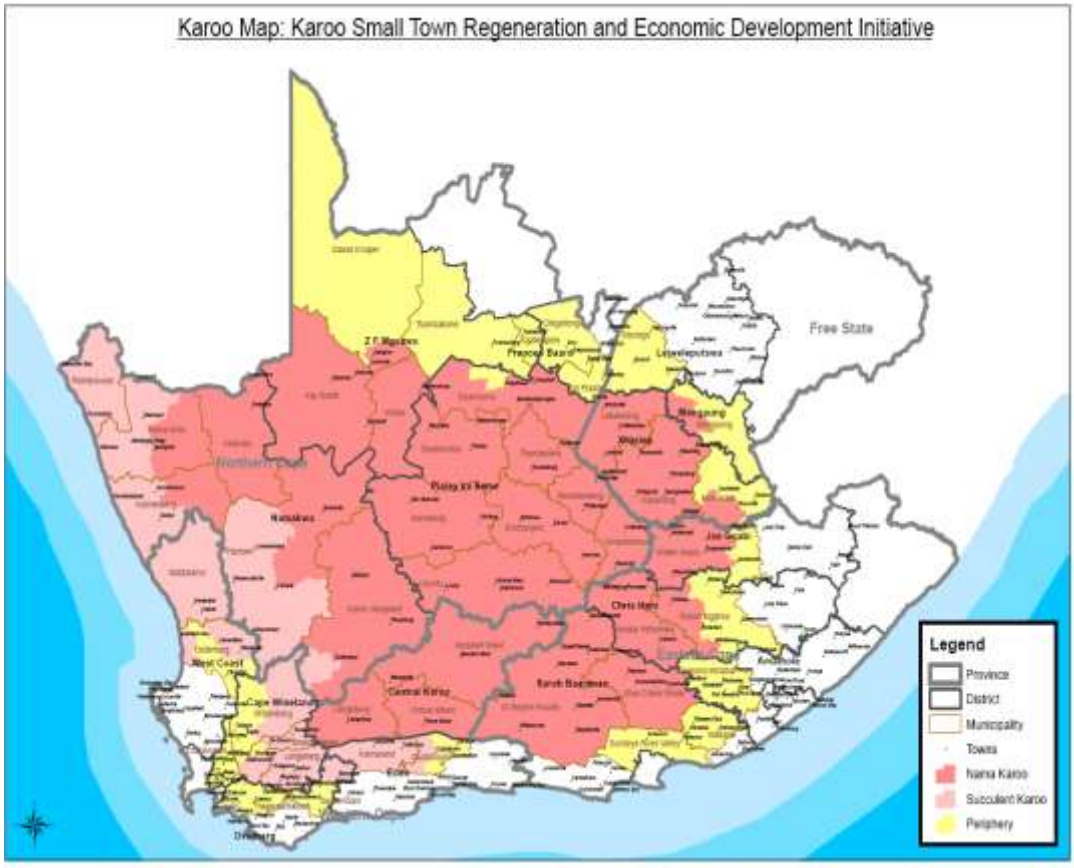


Figure 1. Karoo STR/ RED Initiative Boundary

Source: SALGA (2018). KAROO Regional STR Initiative concept note

The first phase, of which this report is concerned, focused on a selection of 16 local municipalities across four districts in three of the four provinces. The selection of the Phase 1 district municipalities was informed by the need to get at least one district each from the three key Karoo provinces (Northern Cape, Western Cape and Eastern Cape provinces), as well as the need to cover a significant proportion of the political, economic and ecological diversity of the Karoo. This is important given the time pressure to align the mapping exercise with the other STR/ RED initiative research activities, and produce

usable insights. Table 1 presents the list of the districts and local municipalities selected in Phase 1, as well as the number of small towns that were covered. Phase 2, which is expected to begin soon, will focus on the remaining districts.

Table 1. Selected Phase 1 districts and local municipalities

Province	District Municipality	No. of Local Municipalities	List of Local Municipalities	No. of Small Towns
Northern Cape	Namakwa	6	Richtersveld	6
			Nama Khoi	9
			Kamiesberg	5
			Hantam	6
			Karoo Hoogland	3
			Khâi-Ma	5
	Pixley ka Seme	5	Kareeberg	3
			Ubuntu	4
			Emthanjeni	5
			Umsobomvu	3
			Renosterberg	3
Western Cape	Central Karoo	3	Laingsburg	2
			Prince Albert	4
			Beaufort West	4
Eastern Cape	Sarah Baartman	2	Dr Beyers Naudé	11
			Blue Crane Route	4
Total	**4**	**16**		**77**

2.2 Innovation orientation assessment

The mapping of the innovation landscape of the region began with an assessment of the extent to which the selected districts and local municipalities are oriented towards innovation. Understanding the innovation orientation levels of the municipalities was considered crucial, as municipalities play a key role in creating a conducive and supportive environment for innovations and/or innovators to thrive (i.e., innovation

brokers or mediators), as part of developmental local government. It is also important that the municipalities become innovative in their own internal processes and service delivery activities.

Given that the term innovation orientation has been used in the context of mainly the private sector, and with varying conceptualizations and meanings, it is important to define and operationalise this concept for this study. Innovation orientation (IO) is a relatively old concept, which emerged several decades ago as one of the key constructs in the typologies of strategic orientations (Human & Naude, 2010; Miles & Snow, 1978; Miles et al., 1978). However, IO has received increasing attention in recent years in the business strategy and management literature (Dobni, 2006, 2010; Human & Naude, 2010; Norris & Ciesielska, 2019; Siguaw et al., 2006), and lags behind its other cousins in the management, innovation and marketing literature such as entrepreneurial orientation or market orientation (Andrade-Valbuena et al., 2019).

There is not yet consensus on the definition of innovation orientation, but different authors have used varying definitions in different contexts (Norris & Ciesielska, 2019; Siguaw et al., 2006). Perhaps a starting point to understanding innovation orientation is to deal with the basic understanding of the term ‘orientation’ (see Covin & Lumpkin, 2011 for a discussion of this approach in the context of entrepreneurial orientation). A dictionary definition of orientation is that it is ‘a usually general or lasting direction of thought, inclination, or interest’ (Merriam-Webster, undated). An IO, then, could be understood as ‘a usually general or lasting direction of thought, inclination, or interest’ pertaining to innovation. Orientation describes the overall dominant approach that represents an organisation’s competitive posture and strategic focus (Human & Naude, 2010).

A widely used definition of IO in the literature defines it as an organisation's openness to new ideas and propensity to change through adopting new technologies, resources, skills and administrative systems (Hurley & Hult, 1998). Another popular definition of IO, particularly in recent years (Norris & Ciesielska, 2019), is that by Siguaw et al. (2006), who defined IO as a 'learning philosophy, strategic direction, and trans-functional beliefs within an organisation that define and direct the organisational strategies and actions toward specific innovation enabling competencies and processes.' This study adopts this definition by Siguaw et al. (2006). As further articulated in Siguaw et al (2006), these innovation-oriented organisational competencies pertain to key areas of resource allocation, technology, employees, operations, and markets (or service delivery in the context of the public sector). In other words, the way organisations allocate their resources, hire a certain calibre of employees, or make use of certain technologies, is indicative of their level of innovation orientation.

Investigating the innovation orientation levels of an organisation encourages a total or systemic organisational view of innovation, because innovation has everything to do with organisation and attitude (Hargadon & Sutton, 2000). Innovation orientation, therefore, is the knowledge structure that enhances the appreciation of market or service delivery dynamisms, and then provides a knowledge template to develop the required process and to build an organisation's dynamic capabilities (Siguaw et al., 2006).

To what extent do municipalities, as key local innovation brokers, prioritise innovation in their internal operations, and their external interventions? Two approaches were adopted to assess the municipal innovation orientation levels: (a) document analysis; (b) interviews of municipal officials. The succeeding sub-sections explain how these approaches were implemented.

2.2.1 Document analysis

A rapid content appraisal of key strategic municipal documents was done to determine the level of innovation orientation of the selected municipalities. The documents that were targeted for analysis were the respective municipalities' recent and available Integrated Development Plans (IDPs), Local Economic Development (LED) strategies, Spatial Development Frameworks (SDFs), and the annual reports. While it was relatively easy to access IDPs for mostly municipalities, with an exception of a few, it was a challenge to access the LED plans or SDF frameworks. Either these documents did not exist, or if they exist, they had not been uploaded in the municipalities' websites. The research team used the introductory visits to elicit these documents, further to introducing the project and securing buy in and support for the research activities.

A key word search was done to assess the extent to which innovation, and related concepts such as technology, science, knowledge, new or improved methods/ ways, etc., were mentioned, the frequency of mention, and the context in which they were mentioned. The documents were reviewed to gauge whether or not the municipalities have introduced new approaches of conducting their internal operations, improved ways of implementing community participation, and how they select projects to support.

The evidence from document assessment was used to determine the level of innovation orientation of a municipality, using the innovation orientation categories shown in Table 2.

Table 2. Innovation orientation levels for document analysis

Level 0 ***Little or no innovation awareness***	**Level 1** ***Innovation awareness***	**Level 2** ***Innovation prioritisation***	**Level 3** ***Innovation entrenchment***
Little or no mention of innovation or related concepts in municipal documents. Importance of innovation not acknowledged in the municipal documents	Mention and evidence of awareness of innovation in the municipal documents. Importance of innovation acknowledged. However, there is little or no prioritisation of innovation when resources are allocated	Innovation is clearly defined, mentioned frequently, and its importance emphasised. Documents show innovation understanding and prioritisation in terms of resource allocation	Innovation's importance emphasised, and innovation principles are entrenched in the municipal's internal and external processes. Resource allocation is informed by innovation and there are incentives for innovation

As the table indicates, a municipality is considered to be at Level 0 of innovation orientation if there is limited evidence in their strategic documents of innovation or that the importance of innovation is acknowledged. Level 1 is when the documents indicate that the importance of innovation is acknowledged, even though there is limited allocation of resources for innovation purposes. A municipality at Level 2 of innovation orientation prioritises innovation in resource allocation, even though innovation is not yet entrenched in both internal and external processes. The highest level (Level 3) of innovation orientation is attained when innovation is entrenched in municipal operations and resource allocation. Evidence of the attainment of this higher level is, for example, the inclusion of innovation as one of the key performance areas for officials, or the evident continuous search of new or improved ways of enhancing community participation in their development. The document analytical framework, which presents a set of

questions that sought to determine the level of innovation orientation of the municipalities to guide the assessment of the documents, is attached as Annexure A.

Overall, a total of 20 reports (4x districts; 16 x LM) were completed, highlighting the details about the specific documents analysed and the STI-content of the strategic documents for specific municipalities.

2.2.2 Local Economic Development Innovation Orientation (LEDIO) Index

The second approach to assessing the innovation orientation levels of municipalities involved interviews of some officials using the Local Economic Development Innovation Orientation (LEDIO) instrument. The LEDIO instrument is contains 12 variables or items that focus on identifying enablers of innovation within the municipality with respect to, among others, staff incentives for innovation, allocation of financial and human resources for innovation and whether innovation is linked to the overall municipal strategy (Annexure B). The LEDIO index is aimed at gauging innovation orientations along all local actors in the LED space. The IOI applies to all organisations that operate in the LED space, applying to both private and public organisations. Also, the LEDIO index seeks to determine the learning philosophy of organisations, capturing the extent to which there is a lasting direction of thought, inclination, or interest towards innovation. Further, the LEDIO index is also about the strategic focus of municipalities in creating an enabling environment for innovation by other players in their municipal space. The LEDIO index is outward looking, focusing on the innovation brokerage/ intermediation role of local actors such as municipal offices.

The target was to interview at least three municipal officials from the LED offices, planning/ geospatial units, and the municipal manager's office. While the LEDIO instrument is applicable to other organisations, only municipal officials were interviewed due to time constraints. The responses of the interviewed municipal officials to the 12 LEDIO items were used to calculate the index scores, which were then used to determine the orientation levels of municipalities. Table 3 presents the innovation orientation levels for interviews.

Table 3. Innovation orientation levels for index scores

Level 0 ***Little or no innovation awareness***	**Level 1** ***Innovation awareness***	**Level 2** ***Innovation prioritisation***	**Level 3** ***Innovation entrenchment***
Limited, if any, awareness or evidence of innovation on the part of individual officials or the organisation.	Innovation is defined, applied and repeatable. Officials understand innovation principles, but innovation activities occur irregularly.	Innovation is managed and innovation principles are entrenched in the organisation. Officials seek to optimise and evaluate solutions, and improve on these for internal benefit.	Innovation is open and outward looking. New knowledge is applied creatively, based on evidence, in different contexts and shared with others outside of the organisation.

These are the same with those in Table 2, with minor changes in wording so that they are applicable to index scores. A municipality was considered at level 0 of innovation orientation if it scored less than 18, level 1 if it scored between 19 and 28, level 2 if it scored between 29 and 39, and level 3 if it scored above 40. Detailed analysis was done of the individual scores (items that scored the highest; lowest, average) to highlight the strengths and weakness of the municipality. Sixteen reports were completed,

representing the 16 local municipalities. No interviews were done at the district level, and the district level innovation orientation level was estimated by aggregating the local municipal level scores. The decision to interview only local municipal officials was made because the team did not have enough time to include the district officials in the sample.

2.2.3 Weighting and aggregation of document analysis and index scores

Further analysis of the innovation orientation levels of the selected districts was done by aggregating the scores generated by the different approaches. The first level of analysis included producing weighted district level scores by merging both the district office's direct document analysis results with those of the local municipal offices in the district. For example, while a level of innovation orientation for a district was produced by analysing the district office's own strategic documents, it was also considered important to merge the results of the local municipal offices in a specific district to produce a final district innovation orientation level. To do so, weights had to be selected. To keep the discussion simple, the selection of the weights was done arbitrarily, with the district office's score being given a weight of 30%, while the local municipal offices in a specific district contributed equally to the remaining 70%.

The district index LEDIO scores were produced by simply adding and getting the average of local municipal index scores. The district officials were not directly interviewed, so there was no direct district index score. Additionally, the final district level innovation orientation score was produced by combining the weighted district score from document analysis and the LEDIO results. The document analysis score was given a weight of 40%, and the LEDIO score a weight of 60%. The LEDIO score was given a higher weight because it was considered that interviews with the municipal officials represent the de

facto state of affairs in the municipality, while the documents might only represent a tick box exercise by municipalities that they might not strive to fulfil.

2.3 Innovation value chain (IVC) instrument updates and customisation

The innovation value chain (IVC) instrument, which was used to collect data from innovative enterprises, was revised based on literature review and discussions with the local actors. The term 'enterprise' was used in a flexible way to include the public sector, households (or members of households), non-profit organisations, and the informal sector that dominates the rural areas. Against the background that the existing instrument had been last updated in 2015, and that the literature on innovation definition and measurement has been changing (see Section 1.2, for example), it was considered important that the instrument be accordingly revised, so that it is underpinned by recent innovative knowledge, debates and practices. Further, the IVC instrument was customised with the participation of the local actors. The customisation exercise was done during scoping visits with key actors in the local space such as municipal officials, local research institutions and other key private, public and civil society groups, so that the resulting instrument is adapted to the local circumstances of the Karoo region. Additionally, customisation was an important exercise is bridging the gap between researchers, establishing common understanding of the mapping exercise and the expected outputs.

The screening questions that determine whether or not an enterprise is considered an innovator were also revised, so that only those enterprises that meet the criteria were profiled. The key criteria for an enterprise to be considered an innovator was that:

- The enterprise should have implemented a new or significantly improved product, process, organisational or marketing method during the past three years (2017 – 2019).
- The innovation should have been implemented or disseminated through market or non-market channels from their first implementation in a particular organisation to different consumers, markets, sectors, etc.
- The innovation must be deemed to add value. Innovations can have social /welfare or economic value.

The instrument was also revised to strengthen the sections of the instrument that aimed to capture geospatial locations of the enterprises, and the network linkages. Questions that aimed at determining the nature and frequency of their interactions were added to the instrument, and GPS coordinates were collected for all the profiled enterprises.

Figure 2 presents the innovation value chain, indicating the different innovation dimensions captured by the IVC instrument. In summary, the figure indicates that the IVC instrument captures nature of innovation produced by an enterprise, highlighting the innovation types (product, process, organisation and marketing), which are because of different innovation activities (adoption, adaption, diffusion and invention). The IVC also highlights that innovation is sector, actors/ networks and spatial context specific, and is influenced by both the enterprise's internal and external environments.

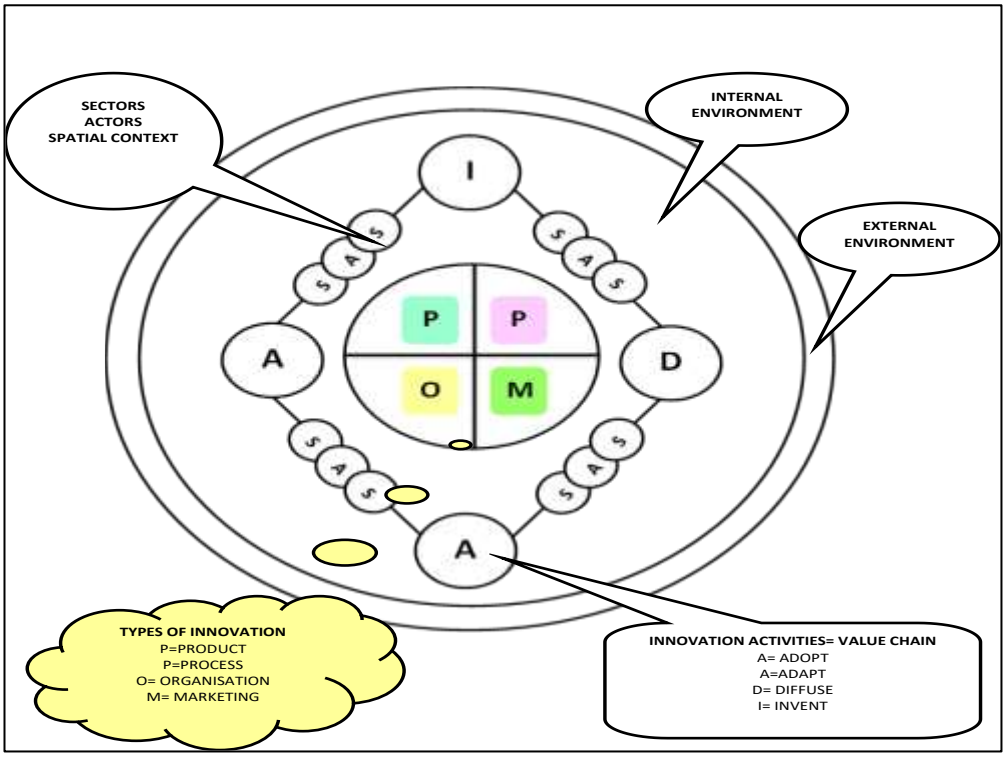


Figure 2. Innovation value chain

2.4 Data collection process and sampling

The survey exercise was completed in the selected districts during October and November 2019. A sample of 168 innovators were profiled, out of the 436 enterprises that were visited by a team of 12 researchers, using face-to-face interviews. The 436 enterprises that were visited included those that met the initial criteria to be potential innovators, from a database of 1038 enterprises that was constructed across the four districts. The initial criteria was for at least one local actor/ stakeholder to mention that they thought the enterprise was potentially innovative. Given that a database of innovative enterprises in Karoo does not currently exist, the participating enterprises

were selected through a referral process. The referral process included both expert or stakeholder referral (local actors) as well as peer referral (other innovators). Expert or stakeholder referral was done through accessing databases of enterprises from local stakeholders such as municipal officials, government departments and other key stakeholders.

A participatory Delphi approach (convergence of evidence approach), was used, involving interviewing different local experts/ actors/ stakeholders to identify the key innovation infrastructure and innovators in the area until the lists from different stakeholders converged. The innovators were interviewed using the Innovation Value Chain (IVC) instrument, and each innovator was requested to refer the research team to other innovators (peer referral), who would in turn refer us to others. Particular consideration was paid to the fact that in the rural and/ or informal areas, innovation activities are below the surface/ radar, and it is hard to find the innovating actors.

2.5 Geospatial and statistical data analysis

The existing geospatial and imagery of the municipalities were accessed from sources such as the office of the surveyor general, planning units of municipalities, government departments, SANSA, etc. Participatory methods, together with observation methods, were used to identify and include information that is excluded from the mainstream or official maps. The identified key innovation infrastructure and innovative enterprises were visited to get GPS coordinates. Innovation infrastructure includes both the basic infrastructure (such as roads, energy, water, schools, etc.) and innovation networks (such as smart grids, broadband and wireless networks) which the innovation actors need to flourish. The data were analysed using descriptive statistics (frequencies, means, bar graphs, pie charts, etc.), and geospatial mapping techniques. The focus was

on presenting a descriptive overview of the Karoo region innovation landscape, as well as geo-referenced maps and summaries of the innovation infrastructure, innovators and their interlinkages in the region.

2.6 Facilitation of PERL workshops

The PERL workshops are a key instrument in the LIAT framework; and draw on the theory and methods of transformative participatory research approaches. These include Participatory Rural Appraisal or Participatory Learning in Action as a means to provide a platform on which insider and outsider knowledge is exchanged. PERL workshops provide a platform whereby information is collectively engaged, generated and reflected upon. At least one participatory, evaluative and reflective learning (PERL) workshop was conducted per district municipality, and included all innovators and stakeholders from the respective local municipalities. A total of six PERL workshops were conducted across the four districts. The workshops were held in partnership with the district and local municipalities, and were centrally located in the respective districts to accommodate innovators travelling vast distances. The PERL workshop brought to light what the participants perceived innovation to be and their level of awareness, if any at all. It further provided a co-learning environment, which empowered participants to envision a future innovation landscape they would like to have in the Karoo.

The main objectives of the workshops were to:

- Present and engage the evidence generated from the IVC survey;
- Explore the ways in which innovation can contribute to Local Social Economic Development;
- Horizon exploration of the local innovation landscape;

- Explore actions to promote local innovation;

The objectives of the workshops were expected to be met through the following activities:

- Facilitate discussions towards a common understanding of innovation and key activities that can contribute to Local Social Economic Development (LSED);
- Facilitate reflections on innovation activities in the respective districts
- Facilitate discussion on the exploration of the future of innovation in the Karoo region;
- Identification of potential High Impact Local Innovation Catalysts (HILICs) in the respective districts.

A uniform approach was used in all the various workshops. The PERL workshops started with introductory proceedings followed by an icebreaker at plenary by posing an open-ended question on what is innovation and asking participants to share expectations for the workshop. A presentation defining key concepts and sharing results of the survey followed. A facilitated discussion engaging the presentation of concepts and evidence from the innovation mapping exercise yielded rich insights and placed the participants on solid ground to identify Potential High Impact Local Innovation Catalysts (P-HILICs). Identification of local innovative initiatives with potential to catalyse the local economy (P-HILICs) for further exploration is a key outcome from the PERL. It testifies to the power of the PERL workshop to empower locals for inclusive local economic development by offering opportunity to put the co-learning to practical use for solution driven innovations.

The insert below presents a summary of the research steps.

Key research steps in mapping the Karoo innovation landscape

In summary, the mapping of the selected districts in the Karoo region included the following key activities:

1. **Desktop review and secondary data analysis**: (a) assessment of key strategic documents to determine the innovation orientation levels of actors in the municipality; (b) analysis of secondary sources of data to produce the district socio-economic profiles; (c) analysis of secondary spatial data to produce initial maps showing the existing basic and innovation infrastructure;
2. **Introductory visits:** Preliminary visits were done to all the selected districts to introduce the innovation mapping study to the local actors (mainly municipalities) and to establish support for the planned fieldwork phase. The research team also used introductory to solicit for municipal documents we were unable to access via the internet or emails, as well as obtaining contact details of key local innovation stakeholders. While the overall target was to meet officials from 20 municipalities (4 DMs & 16 LMs), three municipalities were not successfully met. All the 4 DMs were represented, while of the 16 LMs, 13 were met and 3 were not (these were not available on the appointment date, despite having confirmed). The introductory visits in the municipalities where no official was met face-to-face were completed telephonically.
3. **Scoping visits:** The objectives of the scoping visits were to:
    - Share the research team's operationalisation of the innovation concept; discuss and agree on the criteria for differentiating innovators and non-innovators. This was important, as the local actors assisted the team to identify innovators;
    - Share initial findings on the municipality's innovation orientation based on document analysis, and get feedback;
    - Share the IVC tool with local actors, and use the feedback to customise the instrument;
    - Interview municipal officials using the municipal innovation orientation index (LEDIO) instrument to get the officials' rating of their municipalities' innovation orientation levels;
    - Compile a preliminary list of innovators in preparation for the survey;
    - Identify key innovation infrastructure, and get GPS coordinates, to produce preliminary maps;

In 15 out of the 16 local municipalities, the team physically visited most of the small towns scatted across the selected municipalities, interacting with key stakeholders and innovators. Only Umsobomvu local municipality was not visited during the scoping exercise, and the scoping was completed using google earth as well as telephonic/ email interactions with local actors. This was due to the fact that the team was involved in an accident, which resulted in them being hospitalised before they could complete the visit to the area. While efforts were made to visit as many towns in all municipalities, this was not always possible due to long distances involved, time constraints and road conditions. Google earth and telephonic/ email

exchanges were used to understand the landscapes of the outstanding towns, in preparation for the survey. In most municipalities, the IDP/ LED officials participated in the meetings, and often, the selected LIAT champions in the municipal offices accompanied the researchers to other stakeholders, innovators as well as to get GPS coordinates of key innovation infrastructure.

4. **Preliminary identification of key innovation infrastructure and innovators**: (a) using the participatory Delphi approach (convergence of evidence approach), different local experts/ actors/ stakeholders were interviewed during both the introductory and scoping visits to identify a preliminary list of key innovation infrastructure and innovators in the area until convergence.
5. **Survey of innovators**: using the core IVC mapping instrument (Structured questionnaire for enterprises), a research team of 12 members visited and profiled qualifying enterprises in all the towns in the selected municipalities. Snowballing sampling was used, as no database of innovative enterprises currently exist (which means no sampling frame). The initial database compiled during scoping visits and internet searches guided the teams for the initial appointments and visits. The initial database was augmented during the visits through peer referral - innovators suggested other potential innovators.
6. **Statistical and geospatial analysis**: primary data analysis using descriptive/ micro-econometric and geospatial techniques, producing geo-referenced maps and summaries of the innovation infrastructure, innovators and their interlinkages in a province;
7. **Reflective learning workshops**: workshops involving the key innovation stakeholders & actors were conducted to facilitate conversations, sharing of ideas and co-learning among regional actors on how to stimulate innovation for inclusive development in the area. During the workshops, the results from the mapping exercise were presented to inform the discussions and facilitate the co-production of a vision for innovation in the province.

3 Demographic and socio-economic profile of the selected Karoo districts

3.1 Demographic profile of the selected Karoo districts

This sub-section provides information on the demographic profile of the selected four districts in the Karoo region.

The Central Karoo District

This Central Karoo district is one of the five districts in the Western Cape Province. It is located in the northeast of the province, and it consists of three local municipalities (Laingsburg, Prince Albert and Beaufort West). Figure 3 shows the local municipalities and the main towns located in Central Karoo. The total area of the Central Karoo district is 38 853 km², with a population of 75 064 in 2017. This sparsely populated area covers approximately 30% of the total area of the Western Cape.

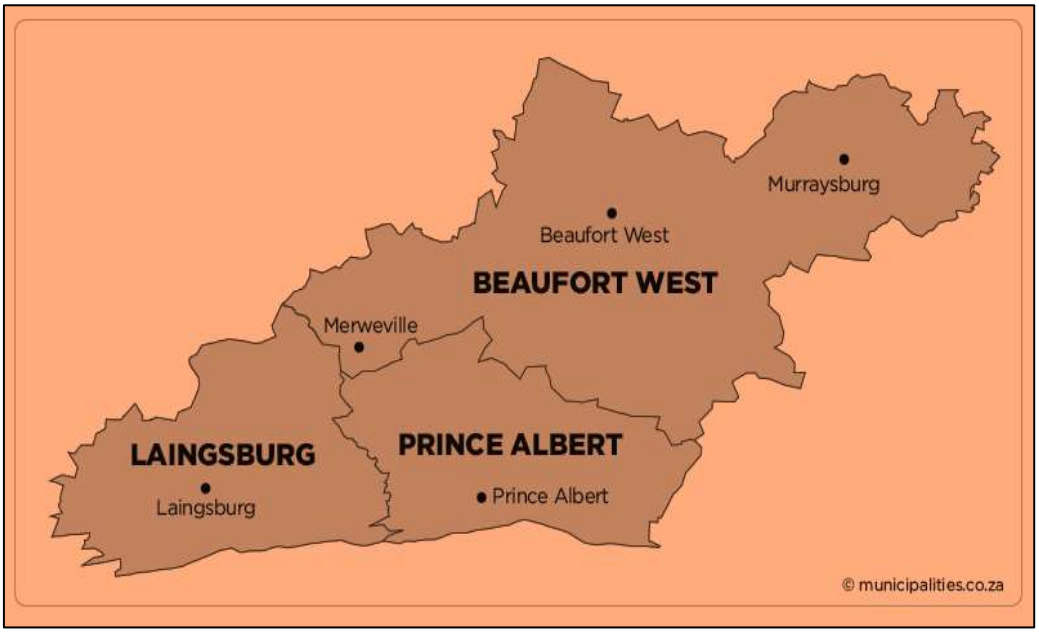


Figure 3. Local municipality and main towns in the Central Karoo District Municipality

The Namakwa District

Namakwa is one of the five districts in the Northern Cape. A category C district, it comprises a land mass of 126 836 km², the largest in the province. Despite its geographic size, the district is the least populated compared to the other four districts in the province. Contained within its boundaries are six local municipalities: Nama Khoi, Khâi-Ma, Richtersveld, Karoo Hoogland, Hantam and Kamiesberg. Figure 4 is a map of the Namakwa district depicting the various municipalities and towns.

Figure 4. Local municipalities and main towns in the Namakwa district

Pixley Ka Seme District

The jurisdiction of the Pixley KaSeme district (as a category C Municipality) covers an area of 103 410km², which is also 27.7% of the total area that constitutes the Northern Cape province. This makes the district the second largest among the five districts in the province, after Namakwa. This district municipal area is the eastern-most district municipality within the Northern Cape, and borders on the Western Cape, Eastern Cape and Free State provinces. The District Municipality comprises of 8 local municipalities, namely Emthanjeni, Kareeberg, Renosterberg, Siyancuma, Siyathemba, Thembelihle, Ubuntu and Umsobomvu, as depicted in Figure 5 below. Five local municipalities were

selected as part of phase 1 research work, and these are: Emthanjeni, Kareeberg, Renosterberg, Ubuntu and Umsobomvu.

Figure 5. Local municipalities and main towns in the Pixley Ka Seme district

Sarah Baartman district

Sarah Baartman is the largest district municipality in the Eastern Cape Province, covering 34% of the geographic area in the province. The municipality is situated on the western part of the province and it consists of seven local municipalities as shown in Figure 6. Two local municipalities (Dr Beyers Naude and Blue Crane Route), which form the core of the Karoo region, were selected for phase 1 of the study.

Figure 6. Local municipalities and main towns in the Sarah Baartman district

Table 4 presents the demographics of the selected district in 2017. Of the four districts, Sarah Baartman had a highest total population, reaching half of million (499 967), followed by Pixley Ka Seme (204 530) and Namakwa (130 660), respectively. The Central Karoo had the least total population of 75 064. The populations are growing at a rate just over 1% in three districts, while there is a decline in the Namakwa population. The table indicates that above 90% of the districts' population reside in urban areas, whereas less than 10% of the districts population reside in rural areas. Household sizes are below 4 members each, and about 40% of these households are headed by females. In general, there are low to moderate dependency ratios (i.e., number of dependent

household members per 100 people in the working age group (15-64 years)) across all the four districts.

Table 4. Demographic characteristics of the selected districts in the Karoo region, 2017

Variable	Central Karoo	Namakwa	Pixley Ka Seme	Sarah Baartman
Population	75 064	130 660	204 530	499 967
Population growth (%)	1.01	-0.07	1.10	1.43
Female (%)	50.7	50.4	50.9	50.4
Male (%)	49.3	49.6	49.1	49.6
Urban population (%)	94	92	92	90
Rural population (%)	6	8	8	10
Pop under 15 years (%)	25	22	26	30
Pop 15 - 64 years (%)	67	68	68	64
Pop over 65 years (%)	7	10	6	6
Dependency ratio	48	47	48	57
Households number	21 980	37 996	56 309	138 182
Average household size	3.4	3.1	3.5	3.5
Female headed households (%)	41	38	37	40

Source: Global Insights, 2017

3.2 Socio-economic indicators and trends of the Karoo Region

Table 5 presents the socio-economic characteristics of the four districts, namely: Namakwa, Central Karoo, Sarah Baartman and Pixley Ka Seme. The table shows that Pixley Ka Seme district had the highest proportion (12%) of the population with no schooling compared to the other three, while Namakwa district had the smallest proportion (4%) of its population with no schooling. Central Karoo had the highest

proportion of matriculants among the four districts, while Namakwa had the highest proportion of those who completed a higher qualification.

Table 5. Socio-economic characteristics of selected districts in the Karoo region, 2017

Variable	Namakwa	Central Karoo	Sarah Baartman	Pixley Ka Seme
Education levels				
No schooling (%)	4	6	5	12
Matric (%)	24	30	25	24
Higher education (%)	8	3	6	5
Key economic indicators				
Unemployment rate (%)	22	26	19	34
Share below poverty (%)	41	45	55	49
Gini coefficient	0.57	0.59	0.61	0.58
Human Development Index (HDI)	0.69	0.69	0.64	0.64
Proportion of gross value added by main economic sectors				
Mining	34	0	0.3	3
Community services	16	27	29	28
Agriculture	13	12	9	16
Trade	12	14	23	12
Finance	10	14	14	14
Transport	9	15	8	14
Construction	3	6	8	4
Manufacturing	2	5	8	3
Electricity	1	7	2	6

Source: Global Insights, 2017

The Pixley district had the highest levels of unemployment rate (34%) among the four districts, followed by Central Karoo (26%), with both districts experiencing unemployment levels higher than the country average. Sarah Baartman had the lowest unemployment level, at 19%. However, despite a relatively lower unemployment rate compared to the other selected districts, Sarah Baartman had the highest (55%) level of poverty (using the upper bound poverty line), and also inequality (Gini coefficient = 0.61). This suggests that a number of employed people in Sarah Baartman are not earning enough to escape the scourge of poverty, implying that dealing with poverty in these districts should move

beyond the quantity of jobs, but also quality (in terms of earnings). Overall, the selected districts are all characterized by high levels of poverty, with almost two thirds of the population experiencing deprivation.

Community services, agriculture, trade, finance and transport were among the main economic sectors that contributed much to the gross value added (GVA) of the selected districts. The mining sector contribute over a third of 34% to the gross value added of the Namakwa district, while community service sector contributed the most to the gross value added of the three district. While agriculture is the second largest contributor to the local economy of Pixley, it is the trade sector in Sarah Baartman, the transport sector in Central Karoo and community services in Namakwa (the only district among the four where community services is not the largest contributor). Electricity and mining sectors are among the least contributing sectors, with a small proportions of contribution to the GVA, with the exception of mining in Namakwa. Even though renewable energy is expected to play a significant role in the upcoming years due to number of solar and wind farms established in the Karoo region, it currently does not yet contribute significantly to the local economies of the selected districts.

Figure 7 shows a decline in the contribution of agriculture to formal employment in all districts, and growth in formal employment in the community services and trade sectors. For example, while formal employment of agricultural sector was 44% on average for the four districts in 2000, it was only 21% on average in 2017. This shows that the sector has declined by more than half percentage points between 2000 and 2017. These results suggest that while agriculture remains important in the sector, there is need for prioritisation of other sectors whose contribution is rising in these districts.

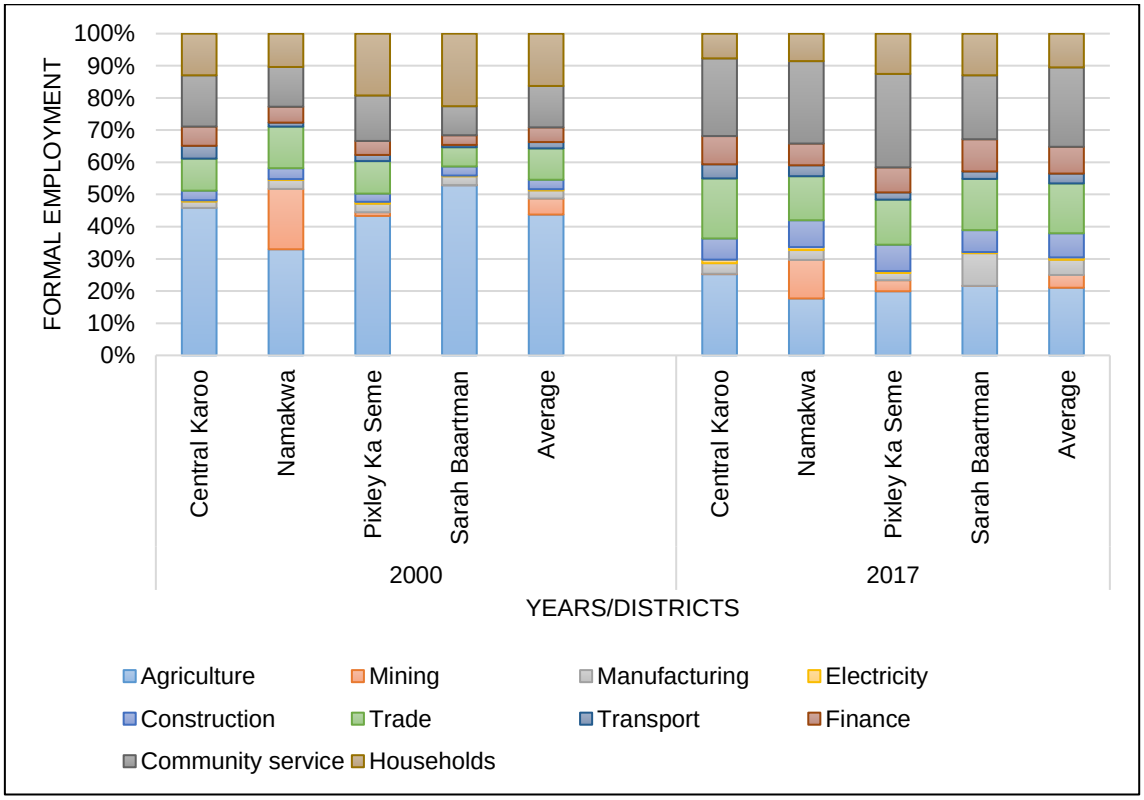


Figure 7. Trends in formal employment by sectors in the selected districts, 2000 - 2017

Figure 8 shows that the trade sector dominated informal employment over the years (2000 and 2017). For instance, between 2000 and 2017, the trade sector contributed more than 40% of the informal employment on average for the four districts. However, the contribution of the trade sector to informal employment declined from 2000 to 2017, with an average of 7%. In Pixley Ka Seme district, the contribution of the trade sector to informal employment deteriorated by 12% points between 2000 and 2017.

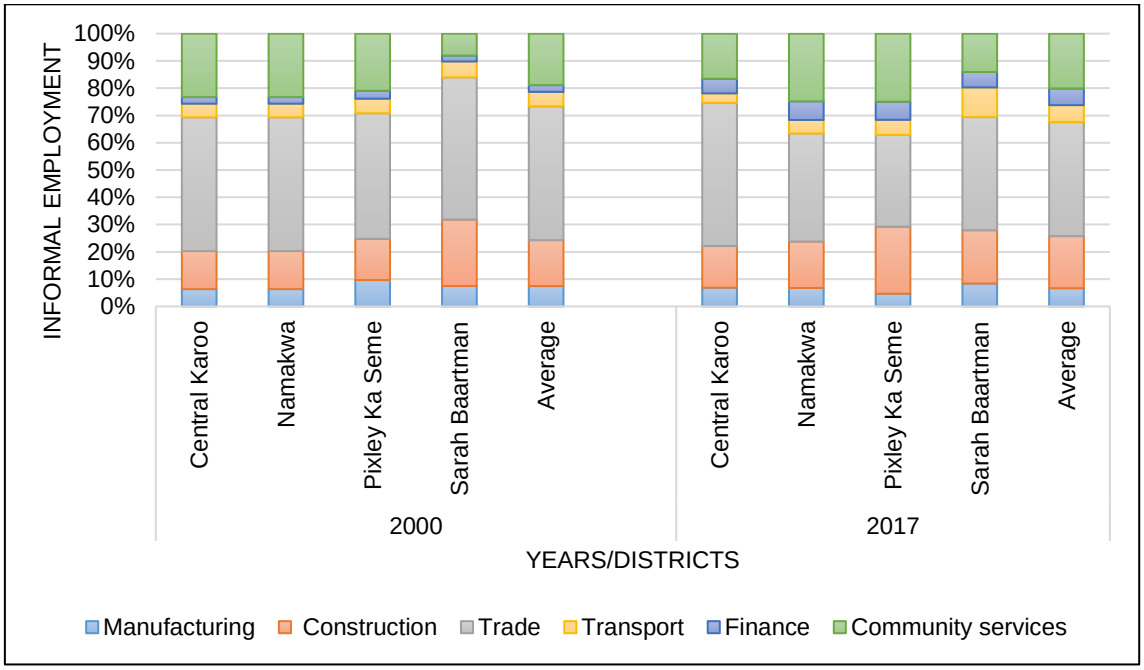


Figure 8. Trends in informal employment by sectors in the selected districts, 2000 – 2017

Figure 9 shows that the community services, trade, finance and transport sectors were among the main economic sectors that contributed much to the gross value added (GVA) of all the four districts between 2000 and 2017. Electricity and constructions sectors are among the least contributors to the local economy, with average small proportions of below 4% contributions.

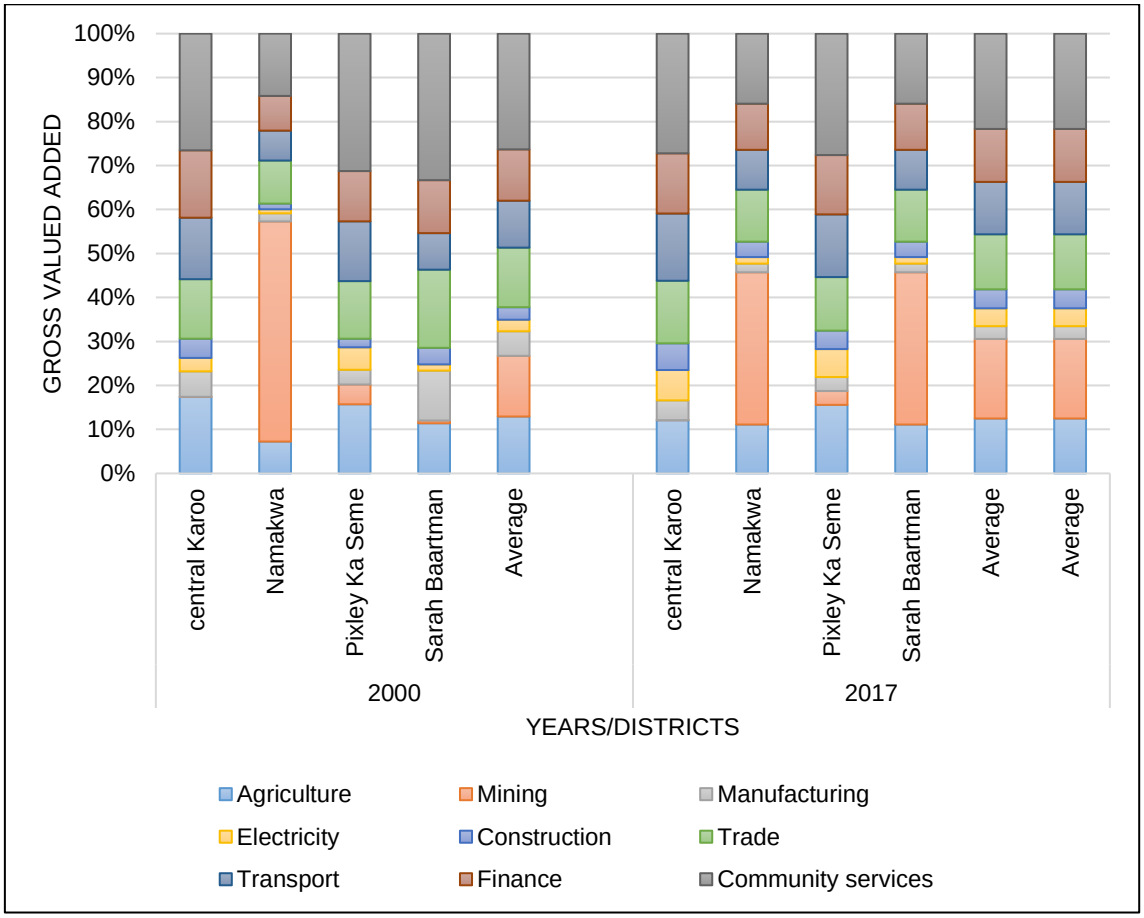


Figure 9. Trends in gross valued added by main economic sectors, 2000 – 2017

4 Availability of innovation infrastructure

Innovation infrastructure includes both the basic infrastructure (such as roads, energy, water, schools, etc.) and innovation networks (such as smart grids, broadband and wireless networks) which the innovation actors need to flourish. Secondary data from different sources were utilised to generate the infrastructure maps. Roads data was from

the Department of Transport (DoT), while other data on schools were from the Department of Basic Education (DBE). Libraries data was acquired from the National Libraries of South Africa (NLSA). The Department of Rural Development and Land Reform in Northern Cape (DRDLR-NC) provided data on beverage boiling points, abattoirs, agricultural industries and tourism attractions.

4.1 Innovation infrastructure availability in the Namakwa district

Figure 10 and 11 show spatial distribution of innovation infrastructure in the Namakwa district in the Northern Cape. Figure 10 shows that most of the infrastructure is located in the northwestern part of the district, clustered around Springbok, the district capital. The figure shows that the main roads are the N7 (which connects Springbok (the district capital) with Cape Town), and the N14, which connects Springbok with Upington. While the figure presents what appears as a good network of roads connecting the main towns in the district, most of these regional roads are gravel roads, which are very difficult to drive on, particularly using low ground clearance vehicles. For example, it is not easy to drive from Calvinia (in the Hantam local municipality) to Sutherland (in the Karoo Hoogland local municipality), as the alternative routes include long portions of gravel and rocky roads.

The Namakwa District only has only one TVET college based in O'Kiep in the Nama Khoi local municipality, and has no universities, science related councils/ institutions. Figure 10 shows that the Namakwa district had in total 72 public schools, which are located mainly in areas around Springbok. There are not many schools in Hantam and Karoo Hoogland local municipalities.

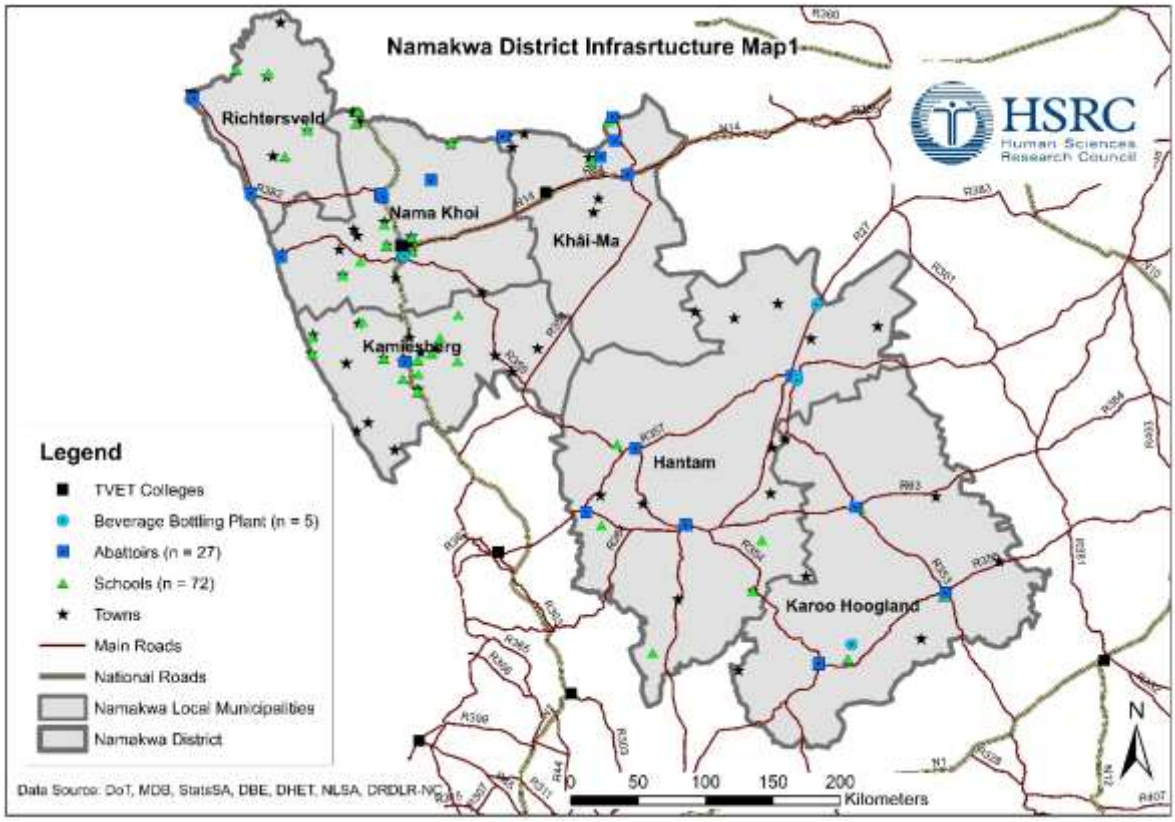


Figure 10. Innovation infrastructure of the Namakwa district- Map 1

Figure 11 shows that Namakwa had a total of 36 libraries, most of which were located within Kamiesberg (10 libraries) and Nama Khoi (7 libraries). Both Hantam and Richtersveld have six libraries each, followed by Khai Ma and Karoo Hoogland with four and three libraries respectively. Libraries play a crucial role in the lives of communities as centres and sources of information, knowledge, history, science and research. As observed during the scoping exercise, achieving the latter activities is however a challenge in almost all of these libraries. Most of them have very old books, often the books are not related recent science. Some of the libraries are without computers, and those with computers have few of these assets. Some of the libraries do not have access

to internet, a challenge that impedes the locals, particularly learners from conducting research. Of all libraries, the team was able to identify about two well equipped libraries (one in Nababeep and one in Springbok) with enough computers, recent books (including science related books) and reliable internet connectivity.

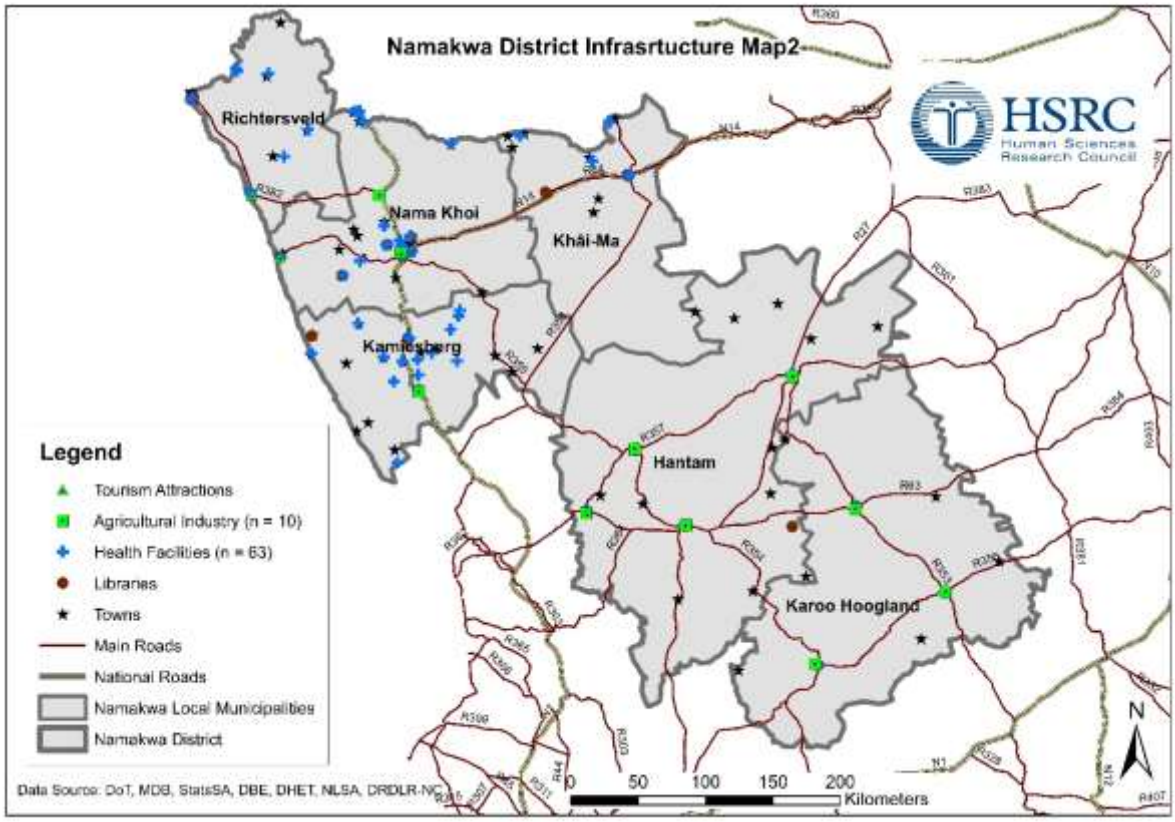


Figure 11. Innovation infrastructure of the Namakwa district- Map 2

Access to ICT infrastructure is a challenge for many in the Namakwa district. Due to the low population and the cost to be incurred in erecting cell phone and data towers, network providers lack incentives to embark in investments to improve network coverage. In the

Kamiesberg local municipality, towns such as Kammasies, Rooifontein, Paulshoek and Soebasfontein are experiencing regular internet and ICT related problems as a result of poor or no telephone reception. Similar to the situation observed in the Kamiesberg municipality, the telecommunication networks in Nama Khoi is insufficient as in some areas in the municipality have very poor cell phone reception and no internet. This not only creates limitations for communication, but it also hampers opportunities for people to access (on the internet) other parts of the region, country and the world and the possible learning, recreation and work opportunities related to this

The Karoo Hoogland local municipality is home to huge innovation projects in the area, such as the Karoo Array Telescope (MeerKAT) project involved the construction of a world-class radio telescope, and the Southern Africa Largest Telescope (SALT), which has become an international known astronomy destination. There is also Suurplaat Wind Energy facility 50 km south east of Sutherland and 41 km north of the N1 national road. The Roggerveld Wind farm development is also proposed in the Roggerveld Mountain, This has seen Sutherland develop into a research and tourists destination leading to extensive tourism investment. Tourists around the world also come to tourist sites such as the Sutherland Planetarium and Sterland.

4.2 Innovation infrastructure availability in the Pixley ka Seme district

Figure 12 and 13 show the innovation infrastructure for the Pixley Ka Seme district. It worth noting that the number of agricultural industries is two times larger than those of Namakwa district. There are also logistic hub and wind power plant in this district. De Aar is the district capital, and the economic hub of the district. As such, better internet connectivity, cell phone, telephone, internet and data card facilities for the than other towns in the district. Furthermore, the only TVET college in the district is situated in De

Aar. It renders an important educational service to the Emthanjeni community and surrounding towns. The other small towns struggle with access to key infrastructure such as roads, ICT, and even schools. Renosterberg has the least innovation infrastructure in all the five local municipalities that were profiled in the Pixley district. For example, the high school computer labs is filled with mainly old and obsolete computers. The library, like the many in the district, is stocked with outdated or material.

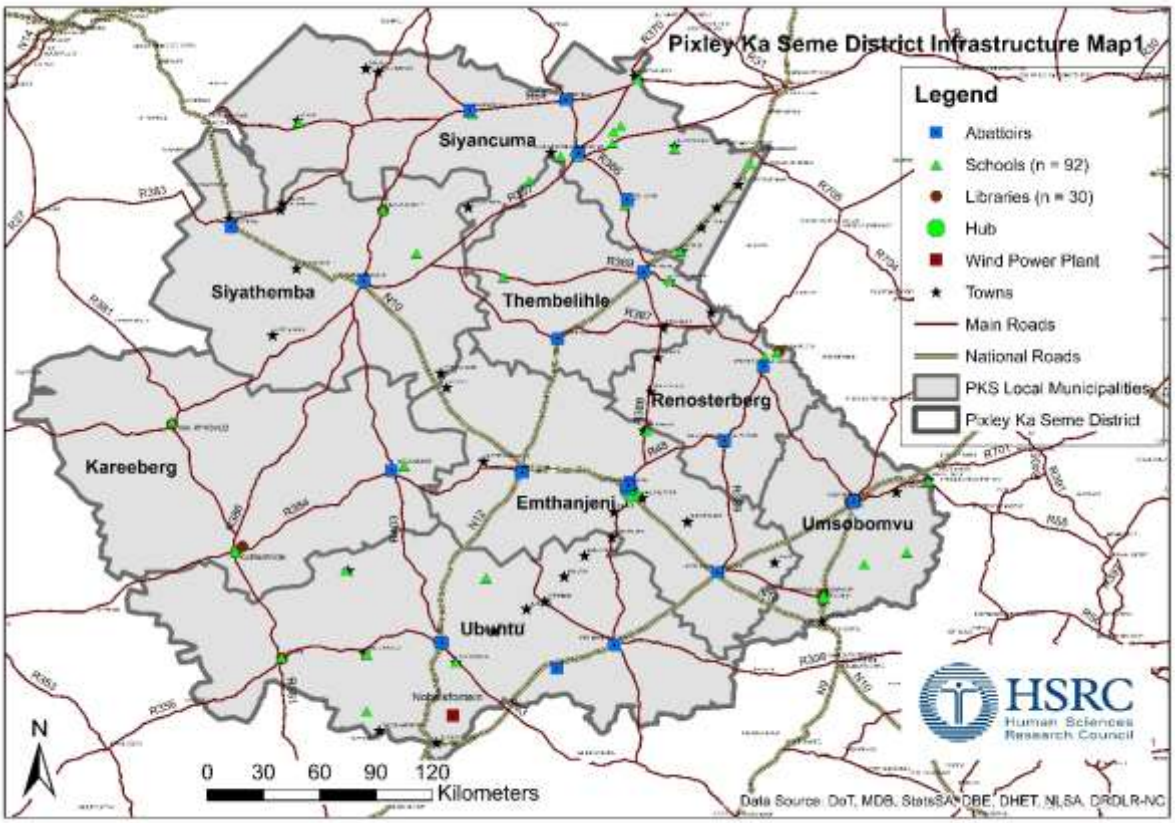


Figure 12. Innovation infrastructure of the Pixley Ka Seme district- Map 1

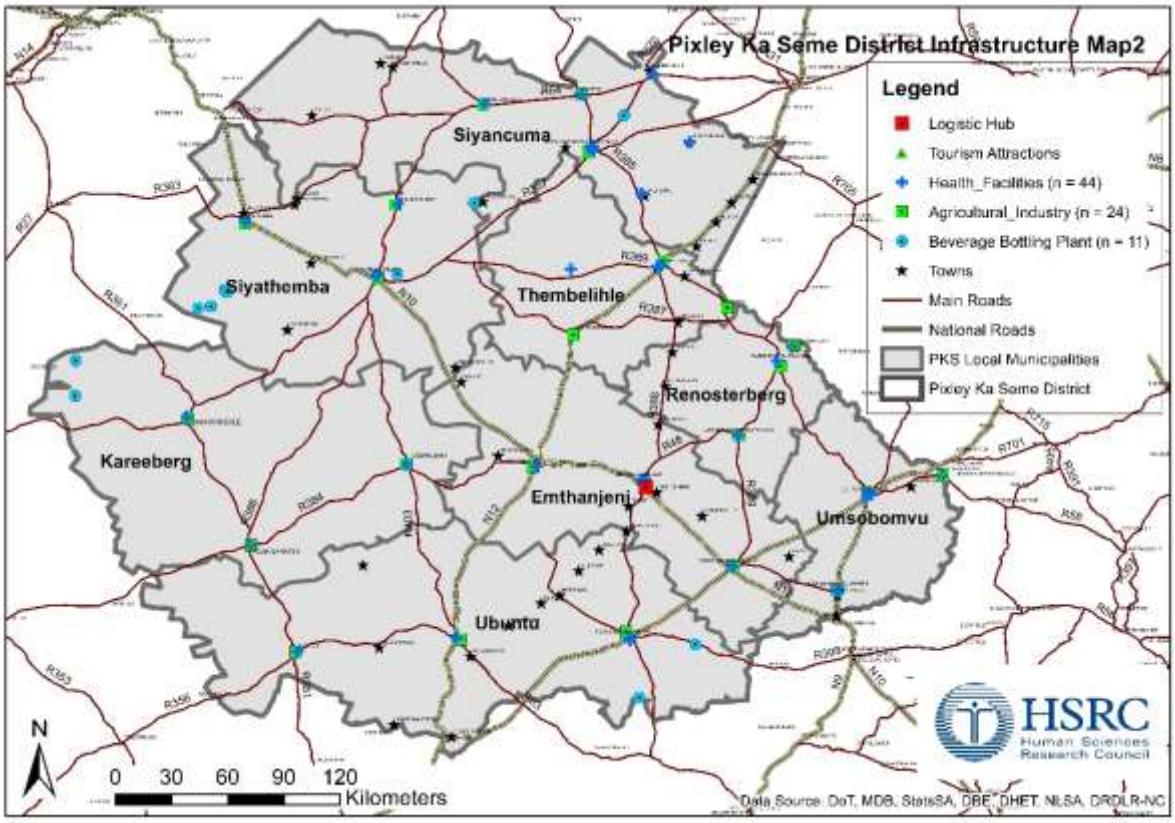


Figure 13. Innovation infrastructure of the Pixley Ka Seme district- Map 2

4.3 Innovation infrastructure availability in the Central Karoo district

Figures 14 and 15 shows the geographical distribution of innovation infrastructure in Central Karoo district in the Western Cape. The road infrastructure in is relatively good in the Central Karoo. However, many artillery roads require upgrading and others require construction especially in and near the indigent areas of the municipalities. Access to farms is on gravel roads that stretch for kilometres on end. Many of the smaller towns

have poor to non-existent road infrastructure and are located in far distances from the Beaufort West, the district capital and hub.

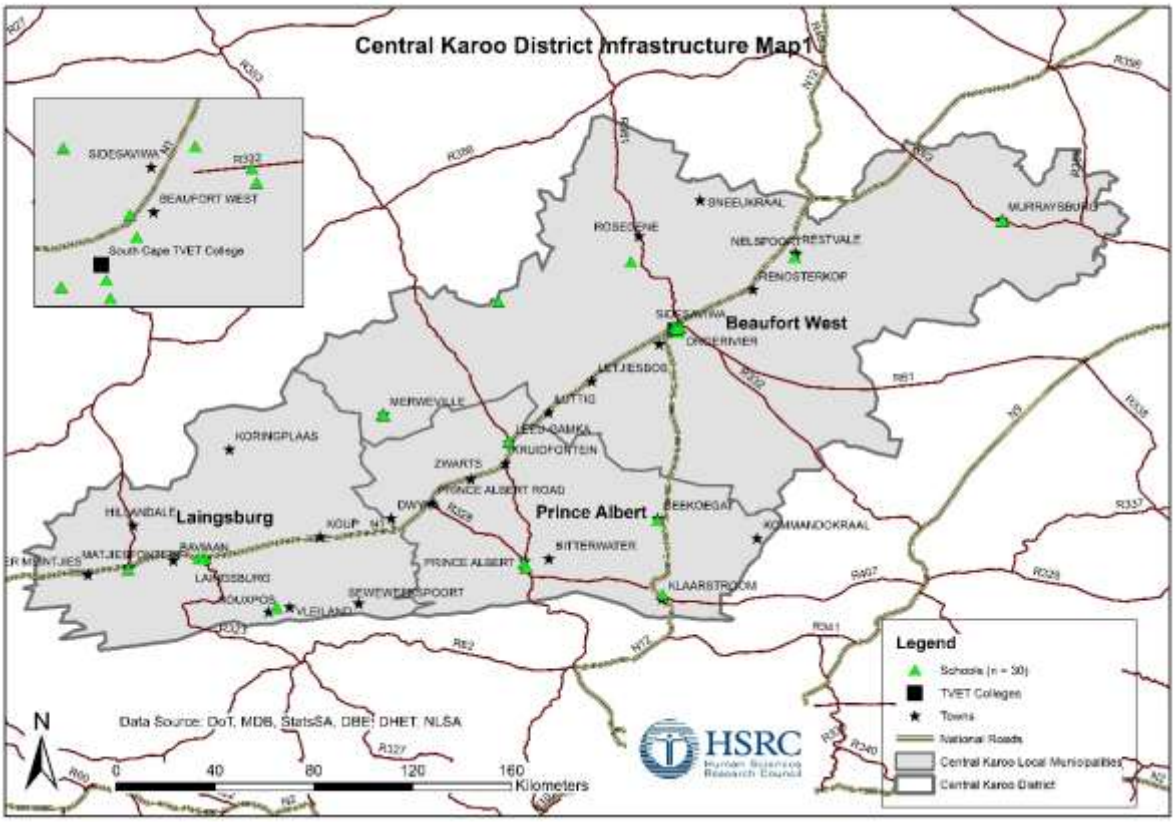


Figure 14. Innovation infrastructure of the Central Karoo district- Map 1

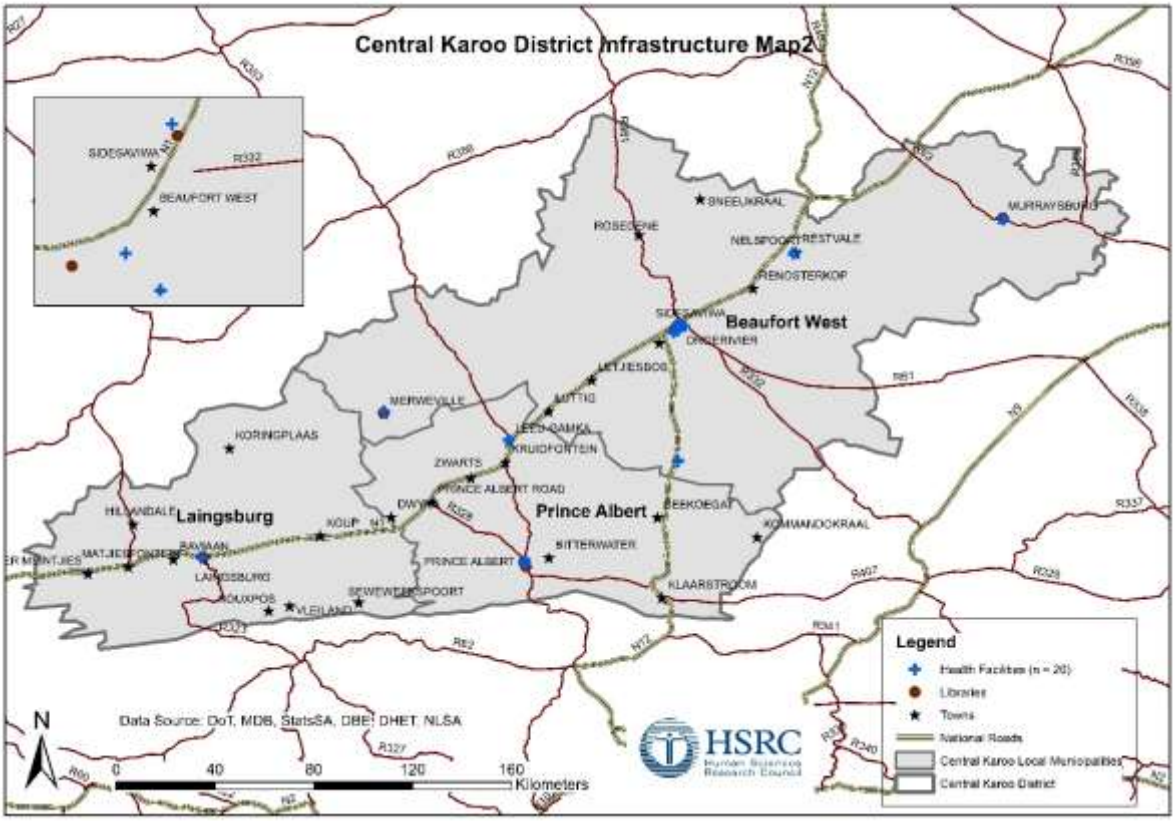


Figure 15. Innovation infrastructure of the Central Karoo district- Map 2

4.4 Innovation infrastructure availability in the Sarah Baartman district

Figures 16 and 17 show the geographical distribution of innovation infrastructure in Sarah Baartman district in the Eastern Cape. The majority (82%) of the road network in the district are gravel roads. While the railway is considered a backbone of economy of the small towns in the district, the railway infrastructure is in a state of dilapidation, partly

because of neglect. The district's head offices are located in Port Elizabeth, in the Nelson Mandela Bay Metropolitan. Added to the public libraries in the metro, there is also a number of higher institutions of higher learning, such as the Nelson Mandela University, Varsity College, Port Elizabeth College, etc. However, the two local municipalities that were profiled (Beyers Naude & Blue Crane Route local municipalities) do not have access to a lot of this infrastructure.

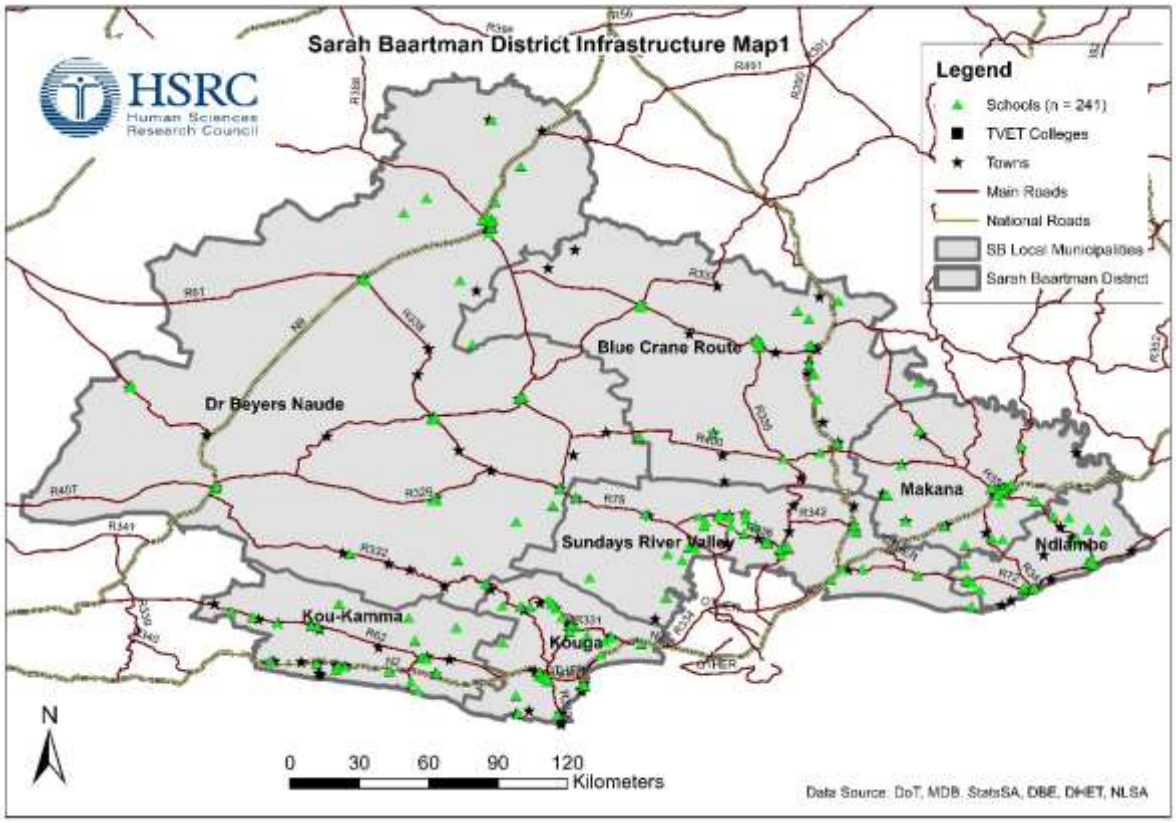


Figure 16. Innovation infrastructure of the Sarah Baartman district- Map 1

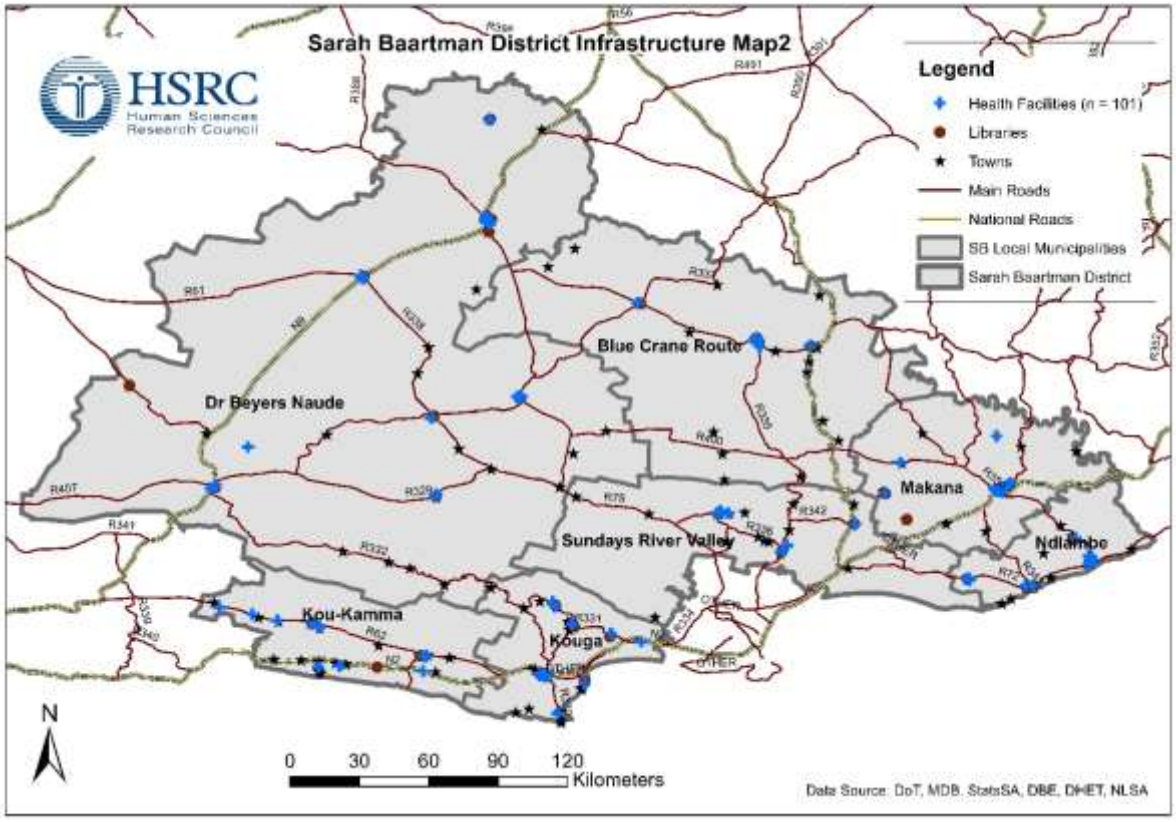


Figure 17. Innovation infrastructure of the Sarah Baartman district- Map 2

In summary, the four districts have moderate access to basic infrastructure such as roads. While there are major roads in good condition that cut through all these districts, most of the regional roads are gravel roads, which are difficult to drive on using low ground clearance vehicles. Internet connectivity is limited in most of the small towns, with stronger networks only found in major towns, often the district capitals and economic hubs. While there are many schools across the four districts, there are not many institutions of higher education in these districts. For example, most of the district have about one TVET college, and none of them has a university institution (NMU is technically located in Nelson Mandela Bay Metro). Despite big sciences projects located in some of

these areas (e.g., SKA, Observatory, etc.), these seem to islands of science excellence, which have not led to noticeable growth in the appetite for science in the region. The schools have limited computer infrastructure, and the books found in libraries are old and mostly unsuitable to shape and prepare the minds of the schoolchildren to a future of big science and rapid technological changes.

5 Innovation orientation results

This section presents the analysis results reflecting the innovation orientation levels of the selected local and district municipalities based on the analysis of strategic documents and LEDIO. Using the weighting approach described in the research methods section, the orientation levels of municipalities were re-calculated and presented together with the original document and LEDIO scores for comparisons purposes.

5.1 Innovation orientation level of the Central Karoo district

Table 6 indicates the innovation orientation level the Central Karoo district municipality and its local municipalities. The analysis of strategic documents, and the LEDIO scores, indicated that the Central Karoo DM along with two of its local municipalities, Laingsburg and Prince Albert, are at innovation orientation level 2, which means that innovation is prioritised and officials seek to optimise and make use of innovation in implementing service delivery solutions.

Table 6. Innovation orientation (IO) levels, Central Karoo district

Municipality	IO level, document analysis	IO level, LEDIO results	IO level, weighted average
Laingsburg LM	2	2	2
Prince Albert LM	2	2	2
Beaufort West LM	0	1	0.6
Central Karoo DM[a]	2	-	-
Central Karoo DM[b]	2	2	2

Notes: [a] is the score from the district's strategic documents; [b] is the weighted average

However, the appraisal of Beaufort West documents indicated that the Beaufort West LM is at level 0 of innovation orientation, which implies that there is limited awareness of innovation and its potential role in internal and external municipal operations in Beaufort West municipality. The interviews of municipal officials using the LEDIO instrument indicated that the municipal is at level 1, which indicates an improvement to a level where innovation is acknowledged, even though there is limited allocation for resources to stimulate innovation. That the Beaufort West local municipality scored the lowest (in terms of document analysis, LEDIO and the weighted average) is contrary to expectation, given that it is the economic hub of the district and hosts the biggest town in the district (i.e., Beaufort West).

Figure 18 presents the scores of the individual items of the LEDIO for the three local municipalities in the Central Karoo district. The figure show that the interviewed officials of all the municipalities in the Central Karoo felt that the municipalities are focused in achieving success in service delivery. Similarly, the municipalities scored high on external and internal collaboration to increase innovative efforts, and enabling procedures. However, the officials felt that there were limited incentives for staff to be innovative, as this item scored the lowest for all the municipalities. There is also limited

allocation of financial resources for innovation, with the exception of Laingsburg that has scored a high of 2.5 on this item.

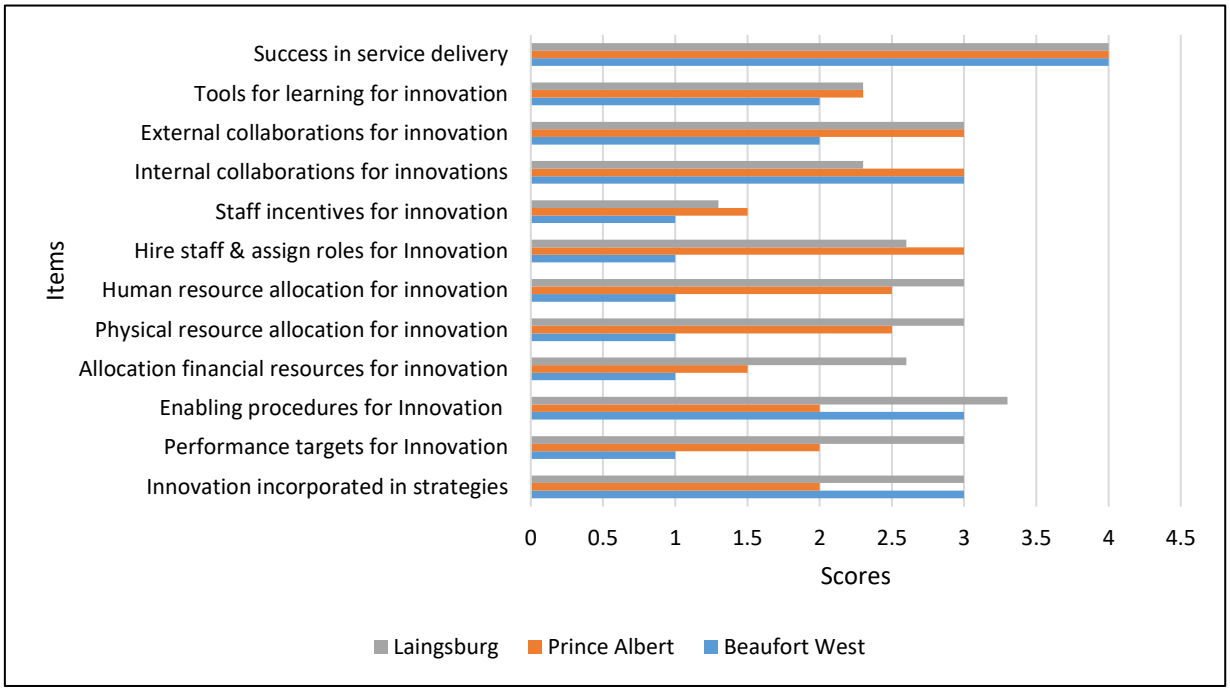


Figure 18. Average scores per LEDIO item for municipalities in the Central Karoo district

Overall, Figure 18 shows that the Beaufort West local municipality scored the lowest in most of the items, indicating limited orientation towards of the municipality, even though it had good scores for collaboration, enabling procedures and had incorporated an innovation focus on its strategies. That the officials felt that Beaufort West incorporates innovation in their municipal strategies (an average of 2.7), is contrary to the results of the assessment of the key strategic documents. This suggests that, while the officials feel that there is focus on innovation in the strategies, this focus has not yet been translated into and entrenched in the strategic documents.

5.2 Innovation orientation level of the Pixley ka Seme district

The results of the assessment of key municipal documents and interviews with municipal officials in the selected five municipalities (5 out of 8 local municipalities, the three outstanding will be analysed during phase 2 of the project), are presented in Table 7. The table indicates variations in the scores generated by document analysis and the LEDIO instruments for three municipalities. In all these cases, the LEDIO scores were higher than the document analysis, indicating that the interviewed officials felt that the municipalities are inclined towards innovation than is captured in the strategic documents. The officials of these municipalities took the opportunity to inform the research team of projects that were either in the planning stage or implemented that were not yet reflected in their documents.

Table 7. Innovation orientation (IO) levels, Pixley ka Seme district

Municipality	IO level, document analysis	IO level, LEDIO results	IO level, weighted average
Kareeberg LM	1	1	1
Ubuntu LM	0	1	0.6
Emthanjeni LM	2	2	2
Renosterberg LM	0	1	0.6
Umsobomvu LM	0	2	1.2
Pixley ka Seme DM[a]	1	-	-
Pixley ka Seme DM[b]	1	1	1

Notes: [a] is the score from the district's strategic documents; [b] is the weighted average

The results in Table 7 shows that the Emthanjeni local municipality, the economic hub of the Pixley ka Seme district, which hosts the major town (De Aar) considered to be more

industrialised compared to all others in this district, was at a higher innovation orientation level (level 2) than all the others. The Emthanjeni municipality's strategic documents indicated evidence that innovation is prioritised in resource allocation, although it is not yet entrenched in both internal and external processes. This was confirmed by the officials, who confirmed the municipality's level 2 of innovation orientation. The weighted scores show that the Pixley district, together with Umsobomvu and Kareeberg local municipality (where the SKA is located) are at level 1, which indicates awareness and acknowledgement of the importance of innovation, however, without prioritisation of innovation in resource allocation. There was a significant difference between the scores from document analysis and LEDIO for Umsobomvu, indicating that the officials feel that the documents are lagging behind in terms of capturing the appetite and inclination towards innovation in the municipality. According to the senior LED manager of Umsobomvu, the documents do not indicate the innovative initiatives being undertaken by the municipality especially in the town of Colesberg.

Two local municipalities (Ubuntu and Renosterberg LMs) were ranked at a weighted average of 0.6, which indicates that while there is some level of innovation awareness, the municipalities have not yet reached a stage where the importance of innovation is understood and acknowledged. Table 7 reflects Pixley ka Seme DM and its LM LEDIO scores. The Senior LED Manger in Umsobomvu placed the municipality at level 2, he was of the view that the municipality's document unfortunately did not

Figure 19 presents the individual item scores for the five local municipalities in Pixley. The figure shows that the Emthanjeni and Umsobomvu local municipalities scored the highest for most of items, particularly in terms of allocation of physical and financial resources and hiring staff and assigning roles for innovation purposes. Overall, issues of staff incentives and performance targets scored less, despite some exception (e.g.,

Umsobomvu scored high on staff incentives for innovation). This implies that the municipalities do not have incentives or enabling tools to promote innovation among the officials.

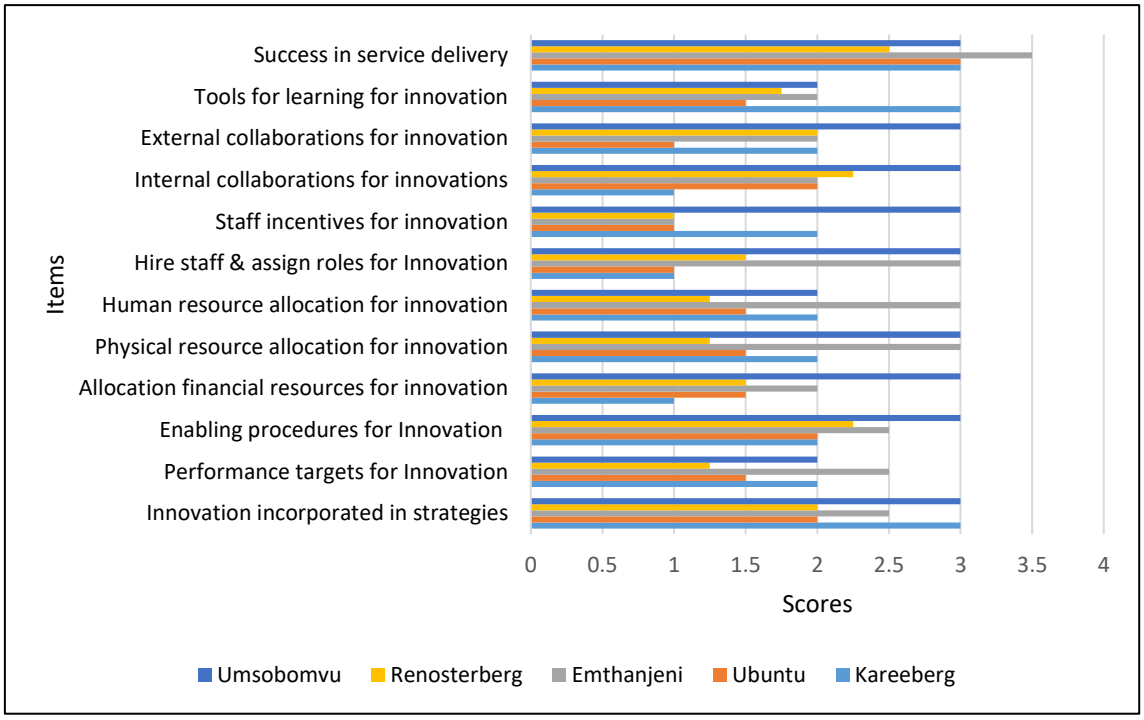


Figure 19. Average scores per LEDIO item for the selected municipalities in the Pixley ka Seme district

5.3 Innovation orientation level of the Namakwa district

Table 8 presents the innovation orientation levels of the Namakwa district and its local municipalities. Like in the case of the Pixley district above, Table 8 indicates

discrepancies in the scores produced through document analysis and the LEDIO instruments for most of the municipalities. In some cases, the document analysis produced higher scores than LEDIO (e.g., Khai Ma and Nama Khoi), whereas in some (e.g., Richtersveld and Karoo Hoogland), the LEDIO scores were higher than the document analysis scores.

The rating based on an analysis of key municipal documents in the Namakwa district indicated that all the municipalities, except Khai Ma LM which was ranked at level 2, were at level 1, indicating that there is evidence of awareness of innovation in these municipalities' documents, and that the innovation is considered important. However, there is little or no prioritisation of innovation when resources are allocated in these municipalities. The analysis of the Khai Ma LM strategic documents indicated that the municipality exhibited innovation prioritisation. The evidence showed that the municipality shows has keen interest in innovation, and identified potential stakeholders to collaborate with in innovation activities for the betterment of the community.

Table 8. Innovation orientation levels, Namakwa district

Municipality	IO level, document analysis	IO level, LEDIO results	IO level, weighted average
Richtersveld LM	1	3	2.2
Hantam LM	1	1	1
Karoo Hoogland LM	1	2	1.6
Khai Ma LM	2	0	0.8
Nama Khoi LM	1	0	0.4
Kamiesberg LM	1	1	1
Namakwa DM[a]	1		-
Namakwa DM[b]	1	1	1

Notes: [a] is the score from the district's strategic documents; [b] is the weighted average

The LEDIO score were a huge source of variation, as municipal officials from different municipalities felt differently, often highlighting that the results of the document analysis were not indicative of the current levels of innovation orientation. The weighted average scores shows that Richtersveld LM was the most oriented towards innovation in the district, while Nama Khoi LM was the least inclined towards innovation. Just like in the Central Karoo district case, where the district hub had the lowest score, it was unexpected that Nama Khoi is the least oriented towards innovation, since that is where Springbok, the district capital and economic hub is located. These results suggests that it is not always the case that the more urbanised economic hubs would be the most innovation oriented.

Figure 20 depicts the LEDIO scores per item for the municipalities in the Namakwa district. The results show varying strengths among the municipalities, with some scoring high on many items (e.g., Richtersveld and Karoo Hoogland), while others score highest in some few items. For example, municipalities such as Hantam achieved high scores in aspects such as tools for learning, allocating financial resources as well as having procedures that enable innovation. However, despite these important enablers of innovation, Hantam for example, scored very low in the aspect of hiring relevant staff and giving incentives for innovation performance. In summary, Nama Khoi scored lowest in most of the key items, with the exception of scoring high on the incorporation of innovation in its strategies. This suggest that there is long way in cultivating an innovation culture in municipalities such as Nama Khoi, however, that innovation has been incorporated in the municipality's strategies is a good start.

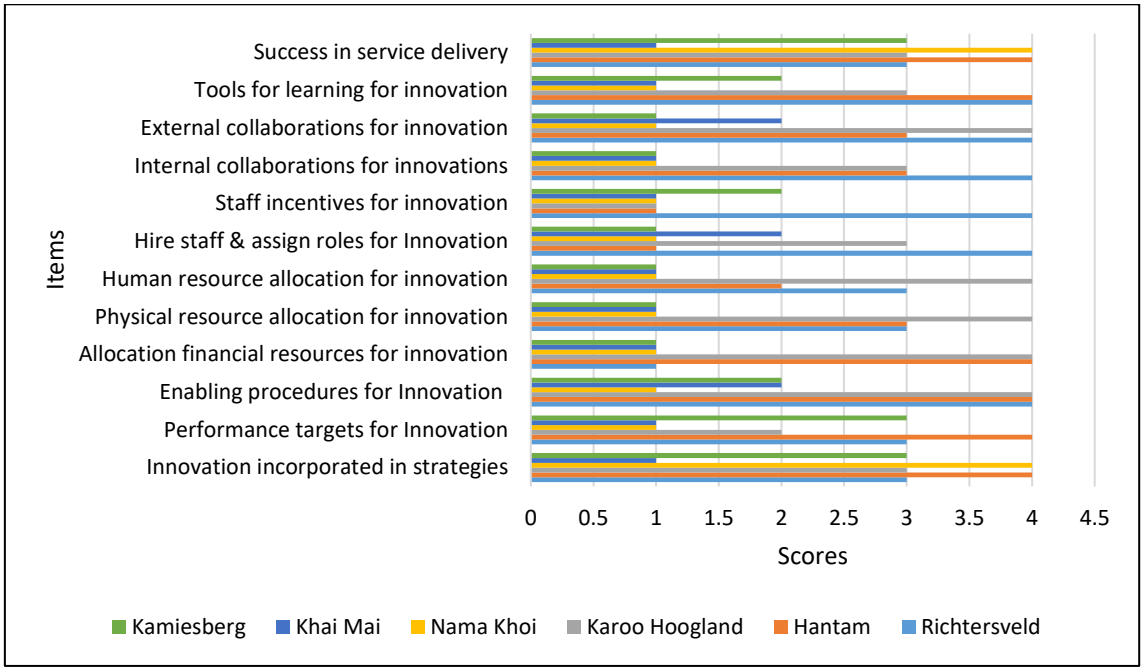


Figure 20. Average scores per LEDIO item for the municipalities in the Namakwa district

5.4 Innovation orientation level of the Sarah Baartman district

The Sarah Baartman district's content analysis and LEDIO results are presented in Table 9. The STI-content analysis results for Sarah Baartman district ranked the district at Level 2 (innovation prioritisation), meaning that the municipality understand the importance of taking up innovative initiatives to improve the standards and service delivery of the municipality, and accordingly allocates resources accordingly. However, the weighted average of document analysis lowers the municipality to level 1, which suggests that the

municipalities in the district are not yet at the district level. Overall, the LEDIO scores were all at the same level for the two municipalities.

Table 9. Innovation orientation levels, Sarah Baartman

Municipality	IO level, document analysis	IO level, LEDIO results	IO level, weighted average
Dr Beyers Naude LM	1	1	1
Blue Crane LM	0	1	0.4
Sarah Baartman DM[a]	2	-	-
Sarah Baartman DM[b]	1	1	1

Notes: [a] is the score from the district's strategic documents; [b] is the weighted average

Figure 21 presents data from the 2 local municiplaities surveyed in the Sarah Baartman DM. The Blue Crane Route LM scored higher than Dr Beyers Naude LM in areas such as tools for innovation, performance targets and incorporating innovation in the municipal strategies. In contrast, Dr Beyers scored higher in internal collaborations for innovation, hiring and assigning staff and allocating physical resources for innovation.

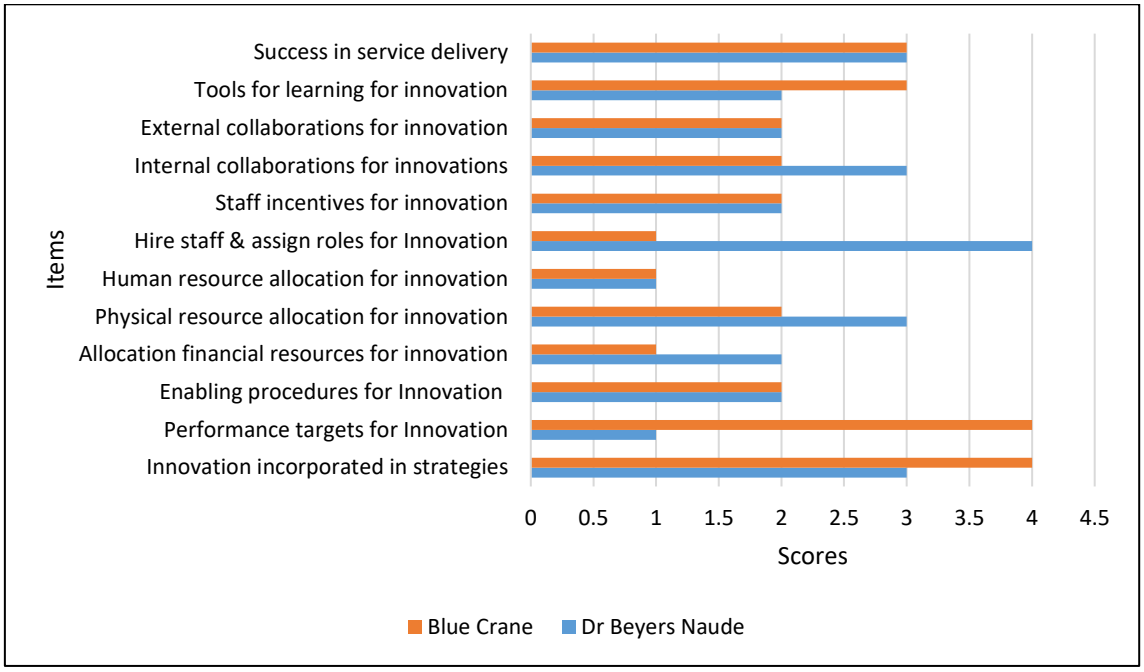


Figure 21. Average scores per LEDIO item for the municipalities in the Sarah Baartman district

5.5 Inter-district comparisons of innovation orientation levels

Table 10 presents the orientation levels of the four districts as per the document analysis of the district, weighted content analysis scores of the districts and the respective local municipalities, and weighted LEDIO scores.

Table 10. Weighted innovation orientation (OI) levels for selected districts

District Municipality	OI, district office document analysis only	OI, weighted average	LEDIO weighted score	Overall score
Central Karoo	2	2	2	2
Pixley ka Seme	1	1	1	1
Namakwa	1	1	1	1
Sarah Baartman	2	1	2	1.6

The table shows that weighting did not change the document based overall scores for three out of the four districts. Only Sarah Baartman received a lower score than when only its strategic documents, which implies that the local municipalities are lagging behind the district municipal office in terms of the strategic orientation towards innovation. The Central Karoo received a LEDIO score that similar to the document analysis score, while Sarah Baartman received a LEDIO score greater than the weighted document analysis score, but similar to the unweighted score.

Table 10 shows that, in terms of the weighted document analysis score, the Central Karoo district received the highest score, at level 2. However, when based on the LEDIO scores, Sarah Baartman also received the highest score, also at level 2, at par with the Central Karoo. The overall score shows that the Central Karoo district is the most oriented towards innovation with an overall score of 2. Figure 22 presents selected items

from the results of the LEDIO to further assess which district municipalities are creating an innovative enabling environment.

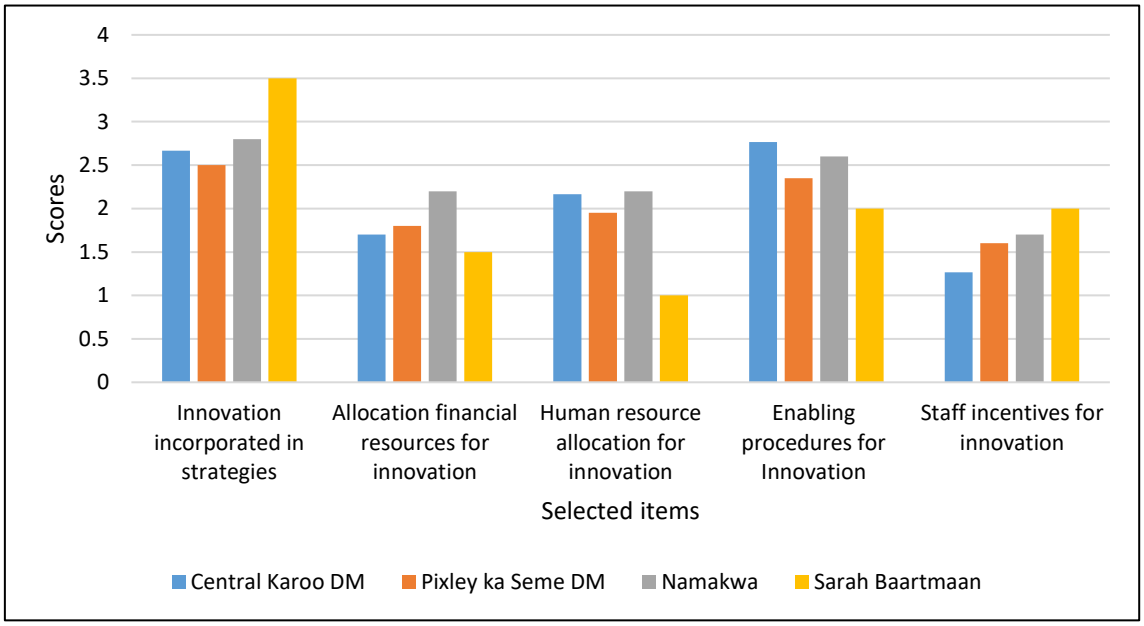


Figure 22. LEDIO scores per selected item for district municipalities

Figure 22 reflects that staff incentives, human resource and financial allocation towards innovation are low compared to the moderately higher scores that the officials gave to the municipalities incorporating innovation into their strategies and the rules, regulations and procedures that enable the introduction of innovation. It appears that the consensus from officials in these districts is that resources for innovation are inadequate, but innovation initiatives are taken up albeit at a low level and officials understand that innovation can accelerate the results of their plans and projects to deliver services in their respective municipalities.

6 Enterprise survey results

6.1 Distribution and profile of the innovative enterprises

Table 11 shows the number of enterprises that were identified in the four districts (based on local actor and peer referrals, and those who were visited (based on the initial screening of the enterprises in the databases obtained). Table 11 shows that most of enterprises in the database were from Namakwa, followed by Pixley, while Central Karoo had the least number of enterprises in the database. This data should not be interpreted to indicate the level of economic activities in these different district, as this was solely based on how many enterprises were identified by local actors and peers in each district. Table 11 also shows the enterprises that qualified to be regarded innovative, and were profiled using the Innovation Value Chain (IVC) instrument.

Table 11. Enterprises visited and profiled per district municipality in the Karoo region

District	All enterprises	Visited	Met second criteria	Profiled
Namakwa	737	175	109	57
Pixley ka Seme	174	174	104	57
Central Karoo	52	41	33	25
Sarah Baartman	74	46	34	29
Total	**1,038**	**436**	**280 (64%)**	**168 (60%)**

Table 11 indicates that of the 1,038 enterprises, 436 enterprises (42%) met the initial screening criteria to be considered potential innovators. A team of researchers visited the 436 potential innovators, and 64% of them (279 enterprises) met further screening criteria, and were thus considered innovators. This indicates that the initial screening based on the views of local actors and other innovators was largely successful, since the majority of those they considered innovative were found to be indeed innovative as per

the criteria applied in this study. Overall, the 279 innovative enterprises represented 27% of the 1038 enterprises in our database. These survey results indicates that there is a relatively moderate level of innovation activity occurring in the Karoo region. Of the total 279 innovators, 60% were interviewed, whilst the remainder did not complete the IVC for various reasons such as lack of interest in the survey, informative person being absent, difficulties setting up appointments, etc.

Of the four districts, Namakwa and Pixley ka Seme districts had the most number of visited enterprises (175 and 174 respectively), enterprises that met the criteria to be considered for interviews (109 and 104 respectively) and well as those that completed the IVC (57 enterprises each). Central Karoo and Sarah Baartman had the least number of visited enterprises, those that met the criteria to be categorised as innovative as well as those that completed the IVC.

Table 12 shows the proportion of sampled innovators located in the local municipalities visited in the four districts. Of the 16 local municipalities, six (Hantam, Emthanjeni, Dr Beyers, Beaufort West, Ubuntu, Karoo Hoogland) contributed the most (10%) in terms of the proportion of sampled innovators.

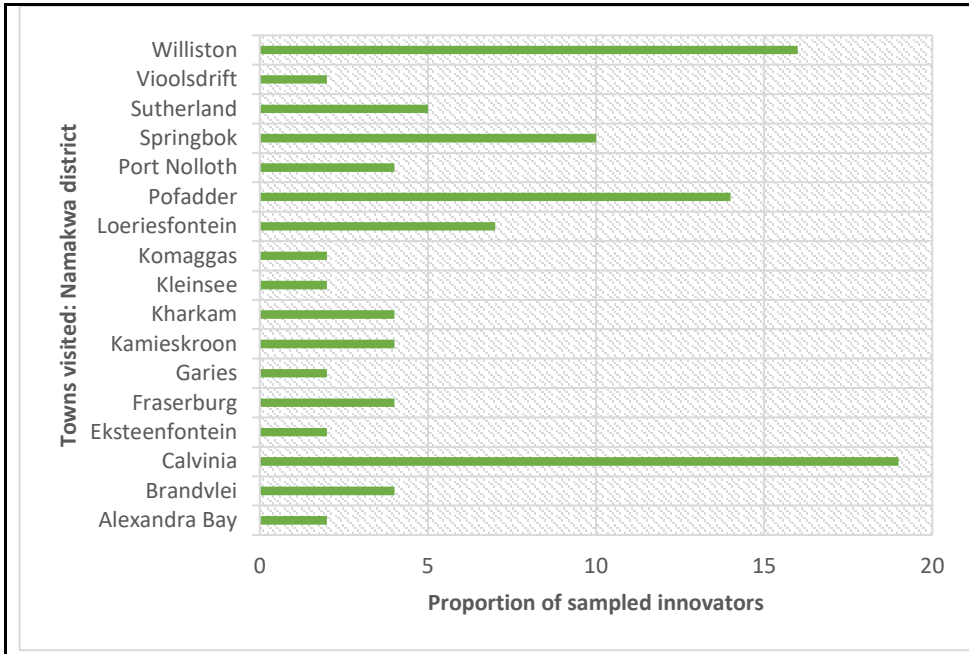
Local municipalities such as Ubuntu and Karoo Hoogland contributed 9% and 8% respectively, while the remaining local municipalities contributed the least number of sampled innovators, with the proportion ranging between 2 and 7 percent. These results are largely in line with expectations, given that the municipalities with the most innovative enterprises host major towns in the districts. However, it was unanticipated that Nama Khoi would contribute the least number of innovators compared to local municipalities such as Hantam and Karoo Hoogland, as it hosts the major town (Springbok) in the Namakwa district.

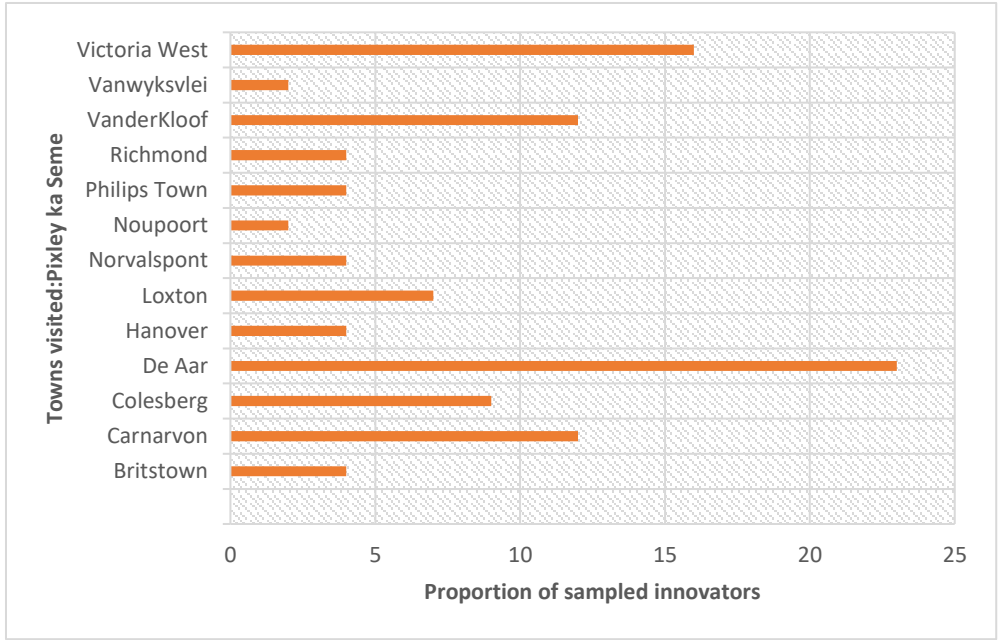
Table 12. Proportion of innovators sampled based on local municipalities in the Karoo

Variable	Frequency	District Percentage
Local municipalities in Namakwa district		
Hantam	17	10
Kamiesberg	4	2
Karoo Hoogland	14	8
Khai Ma	8	5
Nama Khoi	10	6
Richtersveld	4	2
District Total	**57**	**34**
Local municipalities in Pixley ka Seme district		
Emthanjeni	17	10
Renosterberg	8	5
Kareeberg	9	5
Ubuntu	15	9
Umsobomvu	8	5
District Total	**57**	**34**
Local municipalities in Sarah Baartman district		
Blue Crane	12	7
Dr Beyers Naude	17	10
District Total	**29**	**17**
Local municipalities in Central Karoo district		
Beaufort West	17	10
Laingsburg	3	2
Prince Albert	5	**3**
District Total	**25**	**15**
Total	**168**	**100**

Figure 23 shows the proportion of the sampled innovators located in the 42 towns visited in the Karoo region. The figure shows that most of the innovators profiled in Namakwa were located in towns such as Calvinia and Williston, while De Aar and Victoria West contributed the most innovators in Pixley. Most innovators were located in Beaufort West and Laingsburg in the Central Karoo, while Graaff Reinet and Somerset East contributed the most in Sarah Baartman. As expected, most of the sampled innovative enterprises were located in the major towns in the districts. However, as mentioned earlier, it was

unanticipated that Springbok would contribute few innovators to the number of sampled innovative enterprises given that it is a major town in the Namakwa district.


Towns visited: Namakwa district
Williston
Vioolsdrift
Sutherland
Springbok
Port Nolloth
Pofadder
Loeriesfontein
Komaggas
Kleinsee
Kharkam
Kamieskroon
Garies
Fraserburg
Eksteenfontein
Calvinia
Brandvlei
Alexandra Bay
0
5
10
15
20
Proportion of sampled innovators


Towns visited:Pixley ka Seme
Victoria West
Vanwyksvlei
VanderKloof
Richmond
Philips Town
Noupoort
Norvalspont
Loxton
Hanover
De Aar
Colesberg
Carnarvon
Britstown
0
5
10
15
20
25
Proportion of sampled innovators

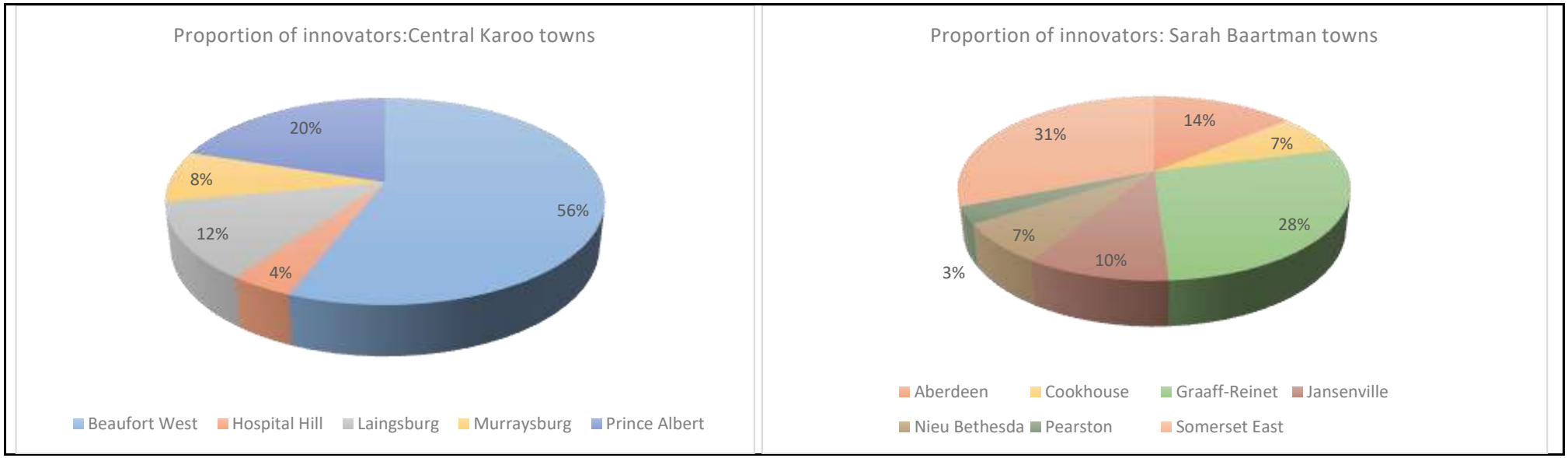


Figure 23. Relative contribution of towns to sampled innovators per selected district

Figures 24 to 27 show the location of the profiled innovators in the four districts (Namakwa: Figure 24, Pixley ka Seme: Figure 25, Central Karoo: Figure 26 and Sarah Baartman: Figure 27. The general trend across all the four districts was that most of the innovative enterprises were mainly located in the urban areas, in the proximity of key infrastructure such as major roads, schools, ICT centres, libraries etc., as the blue dots (showing innovators) often seemed to overlap with the red dots (showing infrastructure) on the maps. This emphasises the importance of infrastructure and market potential in stimulating innovation activities. It is however concerning that some of the innovators are located far from urban centres or innovation infrastructure, putting into question the long-term sustainability or potential growth of these innovative enterprises.

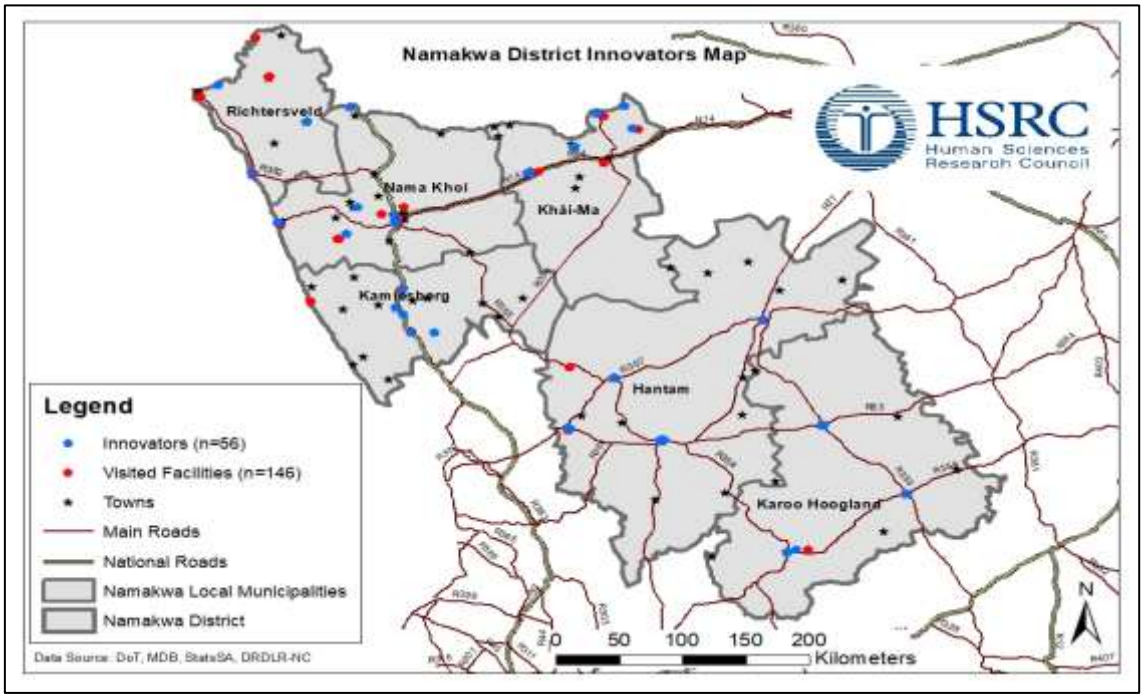


Figure 24. Innovators and infrastructure profiled in the Namakwa district

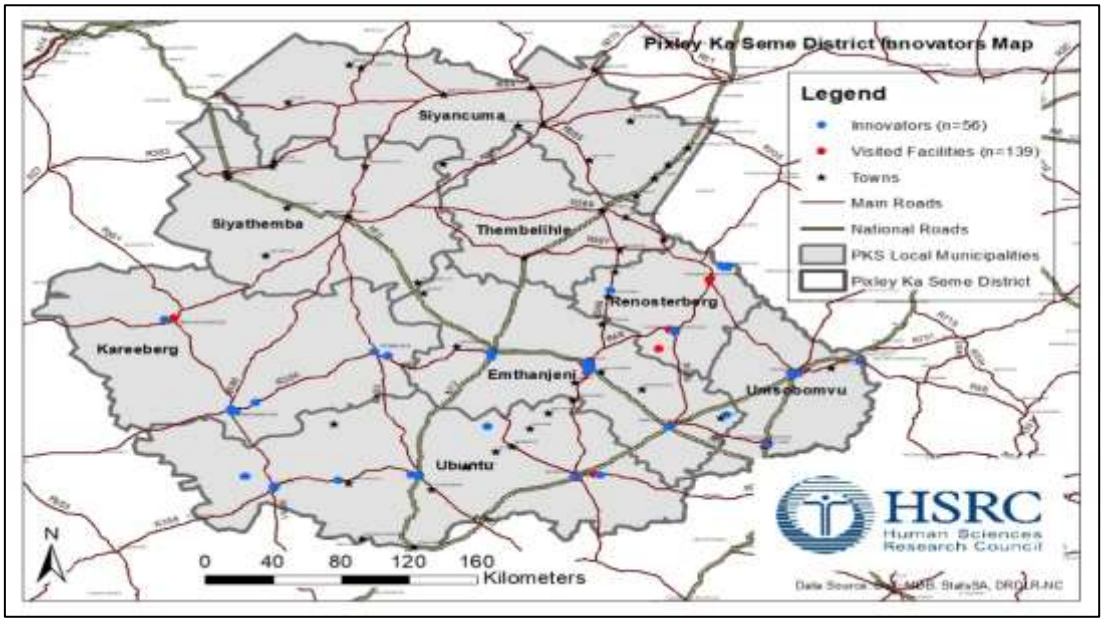


Figure 25. Innovators and infrastructure profiled in the Pixley ka Seme district

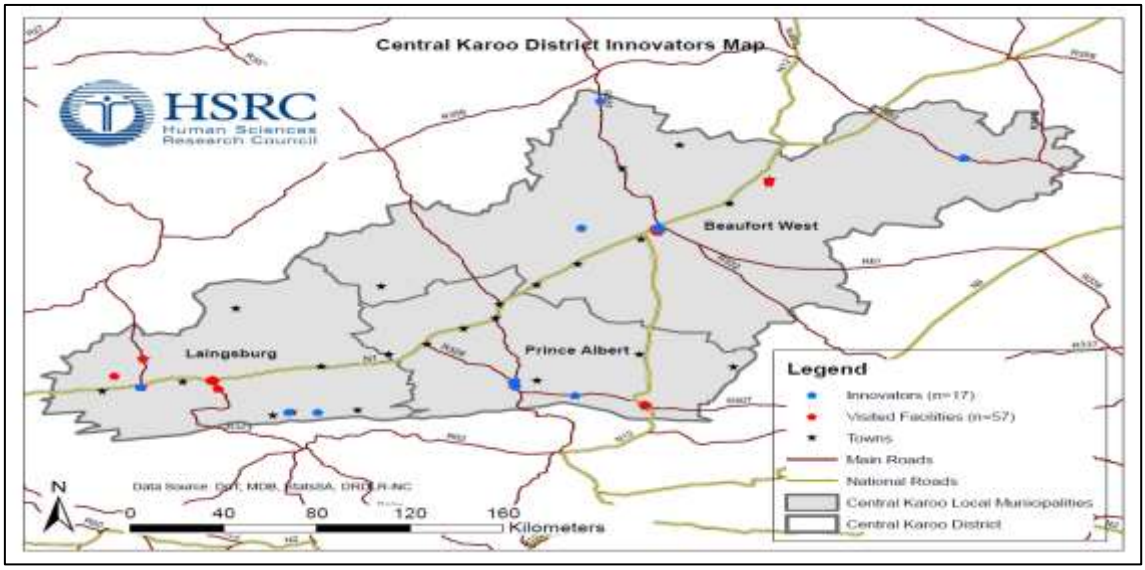


Figure 26. Innovators and infrastructure profiled in the Central Karoo district

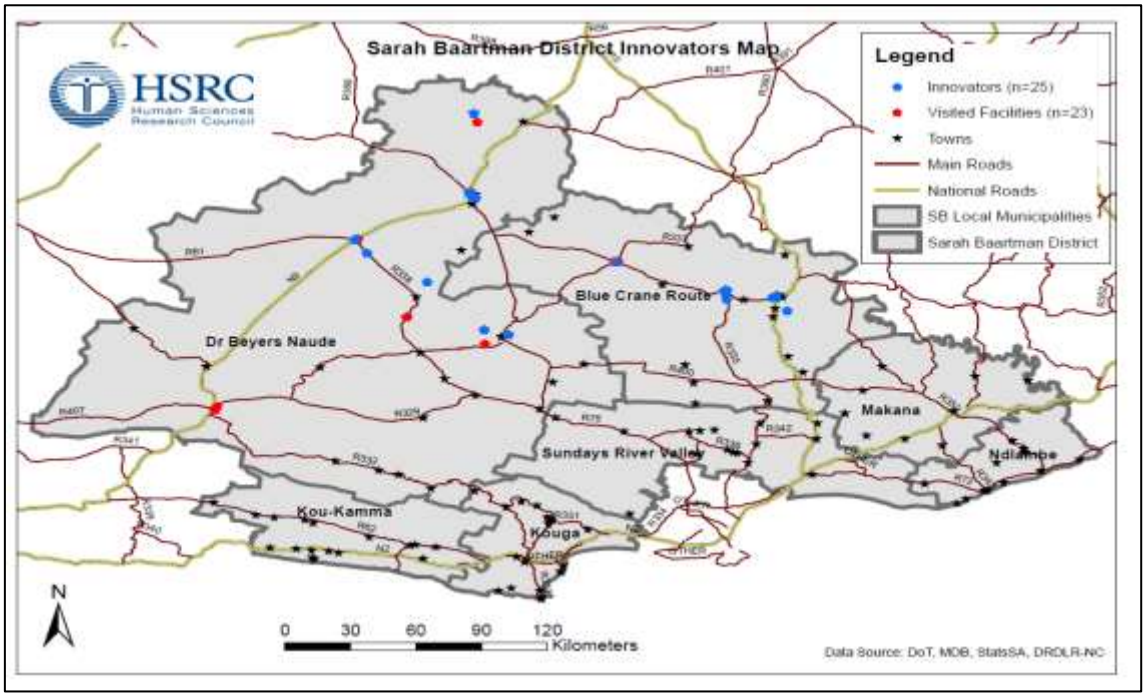


Figure 27. Innovators and infrastructure profiled in the Sarah Baartman district

Figures 28 to 31 show the distance of the innovative enterprises from their respective main economic hubs. Looking at the results, the general observation was that most of the innovative enterprises are located far away (about 100km away) from the main economic hubs, with very few innovative enterprises located within the 10km and 50km radius. For instance, in Namakwa (Figure 28), only 5 (9%) of the 56 profiled innovators were located within a radius of 10km of the main hub (Springbok) and only one enterprise was located over 50km away from the hub. The highest proportion of the innovative enterprises (89%) were located over 100km from the main hub and these included amongst others, small towns such as Calvinia, Sutherland, Williston, etc.) in the district. The Pixley ka Seme map (Figure 29) also presents the same trend, with a majority (71%)

of innovators located over 100km radius from the main district economic hub (De Aar). Only few (23%) of the innovative enterprises in the district were situated within a radius of 10km from the main hub.

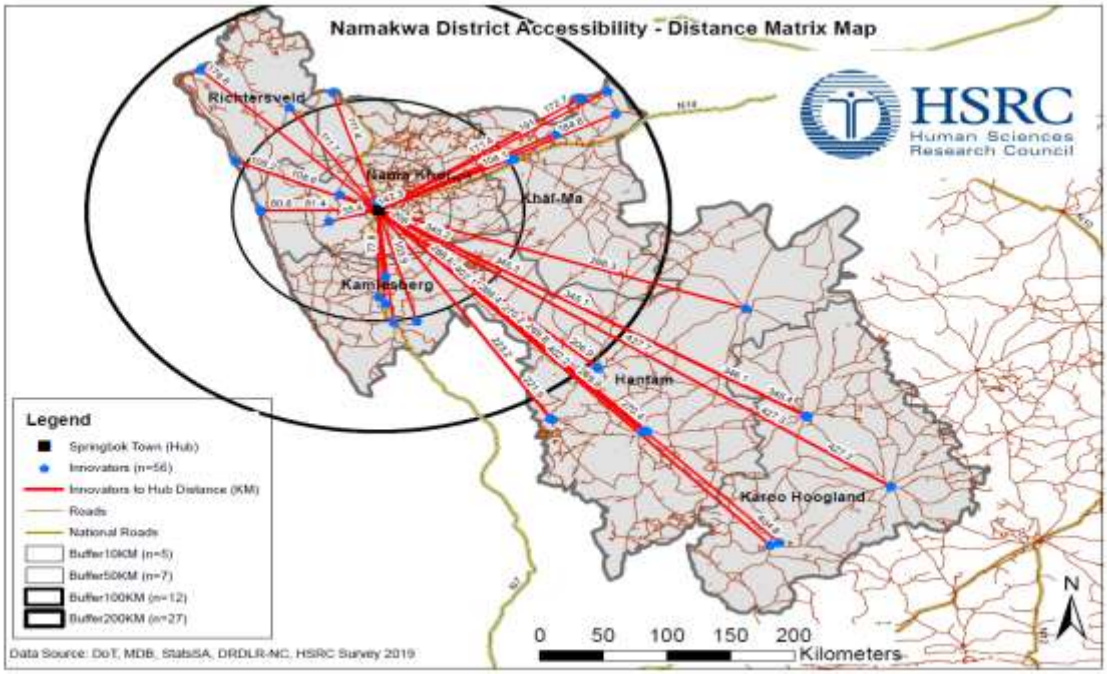


Figure 28. Distance of innovators from the main hub in the Namakwa district

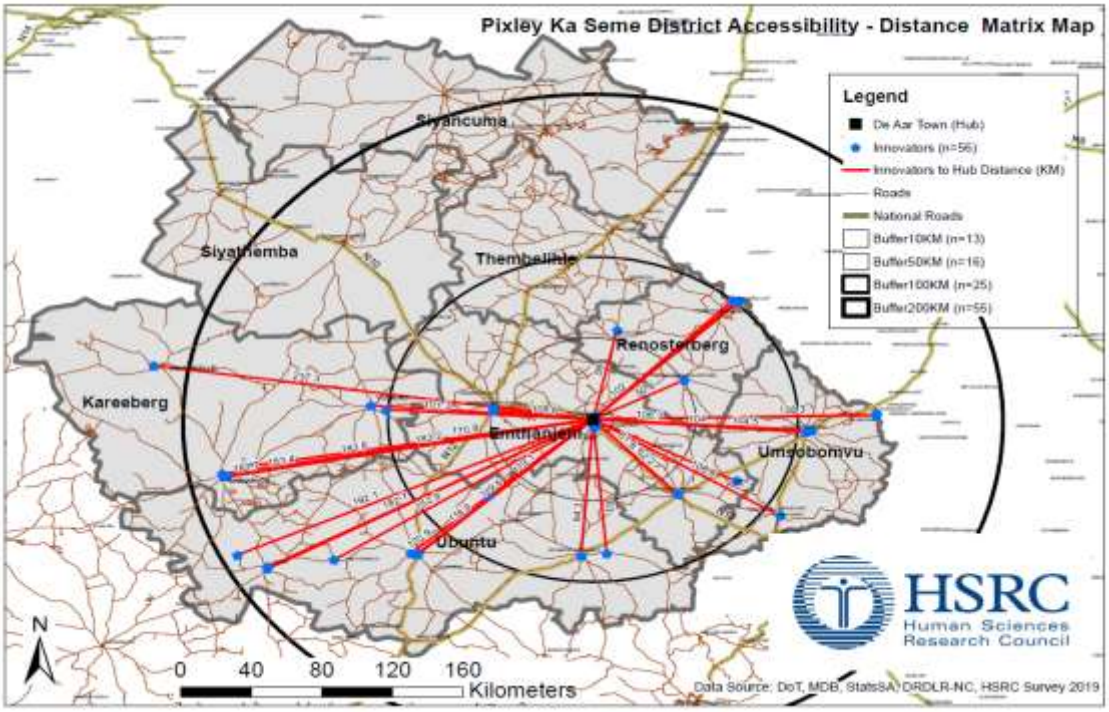


Figure 29. Distance of innovators from the main hub in the Pixley ka Seme district

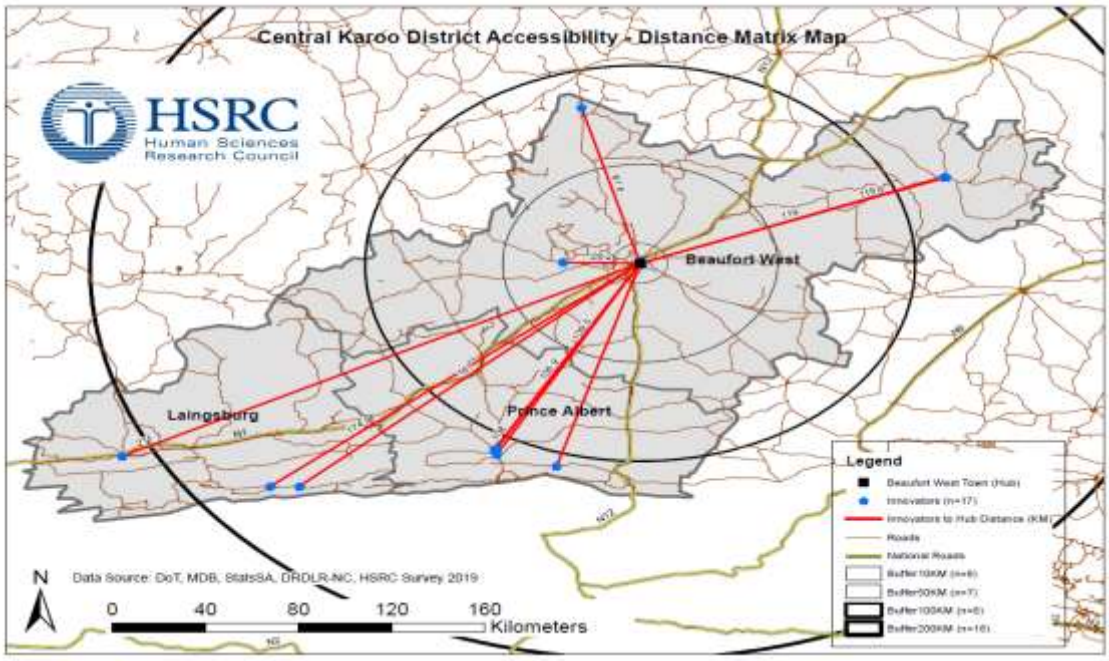


Figure 30. Distance of innovators from the main hub in the Central Karoo district

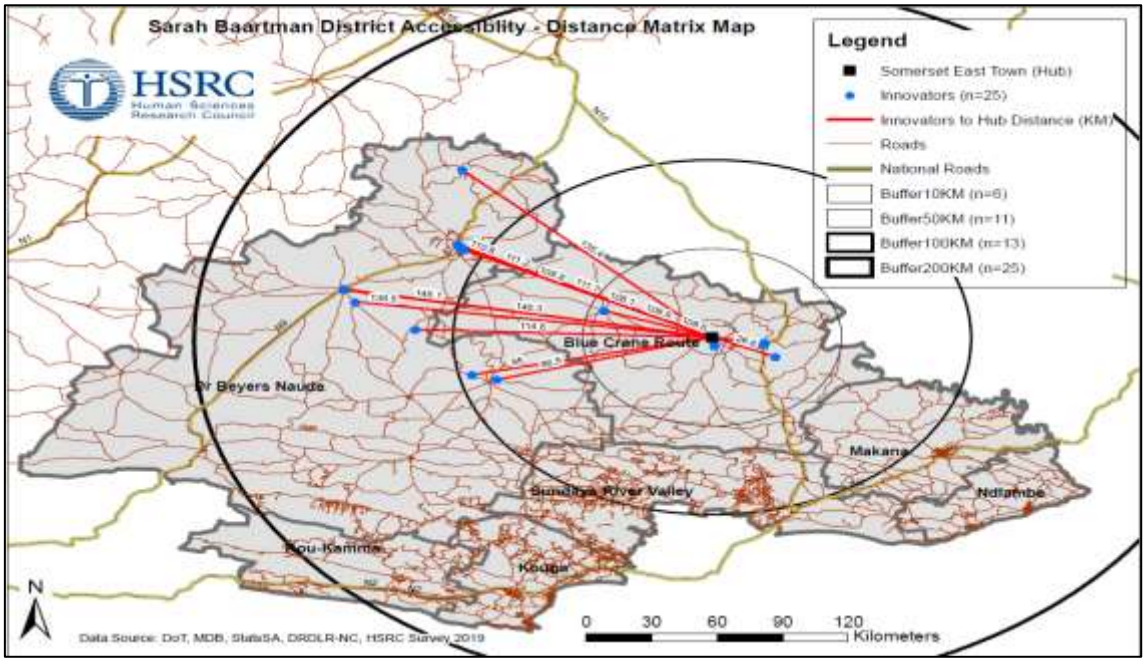


Figure 31. Distance of innovators from the main hub in the Sarah Baartman district

Figure 30 shows that few 35% of the 17 innovators mapped in the Central Karoo were located within a radius of 10km from the main economic hub (Beaufort West). The majority (59%) of the innovators were situated very far from the main hub (over 100 km away) and these were based mainly in the small towns in the district. Findings in the Sarah Baartman district (Figure 31) showed that a significant proportion (44%) of the mapped enterprises were located within a radius of 50km from the main hub (Somerset East). A proportion of 32%, which is the lowest in comparison with other districts, were situated over 50km away from the main hub. The majority of the innovative enterprises were around the two main towns in the district, Graaff Reinet and Somerset East. Nonetheless, similar to what was observed in Namakwa, Pixley ka Seme and Central

Karoo, very few innovators (25%) in the Sarah Baartman district were based within a radius of 10km of the main economic hub in the district.

Figures 32 and 35 shows the shortest routes for the innovators to the main hub in their respective districts. The general observation is that most of the mapped innovative enterprises were located far away from their main economic hubs in the districts. Consequently, this means that they have to travel very long distances (in most instances distances over 100km) to the main economic hubs within their respective districts. In Namakwa (Figure 32), the shortest distance for innovators located in the western side of the main hub (Springbok) is 104 km, followed by the 121 km travelled by those located north of the hub. Innovators located in the south-eastern part travel the longest distance of 529 km to go to the main hub, while the eastern located enterprises incur a distance of 223 km. Namakwa is the largest district in the entire Northern Cape, hence these massive distance between towns such as Sutherland and Springbok (the main district hub).

The Pixley ka Seme shortest routes map (Figure 33) indicates that of the local municipalities that were mapped in the district, the innovators located in the northern side of the main hub (De Aar) had the shortest distance to the main hub (53 km), followed by those from the southern side (86 km). Innovators located in the south-western part travel the longest distance of 240 km, to go to the main hub, while the eastern located enterprises travel a distance of 163 km.

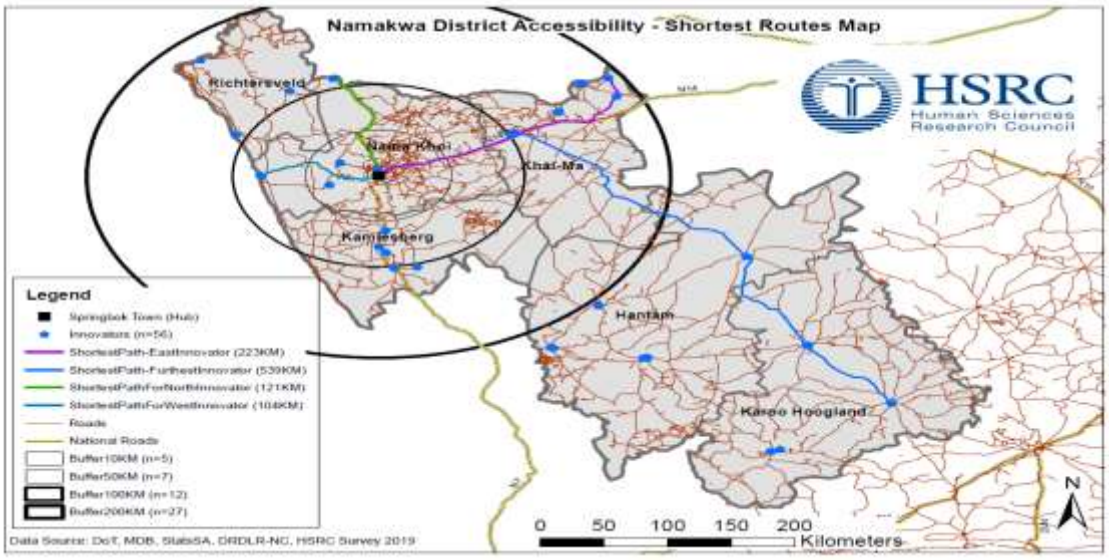


Figure 32. Shortest routes map for innovators in the Namakwa district

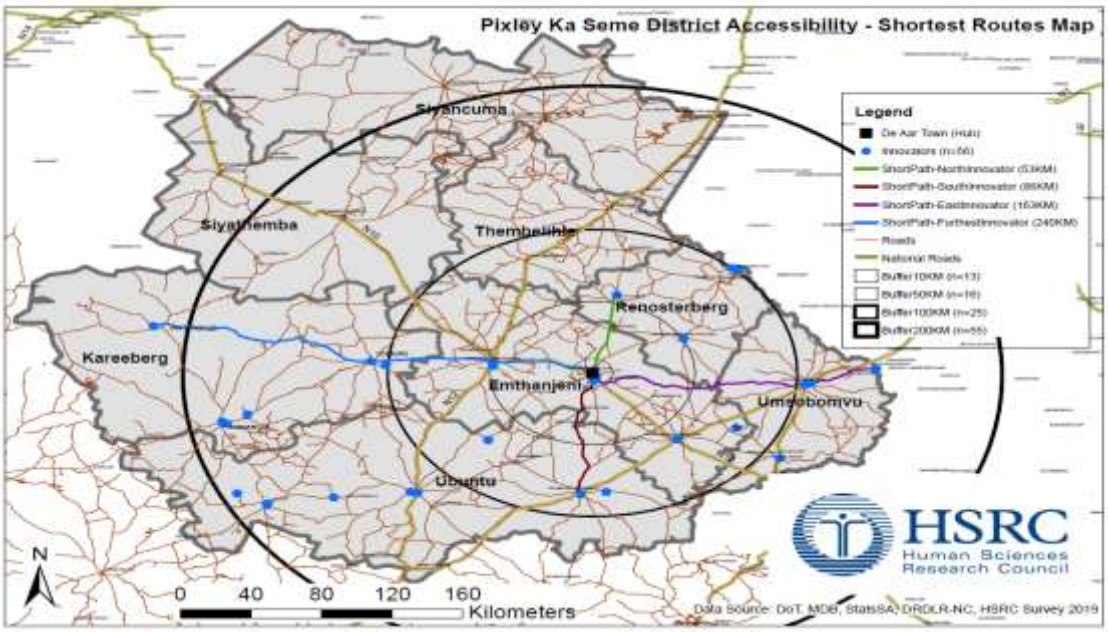


Figure 33. Shortest routes map for innovators in the Pixley ka Seme district

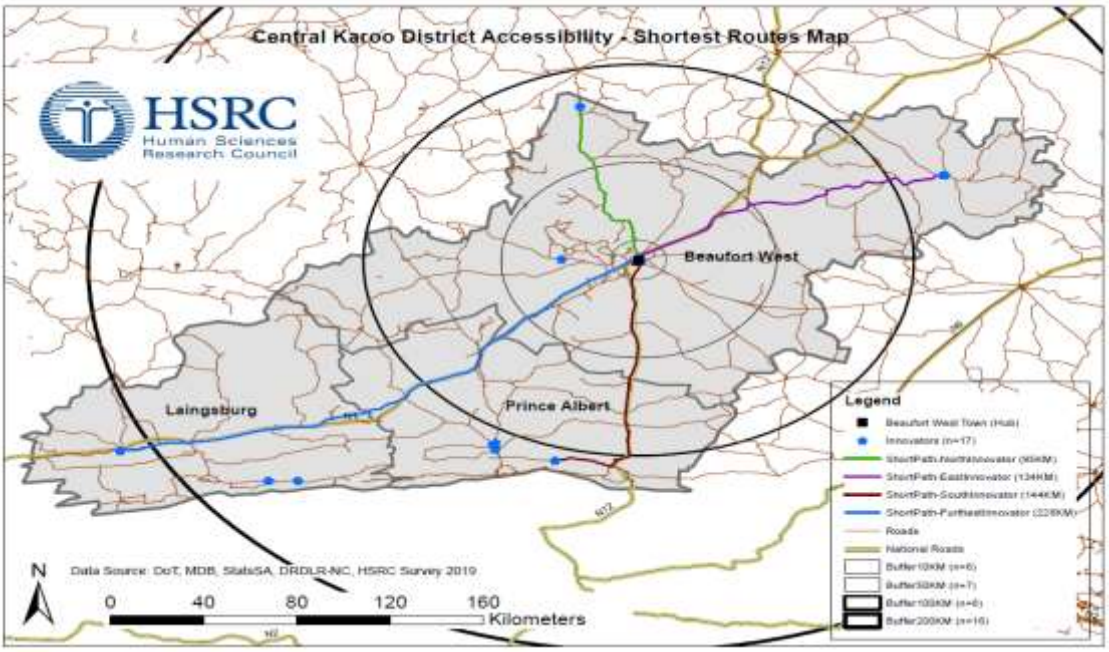


Figure 34. Shortest routes map for innovators in Central Karoo district

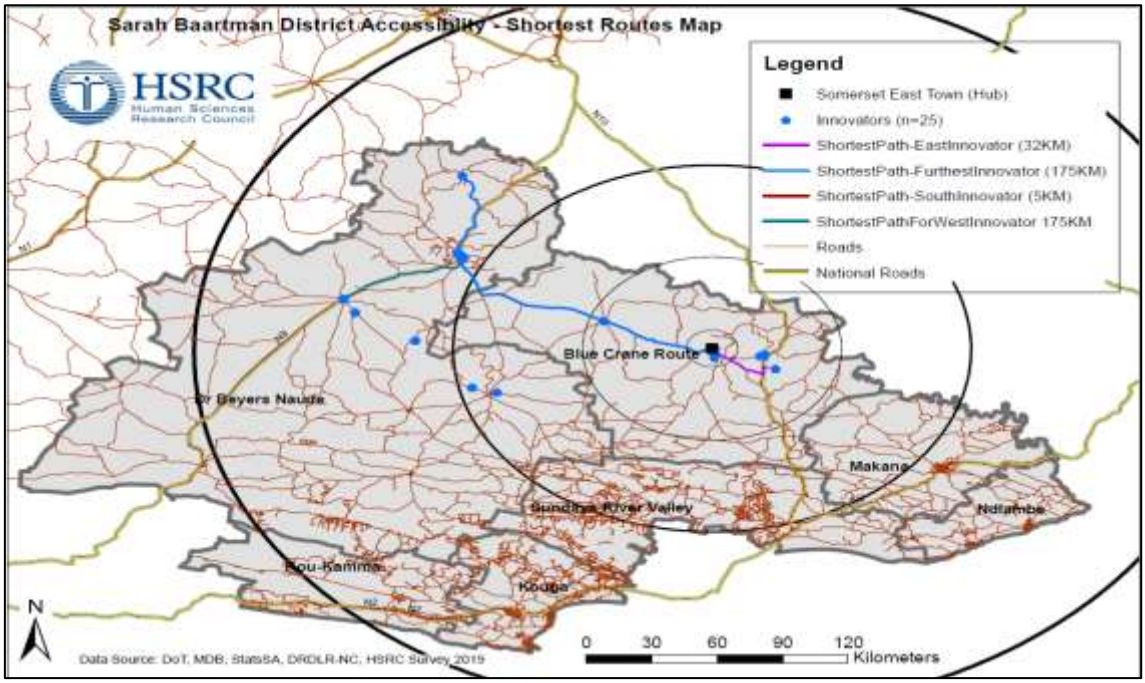


Figure 35. Shortest routes map for innovators in the Sarah Baartman district

In the Central Karoo (Figure 34) shows that the shortest distance for innovators located in the northern side of the main hub (Beaufort West) is 95 km, followed by the 134 km travelled by those east of the hub. Innovators located in the southern part travel the longest, at 228 km, to go to the main hub, while the eastern located enterprises incur a distance of 144 km. However, most of these innovators in the western and southern areas of the district are located in small towns outside of the main hub, and they rarely travel these distances to the main hub.

For Sarah Baartman (Figure 35), the map shows that of the two local municipalities that were mapped in the district, the innovators were located within a radius of 175 km of the

hub (Somerset East). Innovators situated in the south-eastern side of the main hub had the shortest distance to the main hub (5 km), followed by those from the eastern side (32 km). Innovators located in the western and northern parts both travel the longest distance of 175 km to go to the main hub.

Table 13 indicates that most (86%) of the innovative enterprises in the four Karoo districts were privately owned, whilst only 5% operated as public entities. This was the general trend across all districts as over 80% of enterprises were private enterprises in all the the four districts. Non-profit organisations contributed 8% to the total sample while parastatals contributed only one percent. Enterprises that operated as parastatals and NPOs were found in all other districts, with the exception of Namakwa with nil.

Table 13. Enterprise types and registration status in the four Karoo districts

Variables	Namakwa		Pixley ka Seme		Sarah Baartman		Central Karoo		All districts	
Enterprise type	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*
Public enterprise	1	2	3	5	3	10	1	4	8	5
Private enterprise	56	98	47	82	21	73	21	84	145	86
Parastatal enterprise	0	0	1	2	0	0	0	0	1	1
Non-Profit Organisation	0	0	6	11	5	17	3	12	14	8
Total	**57**	**100**	**57**	**100**	**29**	**100**	**25**	**100**	**168**	**100**
Legal entity status registered enterprise authority	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*
Sole Proprietor	6	11	7	12	1	4	4	16	18	11
Business CC/PTY(LTD)	35	65	28	49	16	55	12	48	91	54
Cooperative	5	9	1	2	2	7	2	8	10	6
Partnership	4	7	0	0	0	0	2	8	6	4
Government department	0	0	4	7	3	10	0	0	7	4
Non-profit organisation	0	0	5	9	4	14	3	12	12	7
Not registered	4	7	12	21	3	10	2	8	21	13
Do not know	3	5	0	0	0	0	0	0	3	2
Total	**57**	**100**	**57**	**100**	**29**	**100**	**25**	**100**	**168**	**100**
Enterprise registration with SARS	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*
Business Income Tax/ VAT Compliant	50	89	31	55	19	66	21	84	121	72
Exempted from Business Taxes	1	2	5	9	4	14	3	12	13	8
Not registered	5	9	20	36	5	17	1	4	31	18
Do not know	1	2	1		1	4	0	0	3	2
Total	**57**		**57**		**29**	**100**	**25**	**100**	**168**	**100**

Overall, more than half (54%) of the enterprises were registered as close corporations/ private limited companies, while only 13% were not registered with any authority. Sole proprietorship contributed 11% to the total sample, whereas cooperatives and partnerships contributed 6% and 4% respectively. The results also indicate that a high proportion (72%) of the enterprises were registered with SARS for tax purposes, whilst only a few (18%) were unregistered and were not paying business tax. Namakwa and Central Karoo recorded the highest (over 80%) proportion enterprises who were registered with SARS for tax reasons, followed by Sarah Baartman (66%) and Pixley ka Seme (55%). The figures also indicate that Pixley ka Seme ranked the highest (36%) in terms of the proportion of enterprises who were unregistered with SARS for tax. Based on the findings it is clear that most of the sampled enterprises in the Karoo were operating formally, with very few enterprises meeting the criteria for informality (i.e. being unregistered with any authority or not paying business taxes). Despite being a small proportion (18%), the number of unregistered enterprises suggests that innovation also occurs within informal enterprises operating in the parallel economy. It is important that these innovations taking place in informal settings be acknowledged and harnessed for inclusive outcomes.

Table 14 shows that most enterprises in the region operated within the agriculture, conservation and natural resource sector (32%), followed by the retail (20%) and manufacturing and agro-processing sectors (17%), respectively. Health, research and academic, and energy were the least innovative sectors, each contributing one, two and three enterprises to the total sample. The results show that most of the innovative enterprises were mainly sole owned (49%) or were owned by two owners (30%), totalling an overwhelming 79% for two or less owners. Pixley ka Seme had most innovative enterprises (66%) that were sole owned, followed by Namakwa and Central Karoo, contributing 40% to the total sample each. Namakwa contributed the highest (14

enterprises to the total sample) in terms of the number of innovative enterprises that were owned by two people. The proportion of innovative enterprises owned by 3-5 owners stood at 15%, whereas a small (6%) of the enterprises had more than 5 owners.

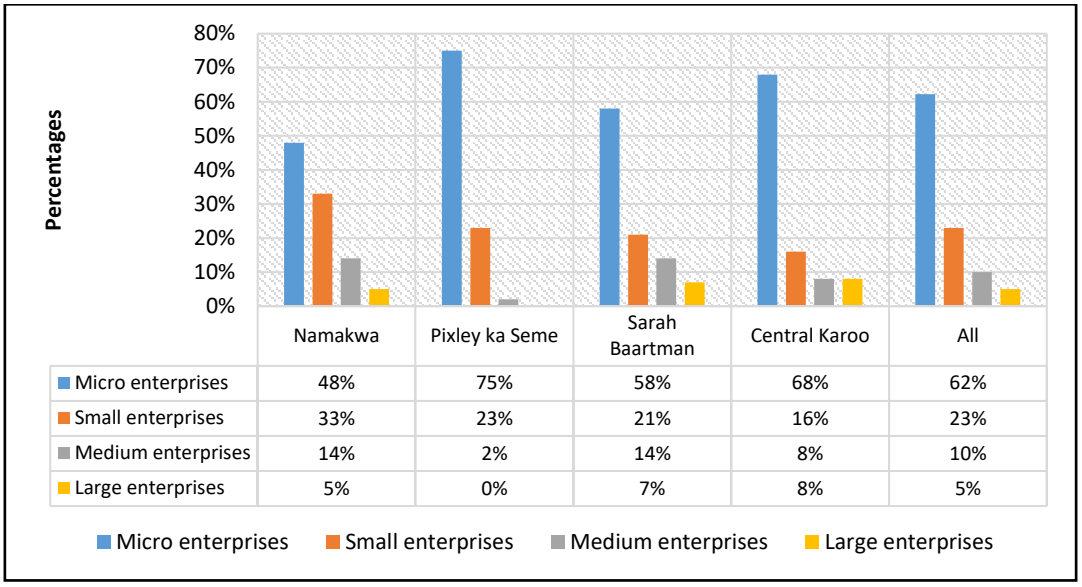
Table 14. Economic sector, type and employment levels of the innovators in the four Karoo districts

Variable	Namakwa		Pixley		Central Karoo		Sarah Baartman		Total	
Main economic sector	*Freq.*	%	*Freq.*	%	*Freq.*	%	*Freq.*	%	*Freq.*	%
Agriculture, Conservation, Natural Resource	13	23	17	30	13	52	10	34	53	32
Construction, Mining & Minerals	9	16	2	4	0	0	1	3	12	7
Information & Communication Technologies	2	4	3	5	2	8	3	10	10	6
Research & academic	1	2	0	0	0	0	1	3	2	1
Retail, Trade & Finance	11	19	17	30	4	16	1	3	33	20
Manufacturing and agro-processing	14	25	7	12	1	4	7	24	29	17
Energy	1	2	1	2	1	4	0	0	3	2
Health	1	2	0	0	0	0	0	0	1	1
Education & Training	3	5	0	0	0	0	5	17	8	5
Community social service	0	0	9	16	2	8	1	3	12	7
Others	2	4	1	2	2	8	0	0	5	3
Total	**57**	**100**	**57**	**100**	**25**	**100**	**29**	**100**	**168**	**100**
Number of people who own enterprise										
1	16	40	31	66	8	40	7	35	62	49
2	14	35	8	17	7	35	9	45	38	30
3 – 5	8	20	7	15	2	10	2	10	19	15
>5	2	5	1	2	3	15	2	10	8	6
Total	**40**	**100**	**47**	**100**	**20**	**100**	**20**	**100**	**127**	
Number of people employed	*Mean*		*Mean*		*Mean*		*Mean*		*Mean*	
Number of permanent employees	29		6.86		13.88		128.44		178.18	

Number of temporary employees	38		2.28		13.04		68		121.32	
Number of non-contracted employees	1		0.73		10.5		0.52		12.75	
Total number of employees	68		9.87		37.42		196.96		312.25	
Enterprise types	*Freq.*	*%.*	*Freq.*	*%*	*Freq.*	*%*	*Freq.*	*%*		
Micro enterprises (1 – 10 employees)	27	47	43	75	17	68	17	58	104	62
Small enterprises (11 – 50 employees)	19	33	13	23	4	16	6	21	42	25
Medium enterprises (51 – 250 employees)	8	14	1	2	2	8	4	14	15	9
Large enterprises (>251 employees)	3	5	0	0	2	8	2	7	7	4
Total	**57**	**100**	**57**	**100**	**27**	**100**	**25**	**100**	**168**	**100**

On average, innovative enterprises across the four Karoo districts region employed 312 employees, which includes 178 permanent and 121 temporary employees. These figures provide a hint of possible increasing casualization of labour among these innovative enterprises, with people most likely to be employed temporarily than permanently. The enterprises located in Sarah Baartman provided more employment (196 employees on average), followed by Namakwa with an average of 68 employees. Central Karoo and Pixley ka Seme had the least number of employees, with an average of 37 and 10 employees, respectively. Overall, some enterprises employed on average 13 labourers without formal contracts, highlighting the informal nature of some of these enterprises. This was mainly done by the few informal/ unregistered enterprises, who employed some of their employees on verbal agreements without signed contracts. Innovators in the Central Karoo district had the highest average of employees without formal contracts (10.5), while the remainder districts employed on average just one worker without a formal contract.

Using the number of employees as a proxy indicator of enterprise size, Table 14 and Figure 36 indicate that most (62%) of the enterprises across the four districts were micro enterprises, which employed 10 or less employees. Small enterprises which employed between 11 and 50 employees constituted 25% of the innovators, with medium and large enterprises constituting 9 and 4% respectively. Pixley ka Seme contributing the highest in terms of the number of micro enterprises (43), followed by Namakwa (27 micro enterprises). Micro enterprises were less dominant in Sarah Baartman and Central Karoo, both constituting 17 micro enterprises to the total sample. Small enterprises were widespread within the Namakwa and Pixley ka Seme districts, constituting 19 and 13 enterprises to the total sample, respectively. In summary, these results indicate that the micro and small enterprises are the key drivers of innovation activity in the Karoo, with medium and large enterprises contributing relatively small proportions.



	Namakwa	Pixley ka Seme	Sarah Baartman	Central Karoo	All
Micro enterprises	48%	75%	58%	68%	62%
Small enterprises	33%	23%	21%	16%	23%
Medium enterprises	14%	2%	14%	8%	10%
Large enterprises	5%	0%	7%	8%	5%

Figure 36. Enterprises size categories in the four Karoo districts

While most of the innovative enterprises were small, as Figure 36 shows, Table 15 indicates that these enterprises were mature, having been in operation for over 13 years on average. The general trend across all districts was that innovative enterprises have been in operation for a period of 10 to 15 years. Further analysis on Table 15 shows that 27% of the enterprises have been operating for at least 2 and at most 5 years, whilst only a few (17%) were start-ups formed a year or less prior the survey. Pixley ka Seme ranked the highest in terms of the proportion of emerging enterprises (44%), followed by Namakwa (19%), while Sarah Baartman and Central Karoo had only 17% and 16% of emerging enterprises respectively. Most (38%) of the enterprises had been in operation for over 11 years, indicating that they are now established in the market, followed by 185 of the enterprises who have been in operation for between 6 and 10 years. While these values highlight the higher maturity levels of the innovators, suggesting that enterprise maturity is positively linked with innovation proclivity, what is of concern is that the

employment levels of these enterprises remain low, as Figure 36 indicated that 62% of these enterprises employed 10 or less employees.

Table 15. Maturity levels and head office location of the innovative enterprises

Variable	Namakwa		Pixley		Sarah Baartman		Central Karoo		Total	
	Mean	**SD**	***Mean***	**SD**	***Mean***	**SD**	***Mean***	**SD**	***Mean***	**SD**
Years enterprise in operation	15.22	18.31	10.68	25.13	13.31	15.88	12.87	15.01	13.02	18.58
Enterprise maturity stage	***Freq.***	**%**	***Freq.***	**%**	***Freq.***	**%**	***Freq.***	**%**	***Freq.***	**%**
Start-up/ nascent enterprises (1 year or less)	5	9	10	18	7	24	6	24	28	17
Emerging enterprises (2 and 5 years)	11	19	25	44	5	17	4	16	45	27
Established enterprises (6 – 10 years)	14	25	7	12	6	21	4	16	31	18
Very established enterprises (11 years or more)	27	47	15	26	11	38	11	44	64	38
Total	**57**	**100**	**57**	**100**	**29**	**100**	**25**	**100**	**168**	**100**
Enterprise part of larger organisation	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Yes	24	42	39	68	10	34	11	44	84	51
No	33	58	18	32	17	58	14	54	82	49
Total	**57**	**100**	**57**	**100**	**29**	**100**	**25**	**100**	**168**	**100**
Head office of the larger group	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**	**Freq.**	**%**
Northern Cape	14	64	32	82	0	0	0	0	46	53
Western Cape	5	23	2	10	1	7	9	82	17	20
Gauteng	3	14	4	5	0	0	1	9	8	9
North West	0	0	1	3	0	0	0	0	1	1
Eastern Cape	0	0	0	0	12	86	0	0	12	14
Outside SA	0	0	0	0	1	7	0	0	1	1
Limpopo	0	0	0	0	0	0	1	9	1	1
Total	**22**	**100**	**39**	**100**	**14**	**100**	**11**	**100**	**86**	**100**

Table 15 shows that a significant proportion (51%) of the enterprises in the Karoo were branches or part of a larger organisation. While this was the case, a considerable proportion (49%) of the enterprises reported that they were not part of a larger organisation. Pixley ka Seme had the highest proportion (68%) of enterprises that were part of a larger group, followed by Namakwa (42%). Most of the headquarters of the innovative enterprises who were part of larger organisations were located within provinces were the survey was conducted (i.e., Northern Cape, Western Cape and Eastern Cape). There were however some enterprises whose headquarters were based in Gauteng, North West and Limpopo provinces and very few that had headquarters outside of South Africa.

Presented in Figure 37 are the geographic markets of the innovative enterprises in the selected Karoo districts. A significant proportion (91%) of the innovators in the region sold or distributed free of charge their goods or services within their own local municipalities, followed by over half (62%) of the innovators who indicated to have also done so in other local municipalities within their own district. This was a similar trend across all the districts, as the majority (over 80%) of the innovators in these districts sold or distributed free of charge their goods or services within their own local municipalities. Innovators in the Central Karoo ranked the highest proportion in this regard, as all of the innovators sold or distributed all their goods within their own local municipality.

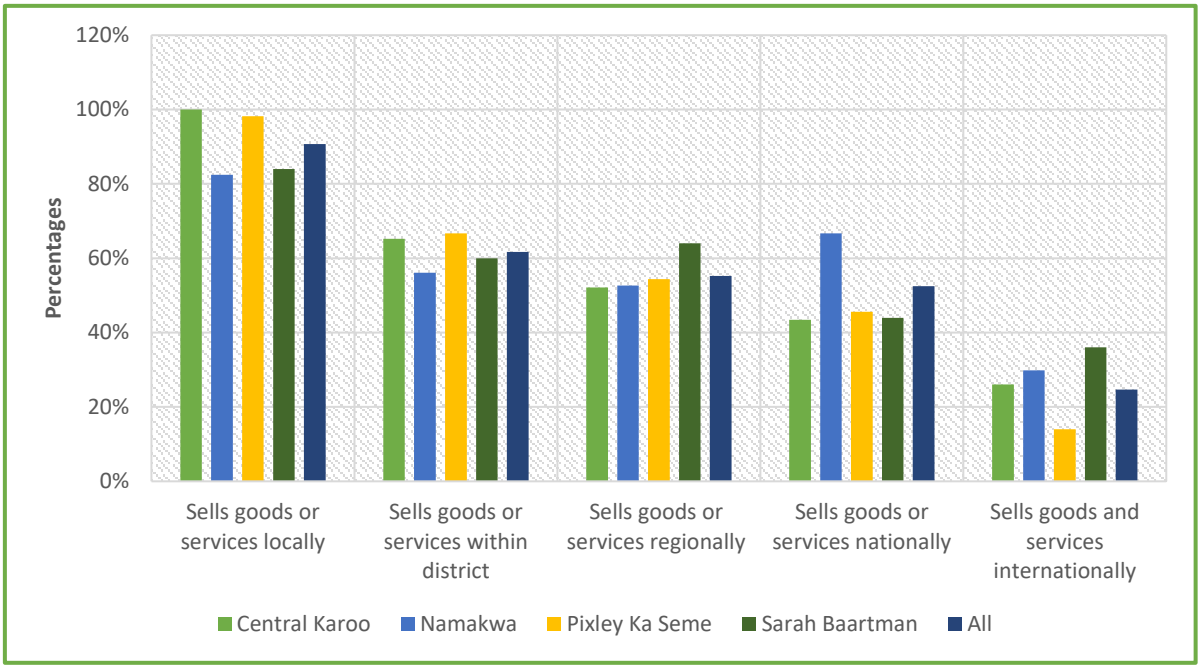


Figure 37. Enterprise markets for goods and services

The results also show that a significant proportion (over 50%) of the innovators across the four districts also sold or freely distributed goods or services regionally (i.e., other district municipalities within their own province). Most (52%) of the innovators in the Karoo also sold or freely distributed products nationally. Namakwa had the highest proportion (67%) of innovators who sold or freely distributed their goods nationally, followed by Pixley ka Seme (46%), Sarah Baartman (45%) and Central Karoo (44%). The results suggest that while nearer markets within own municipality are key, distant markets outside one's province also play a significant role in the success of local businesses. As such, it is important that support for market access not only focus on the local opportunities, but also other distant markets. It is important that reflections be done on how local enterprises can focus on their own districts or province before searching for

markets faraway, as these distant markets are associated with higher transaction costs that may significantly undercut profits.

Despite the small proportion, it is also important to note that there is a lot of export activity among innovative enterprises in the region. Overall, a quarter (25%) of the innovators indicated they sold goods and services outside the country. Comparatively, exportation of products occurred mainly in Sarah Baartman (34%), Namakwa (30%) and Central Karoo (28%), but rarely happened in Pixley ka Seme (14%).

Figure 38 shows the main markets in terms of turnover where goods or services within innovative enterprises in the four Karoo districts were sold or freely distributed. Overall, markets located within the innovators' local municipalities contributed the most (55%) to their turnover in the previous financial year, followed by markets located within the enterprises' district and outside the country both contributing 10% to the total sample. Regional and national markets were the least dominant, contributing only 4% to the turnover. Looking across districts, a similar trend is observed as markets based within innovators' local municipalities contributed the most to their turnover during the previous financial year.

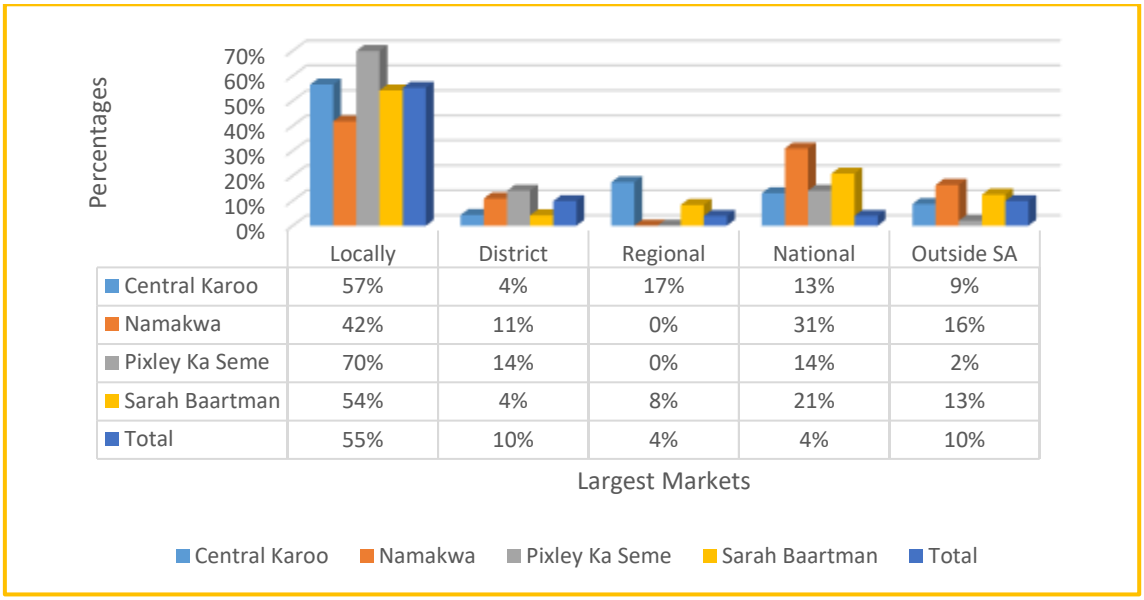
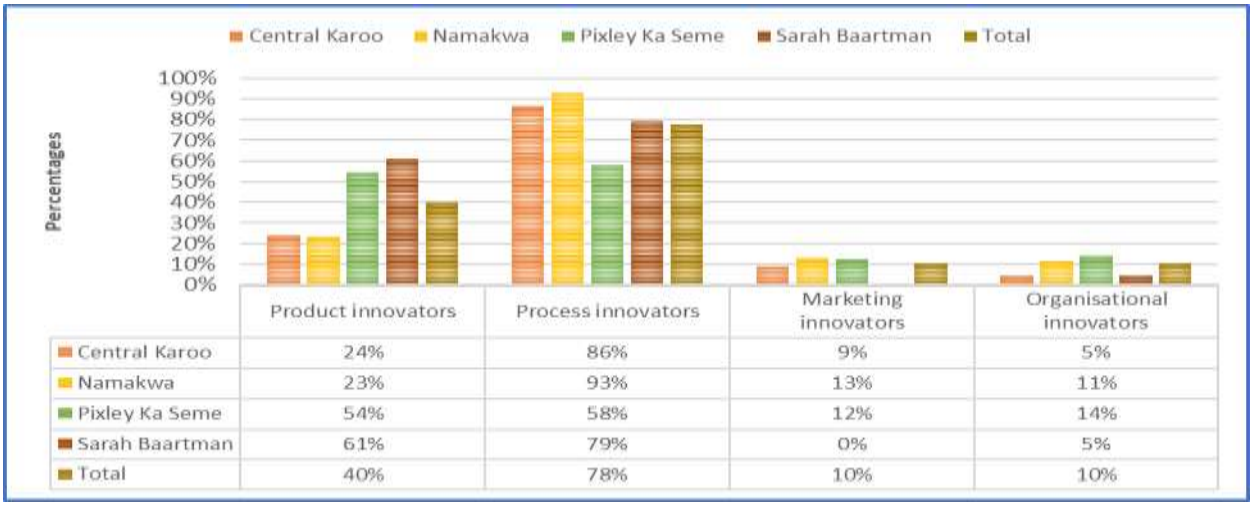


Figure 38. Main markets where goods or services are sold or freely distributed

An unexpected result for the Namakwa and Pixley ka Seme districts was that no enterprise reported receiving most of their revenue from markets in other districts within their province, suggesting that district markets are not very profitable to these enterprises. Another interesting finding, particularly for Namakwa, Sarah Baartman and Central Karoo districts, was that although other markets located within enterprises' districts also contributed to the turnover, their relative contribution was lower (11% for Namakwa and 4% for both Sarah Baartman and Central Karoo) than the contribution made by exported products (16% for Namakwa, 13% for Sarah Baartman and 9% for Central Karoo). This despite that few enterprises exported, indicating the lucrative nature of the export markets, which are such that for most of the enterprises that export, the export revenue often becomes the highest contributor to turnover.

6.2 Innovation types and activities

Figure 39 shows that, generally, production process innovation was the most popular innovation type, reported by 78% of the innovative enterprises in the region. Product innovation was the second most popular innovation type, reported by 40% of the innovators. Marketing and organisational innovations were the least reported innovation types, both practiced by only 10% of the innovators. Process innovation was the most popular innovation type in Namakwa, Central Karoo and Sarah Baartman districts, practiced by over 70% of the enterprises in these districts. Pixley ka Seme reported the least (58%) proportion of enterprises which practiced process innovation as compared to other districts. In regards to product innovation, Sarah Baartman and Pixley ka Seme reported the highest proportion of enterprises (61% and 54% respectively) which practiced this innovation type, while only a quarter of the enterprises in both Namakwa and Central Karoo produced product innovations. The findings suggest that innovative enterprises in the selected Karoo districts focused mainly on improving the processes of producing or manufacturing goods or services, and rarely on improving their marketing or organisational arrangements.



	Product innovators	Process innovators	Marketing innovators	Organisational innovators
Central Karoo	24%	86%	9%	5%
Namakwa	23%	93%	13%	11%
Pixley Ka Seme	54%	58%	12%	14%
Sarah Baartman	61%	79%	0%	5%
Total	40%	78%	10%	10%

Figure 39. Innovation types in the selected Karoo districts

Figures 40 to 43 shows the distribution of the innovation types in the four districts of Namakwa, Pixley, Central Karoo and Sarah Baartman, respectively. In summary, the maps indicate that all innovation types are prevalent in areas near towns, particularly product innovations. Further, the maps show that the different innovation types often occur in the same areas, suggesting that these are the areas conducive for all the innovation types.

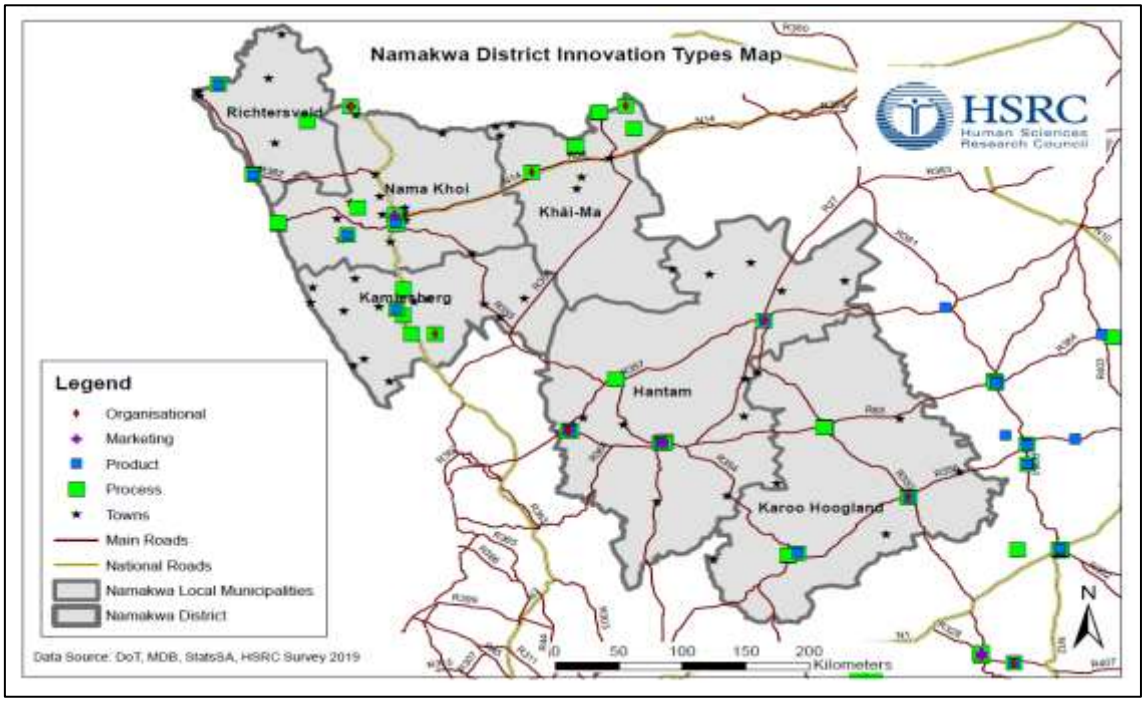


Figure 40. Innovation types location in Namakwa district

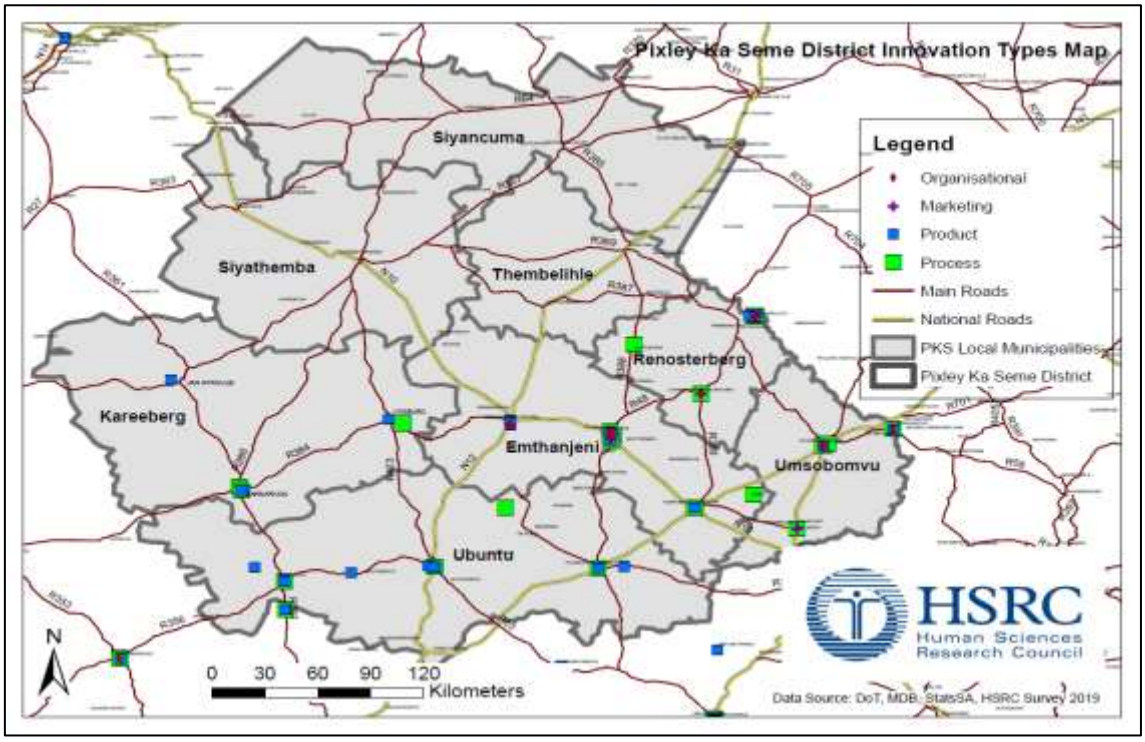


Figure 41. Innovation types location in Pixley district

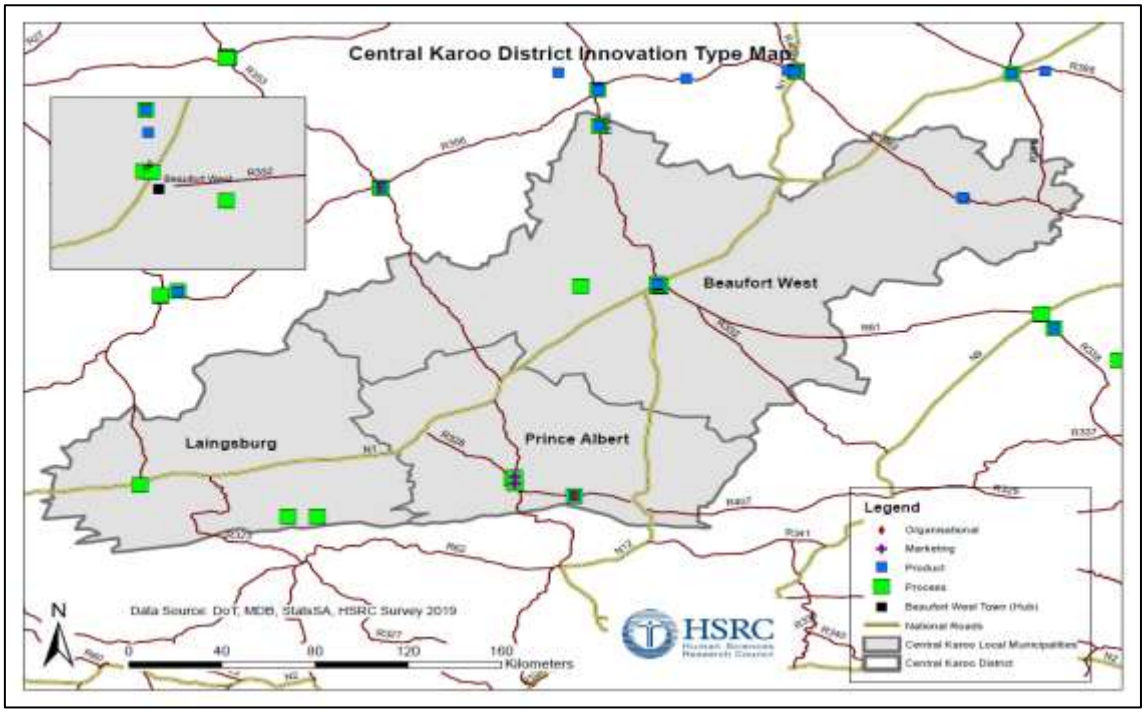


Figure 42. Innovation types location in Central Karoo district

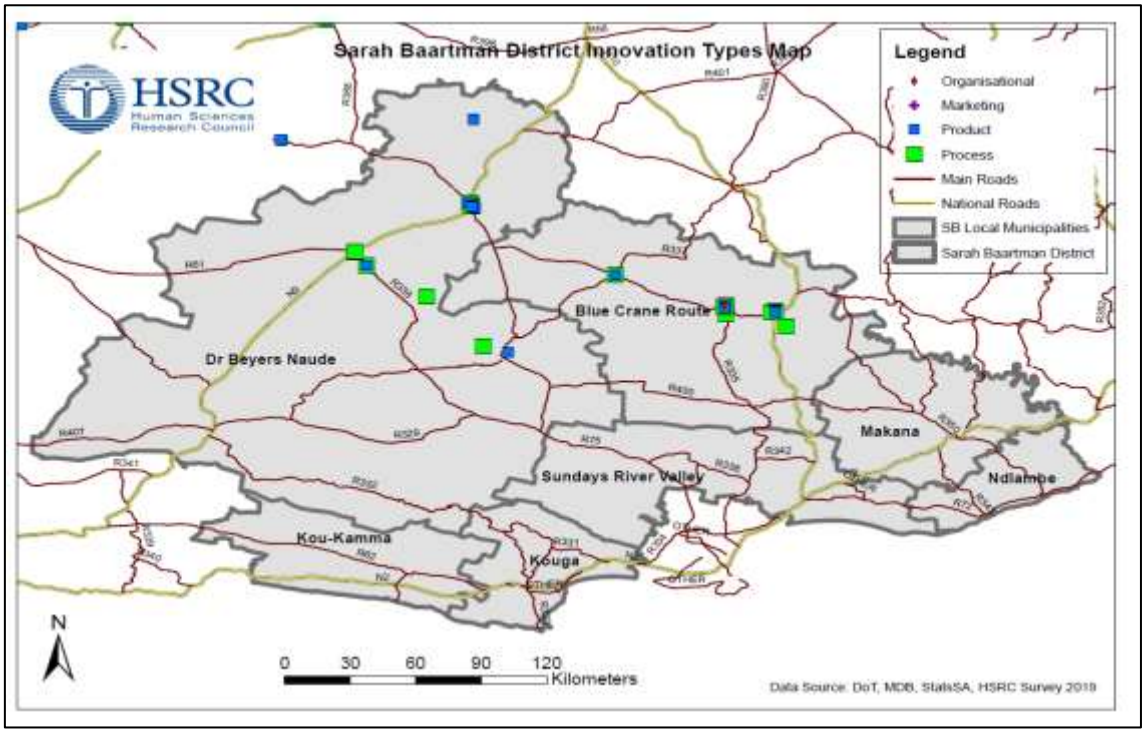


Figure 43. Innovation types location in Sarah Baartman district

Figure 44 shows the different innovation activities that enterprises in the selected Karoo districts were engaged in to implement innovations. Overall, adoption was the most widespread innovation activity in the region, reported by the majority (85%) of the enterprises. Adaptation was the second most common innovation activity practiced by 29% of the enterprises. Namakwa and Sarah Baartman reported the highest proportion (40% and 48% respectively) of the enterprises which made adaptations to the innovations they had adopted from others, followed by Central Karoo (28%) and Pixley ka Seme (14%). This is an important finding as it suggests that innovators in the Karoo are making improvements to production technologies adopted from others to suit their specific needs and local circumstances.

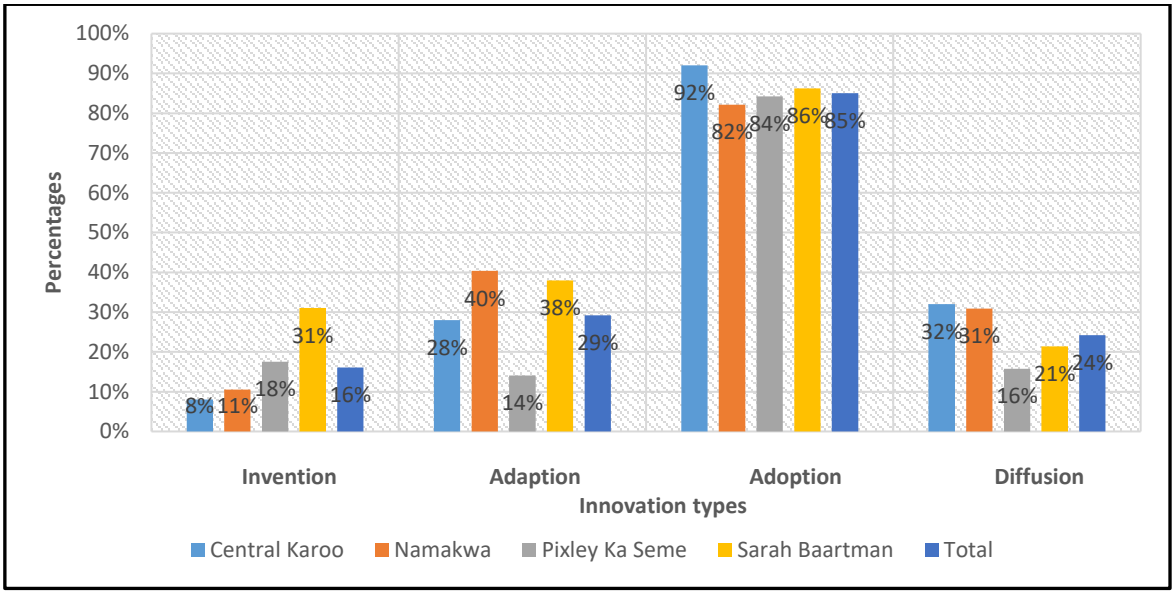


Figure 44. Innovation activities in the selected Karoo districts

Diffusion was the third most popular innovation activity, practiced by just less than a quarter (24%) of the innovators in the region. A considerable proportion of innovators across the four districts shared their innovations with others, with Central Karoo and Namakwa contributing the highest proportions (32% and 31% respectively), followed by Sarah Baartman (21%) and Pixley ka Seme (16%). The finding that some innovators are sharing their innovations with others is important as it indicates that innovators who are adopting production technologies from elsewhere are sharing these innovations with others, which augurs well in terms of technology spread and adoptions. Generally, inventors of original and ground breaking artefacts or innovations were very few, with only 16% of the enterprises, reporting to have engaged in inventions. This is unsurprising given that most of the innovation activities in the developing countries are mainly imitation of the inventions from the developed countries. By contrast, Sarah Baartman

reported the highest proportion (31%) of inventors, followed by Pixley ka Seme (18%), Namakwa (11%) and Central Karoo (8%).

Innovators in the Karoo adopted a wide range of technologies which assisted them in running their business operations and providing goods/ services better or faster. One such enterprise is a fruit farm based in Laingsburg, Central Karoo district, which has adopted drones to implement precision agriculture. The drones are used to collect real time accurate information that allows for precise decisions (e.g., monitoring water pipes in the field for early detection of any damaged pipes, thus saving repairing costs), as well to patrol the activities in the farm to improve security. Other examples of process innovations identified in the agricultural sector included those that were adopted and implemented by innovators in the Namakwa district where farmers adopted computerised irrigation systems and packaging systems.

In the manufacturing and agro-processing sector, examples of process innovations adopted by innovators included new, technologically advanced machinery utilised to assist in speeding up the process of producing more products, resulting in improved supply of products to markets and increased profits. The machines, as indicated by the innovators, also helped in reducing labour costs as they did not have to spend more money on labour given that much of the work was executed by machines. Examples of such machines were identified in innovative enterprises in Concordia and O'Kiep, Nama Khoi local municipality. Another interesting technology was identified at the Robert Mangaliso Sobukwe Museum's craft tech club based in the Sarah Baartman district. The enterprise adopted a 3D printer which uses recycled plastic for to produce educational toys and equipment to educate local youth. In addition to the equipment, the youths are trained in coding techniques.

In the retail sector, moving away from the manual way of carrying out tasks by adopting advanced computer applications / ordering systems which were then adapted to suit enterprises' needs was the most popular process innovation. The softwares were adopted and adapted to assist in stock monitoring, record keeping/filing and automatically tracking all transactions. Innovations also occurred within the education and training sector. One such enterprise was a driving school based in Springbok which adopted a simulator (a technologically advanced demo car machine) which assisted the learners, especially the disadvantaged ones without cars at home, in gaining confidence in driving prior going to the driving field to drive actual vehicles.

Figure 45 to 48 show the prevalence of innovation activities in the respective four Karoo districts. Overall, the different innovation activities are prevalent around the small towns, and especially near major transport and communication infrastructure.

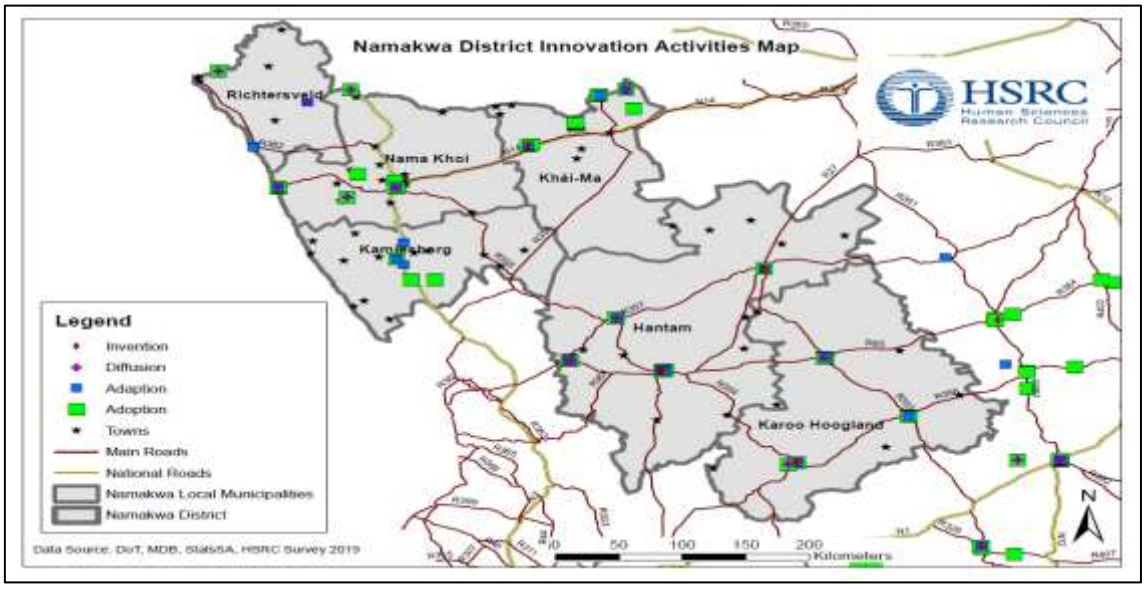


Figure 45. Innovation activities location in the Namakwa district

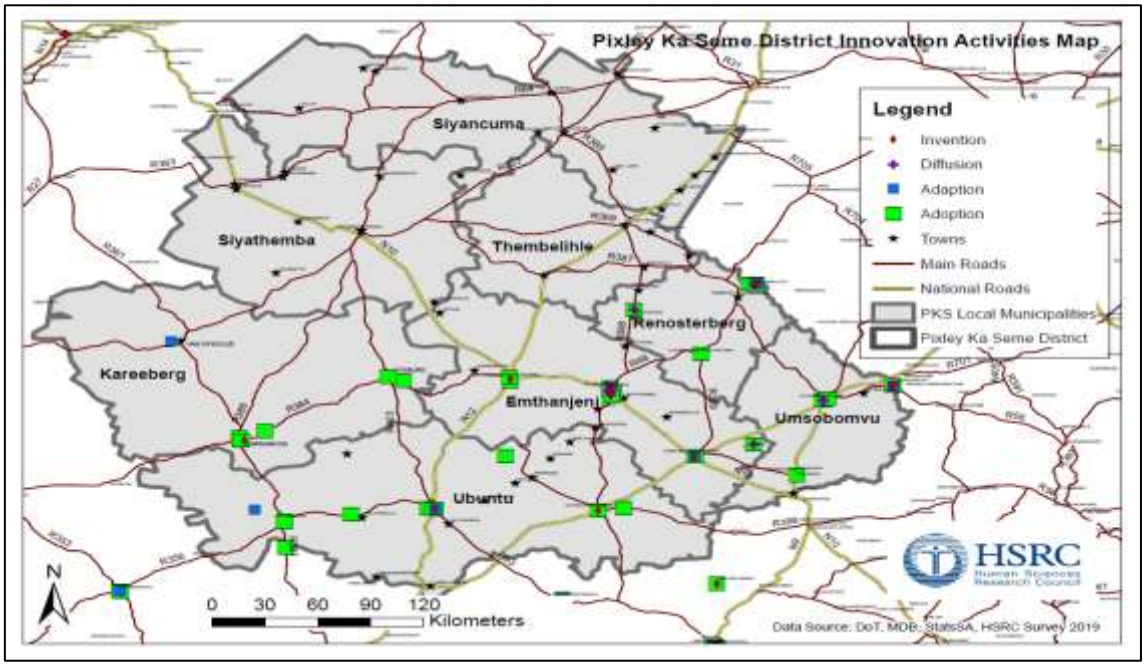


Figure 46. Innovation activities location in the Pixley district

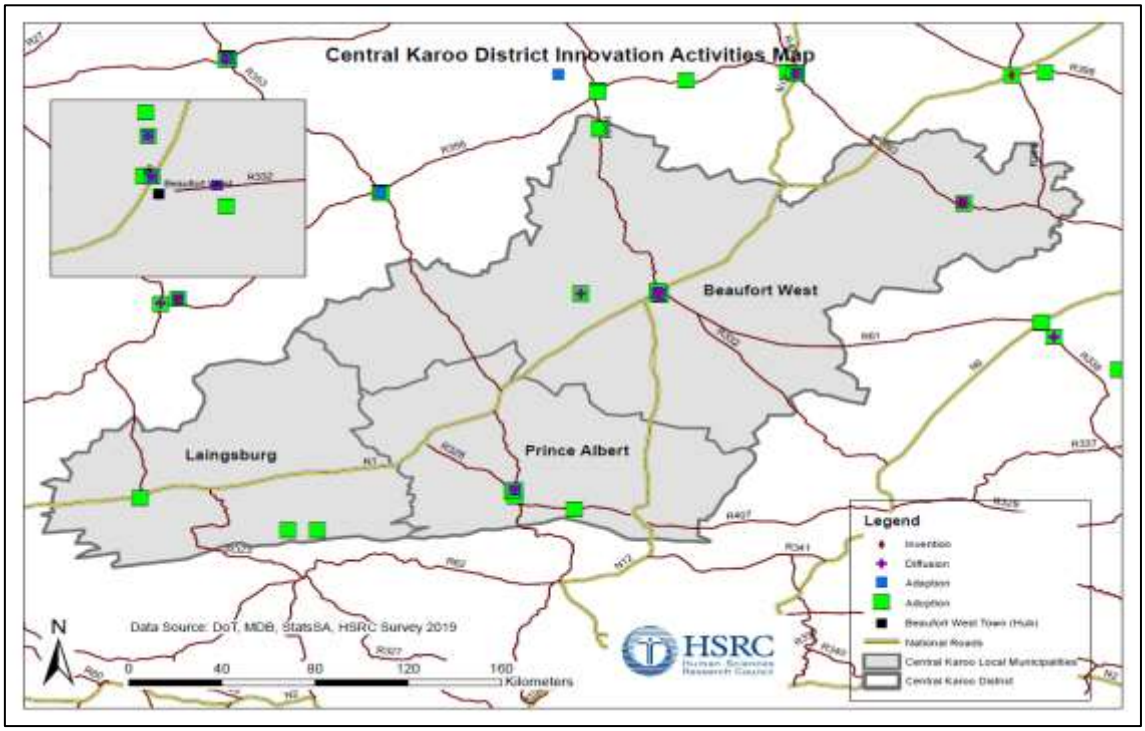


Figure 47. Innovation activities location in the Central Karoo district

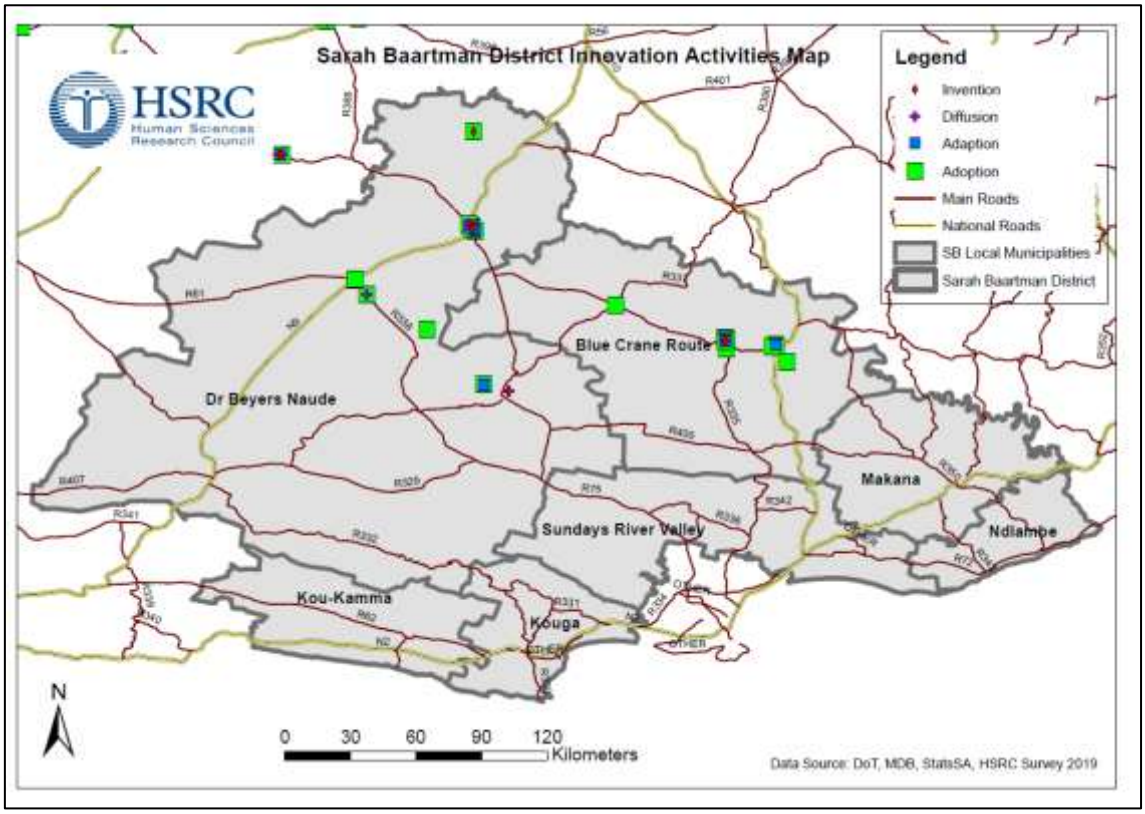


Figure 48. Innovation activities location in the Sarah Baartman district

The general trend across the districts (Figure 49) was that very few enterprises (24%) implemented ground-breaking innovations that were new to the sector. The exception is, Sarah Baartman, which had the highest (66%) of innovators that reported to have implemented innovations that were new to the sector. An example of such an innovation is an internet café which was established in 2017 in conjunction with Bedford IT Hub introduced solar energy customised container, and is both new in the area and market. The results indicate that most of the enterprises (90%) across the Karoo districts implemented innovations that were only new to their own enterprises.

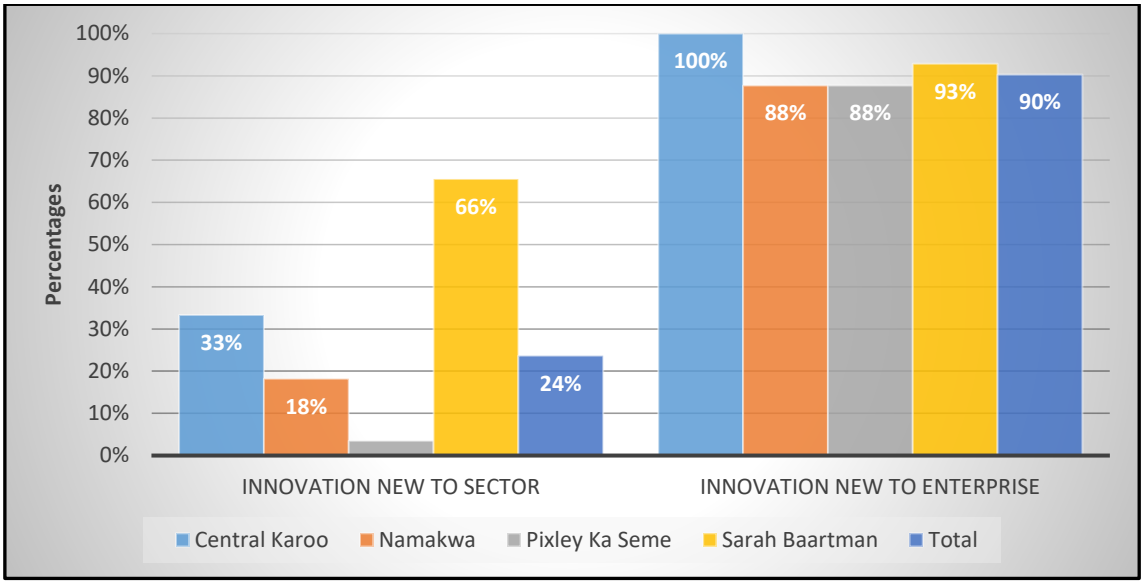


Figure 49. Newness of the innovations to the enterprise or sector

As shown in Figure 50 a considerably small proportion (4%) of innovators in the region indicated registering their inventions as intellectual property. This finding is to be expected as the level of invention in the region is low (Figure 36).

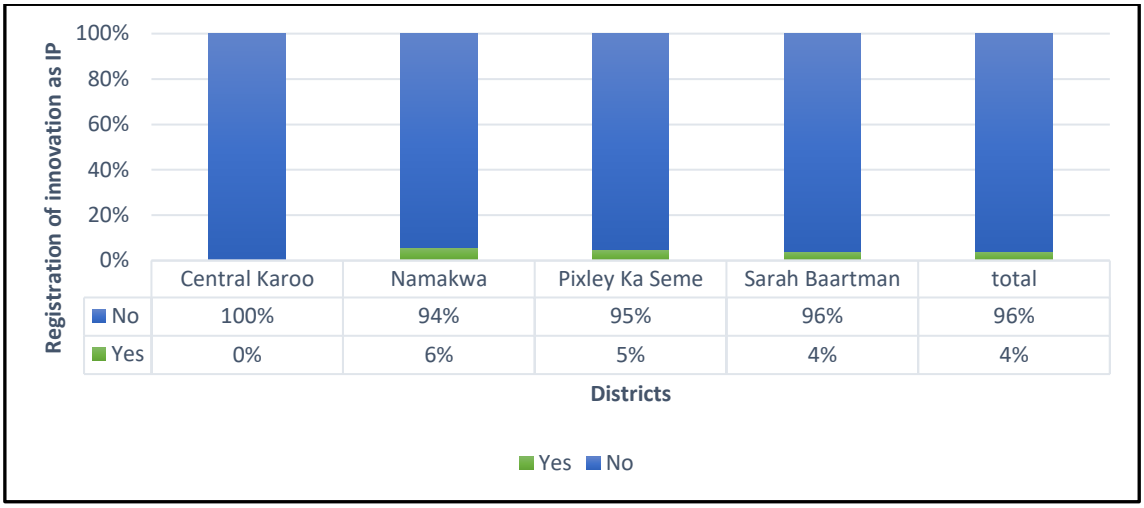


Figure 50. Registration of inventions as intellectual property

The results as shown in Figure 51 indicate that a high proportion (56%) of the innovative enterprises in the four Karoo districts adopted low-tech innovations. Namakwa and Central Karoo districts contributed the highest (76% and 64% respectively) in terms of the proportion of enterprises that implemented low-tech innovations. A considerable proportion of innovating enterprises in Sarah Baartman (57%) and Pixley ka Seme (51%) adopted high-tech innovations. The results suggests that the innovators in these districts focussed mainly on adopting high-level technologies to improve their production activities. This explains why these enterprises fail to make any changes to these high-tech production processes.

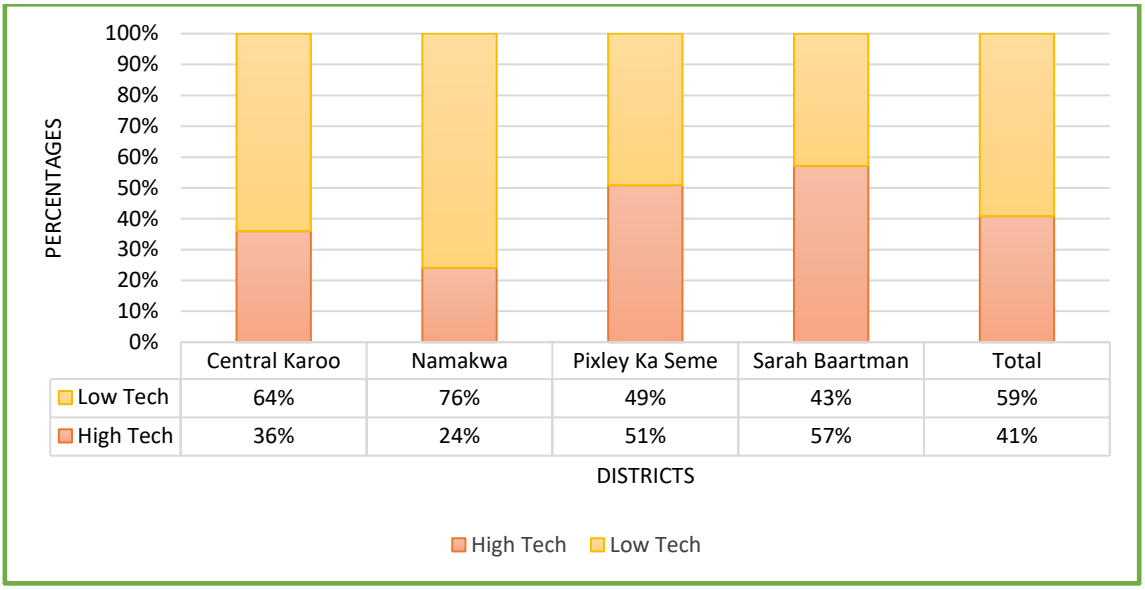


Figure 51. Adoption of high-tech or low-tech innovations

6.3 Internal enterprise environment and access to resources for innovation

Figure 52 shows that most of innovation activities occurred in the business premises/ plants/ workshops / factories of the enterprises (53%), followed by farmlands or fields (24%). Less formal spaces such as home and villages are at 19% and lastly, only 2% of innovation activities took place in education institutions or research laboratories where innovation activities would be expected to originate.

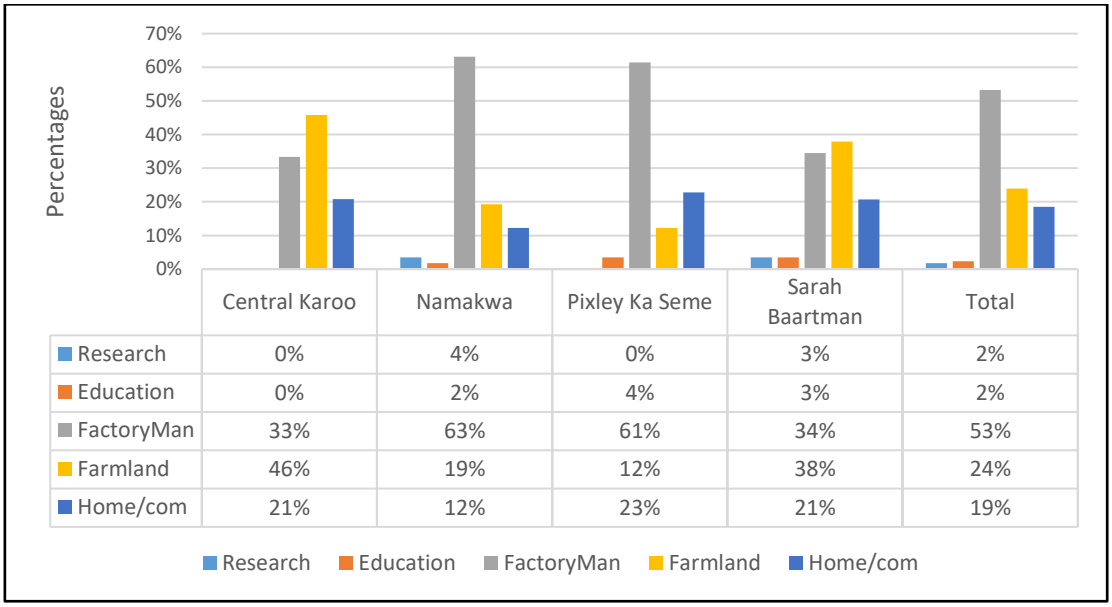


Figure 52. Main place for innovation activities

Figure 53 indicates that a high proportion of the enterprises in the Karoo had access to reliable electricity (87%) and access to ICT (71%). However, less than half (47%) of enterprises had access to ICT infrastructure in Pixley. The results indicate that only a paltry 12% of the innovating enterprises had access to libraries with relevant information and publications and 14% indicated having access to science laboratories with usable equipment.

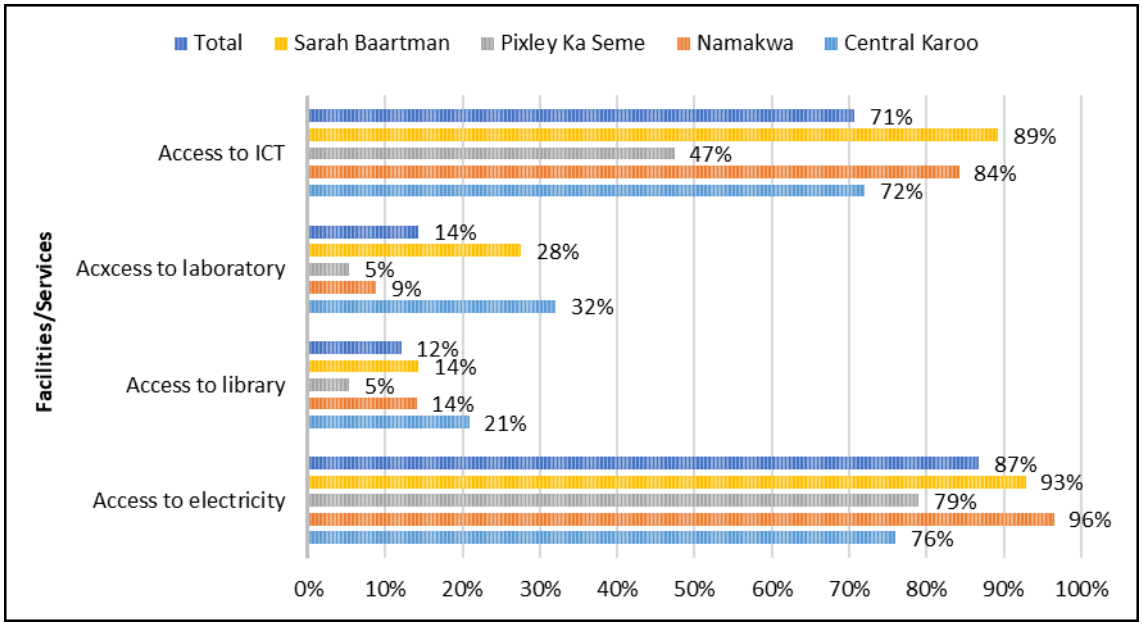


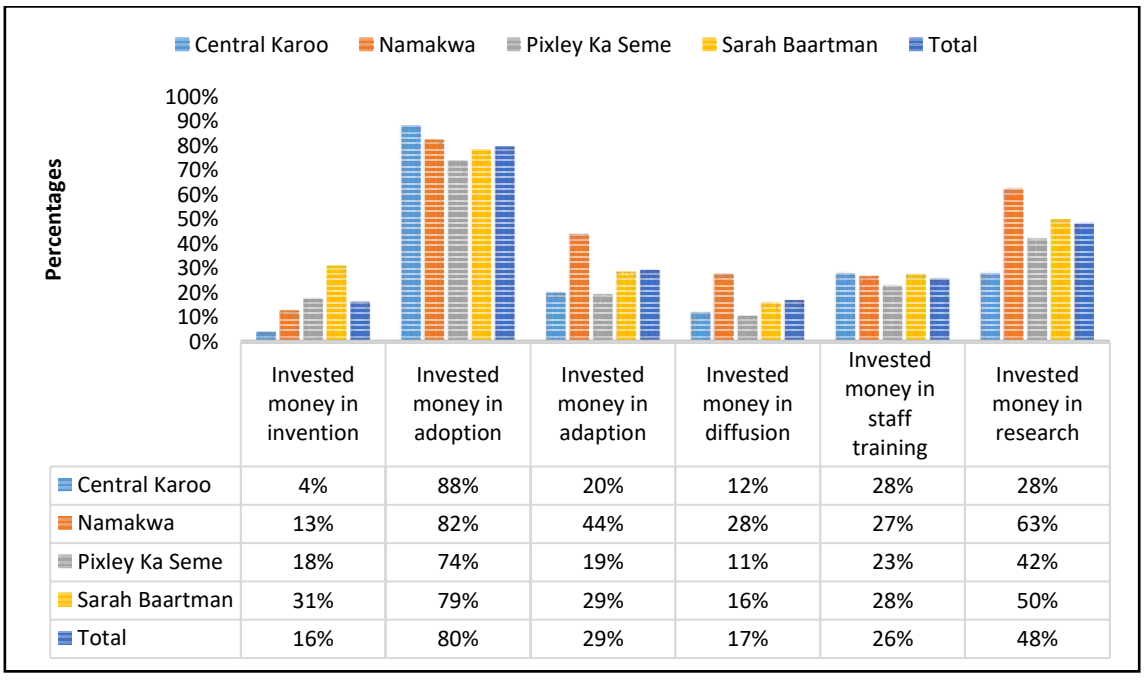
Figure 53. Access to innovation enhancing infrastructure

While the results indicates a high proportion of access to electricity and ICT, it is important to note that many of the enterprises surveyed formed part of the commercial private sector, placing a skewed view of the reality of the many other enterprises and individual innovators who do not have access to electricity and functioning ICT. Indeed this is a reality for many living in the rural areas of South Africa, particularly the Karoo.

The survey has indicated that in many parts of the selected Karoo districts, libraries act as centres of access to ICT including the internet for people in the marginalised areas. Thus, limited access to the relevant information, publications and laboratory facilities perhaps explains why innovators are focusing on adopting technologies developed elsewhere, and mainly applying them without making any changes. It is therefore

important that further investment and support of the facilities be placed for the growth of innovation especially in the marginalised areas.

Figure 54 illustrates that a large portion (80%) of innovators in the Karoo invested a significant amount of their money or profits towards the adoption of innovation. Half (50%) of the enterprises in the region also invested their money or profits in staff training for the use of innovation. This possibly suggests that enterprises are keen to learn and enhance their capacity and knowledge to improve the quality of goods and services and efficiency of workflows. In addition, as new technology is adopted, training demands within the enterprises are likely to rise as staff would require upskilling.



	Invested money in invention	Invested money in adoption	Invested money in adaption	Invested money in diffusion	Invested money in staff training	Invested money in research
Central Karoo	4%	88%	20%	12%	28%	28%
Namakwa	13%	82%	44%	28%	27%	63%
Pixley Ka Seme	18%	74%	19%	11%	23%	42%
Sarah Baartman	31%	79%	29%	16%	28%	50%
Total	16%	80%	29%	17%	26%	48%

Figure 54. Investments in innovation activities

The Namakwa district stands out with 44% of the enterprises investing in adaptation of innovations signifying a growing trend in the district to customise adopted innovations to the local context. Further, enterprises in Namakwa invest more on research than enterprises in the other districts. In line with the other previous results (which showed higher proportions of invention and new innovations to the sector), the results shows that enterprises in Sarah Baartman are more focused on investing in invention activities than those in the other districts.

Figure 55 indicates that 52% of the innovators felt their innovations required further research by another organisation. This is a significant finding considering many innovators were found to be adopting innovation. It is possible that these innovators seek further research as a means to improve or adapt the technologies to better fit local contexts. There is thus an indication that innovators have identified areas of improvement with their adopted technologies. Furthermore, of those who required further research for their innovations, many required the research from South African Universities (54%) and least from state funded research institutions (28%) and SA private research facilities (29%). Looking at district results, innovators in the Namakwa district felt they could in contrast benefit greatly from further research conducted by state funded research institutions (64%), and by international research facilities (57%).

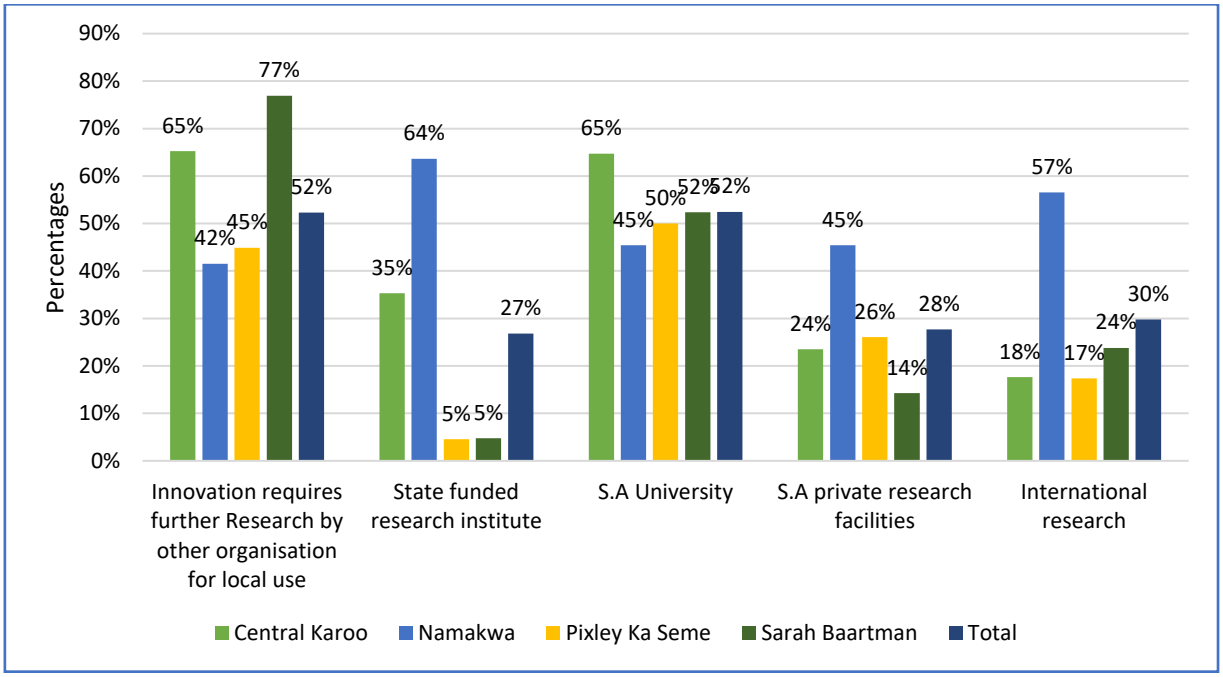


Figure 55. Required research by another organisation for innovation

Innovators in the Karoo face challenges in terms of accessing resources they require for innovation. Figure 56 indicates that only 27% of the innovators in the Karoo had access to resources they require for innovation locally (within a radius of 50 km). Even within the provinces where the district municipalities were found, only 26% of innovators had access to resources they required for innovation. A majority (72%) of the innovators indicated that they accessed the resources in other provinces. For some innovators (11%), they accessed resources required for innovations outside the country's borders.

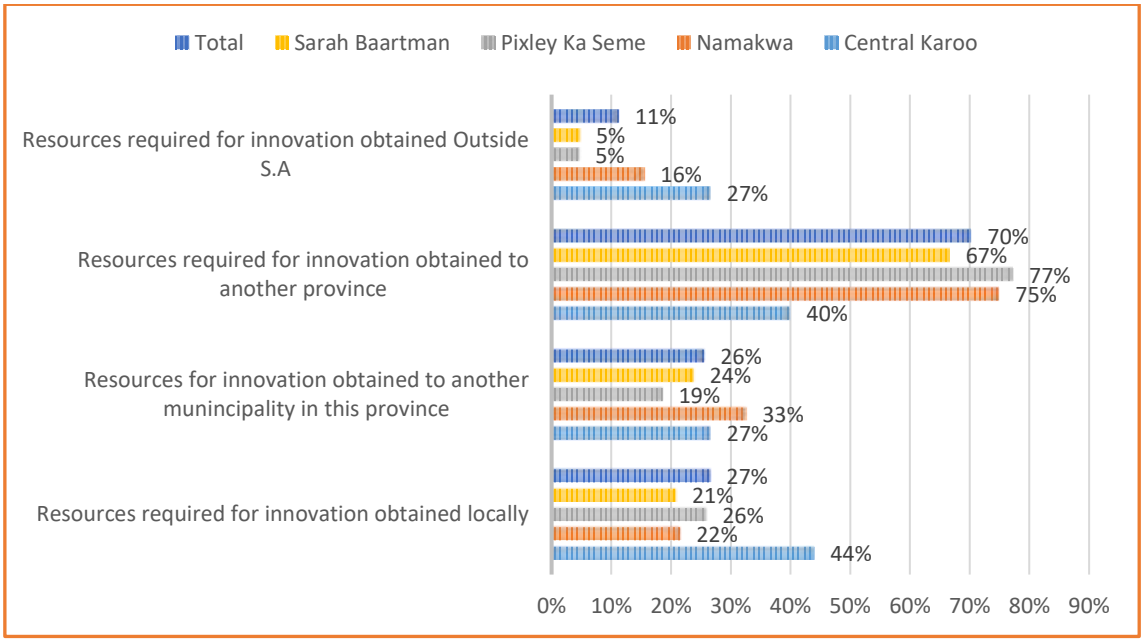


Figure 56. Availability of resources required for innovation

6.4 External enterprise environment for innovation

Figure 57 indicates that a majority of the enterprises in the Karoo (72%) used electricity or energy supplied by the public sector for their innovations, while a small portion of enterprises (19%) used privately sourced energy or electricity. However, in Central Karoo, 45% of the enterprises mentioned using a private source of electricity or energy for their innovations. The results further indicate (Figure 58) that many enterprises in the Karoo (47%) also depended on the public sector for water supply with a small but significant number of enterprises (20%) also reporting depending on private supply of water. Interestingly, Central Karoo stands out with a larger number of enterprises (50%) depending on private water supply. The results are no surprise as the Karoo faces

serious water challenges. The survey results are thus a reflection of these circumstances.

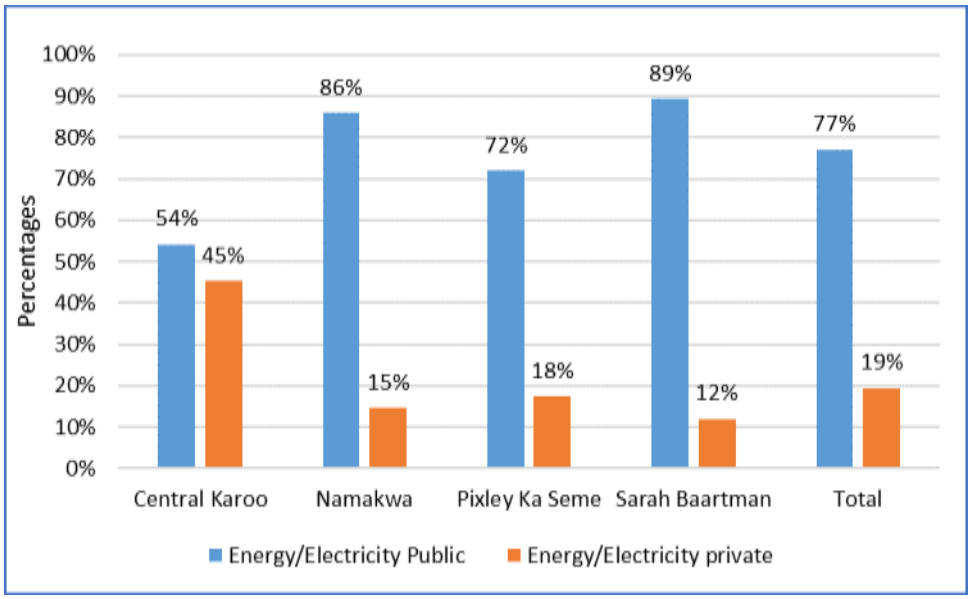


Figure 57.Use of private or public energy/electricity sources

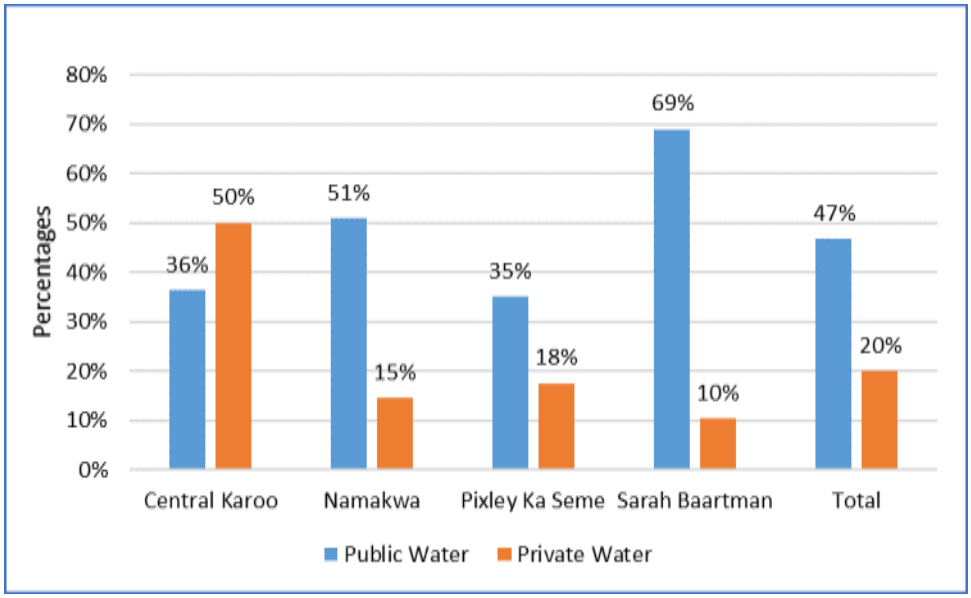


Figure 58. Use of private or public water sources

The survey results also reveal that a small percentage of enterprises depended on the use of higher education and training institutions from both the public and private sources for innovation at 10% and 6% respectively (Figure 59).

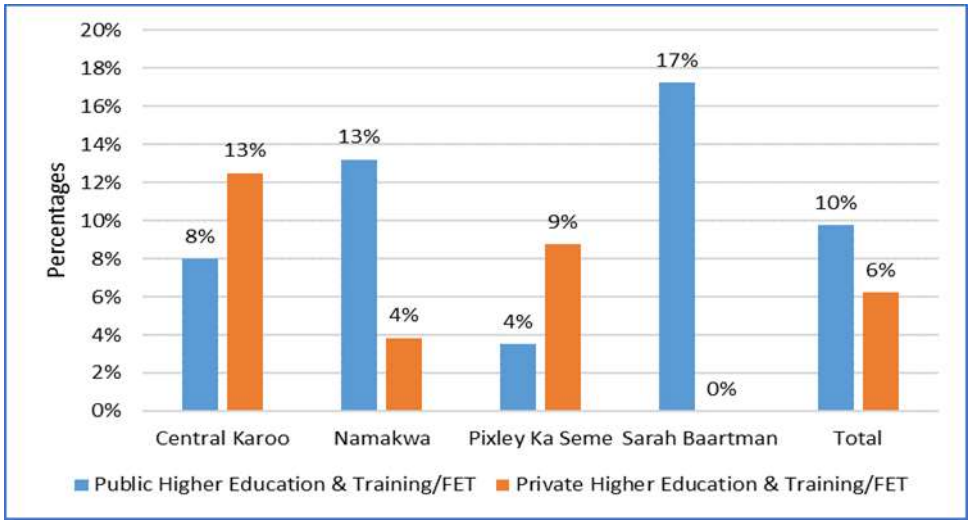


Figure 59. Use of public or private Higher Education & Training institutions

Similarly, a small percentage of the enterprises depended on the use of public (6%) and private research agencies (Figure 60).

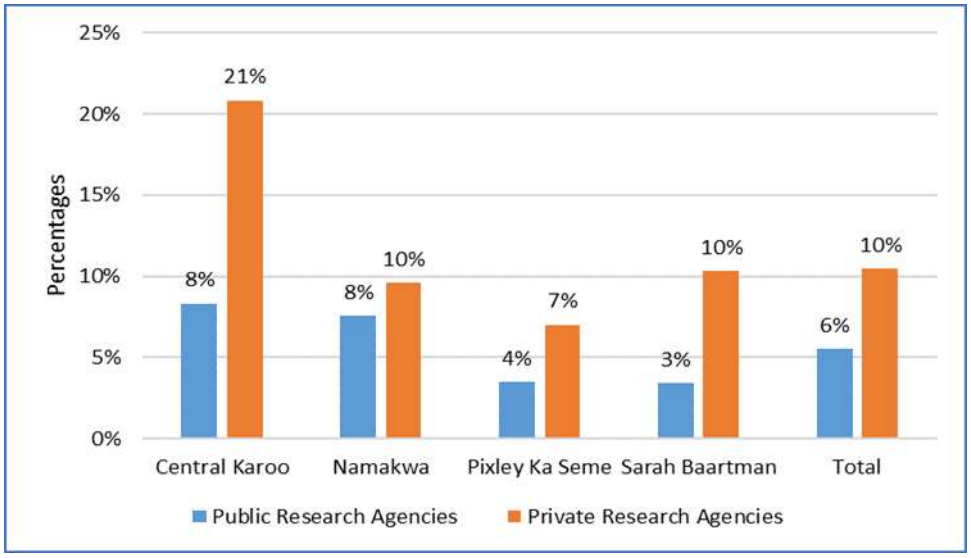


Figure 60. Use of private or public Research Agencies

Private sources are the dominant supplier of ICT within the Karoo (51%) as seen in Figure 61. Supply from the private sources is more dominant in Central Karoo and Sarah Baartman both at 63%, followed by Namakwa at 57%. The use of ICT from public sources in the four Karoo districts remains low at 9%.

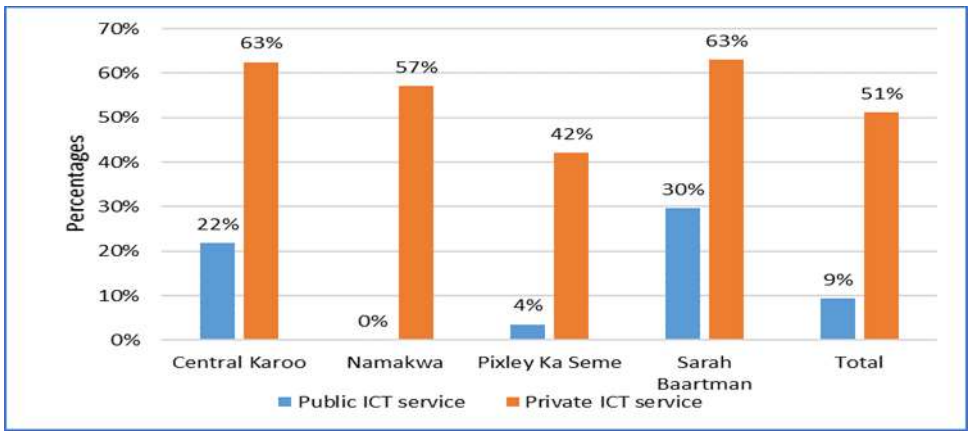


Figure 61. Use of private or public ICT and available devices

A great number of innovators in the Karoo, more than 50%, depended on the use of private sources for security and policing of their innovations (Figure 62). Only an approximate 7% of the innovators utilised public sources for securing their innovations. This is highly suggestive of a large number of private companies in the Karoo that provide encryption, security or policing of enterprises and their innovation.

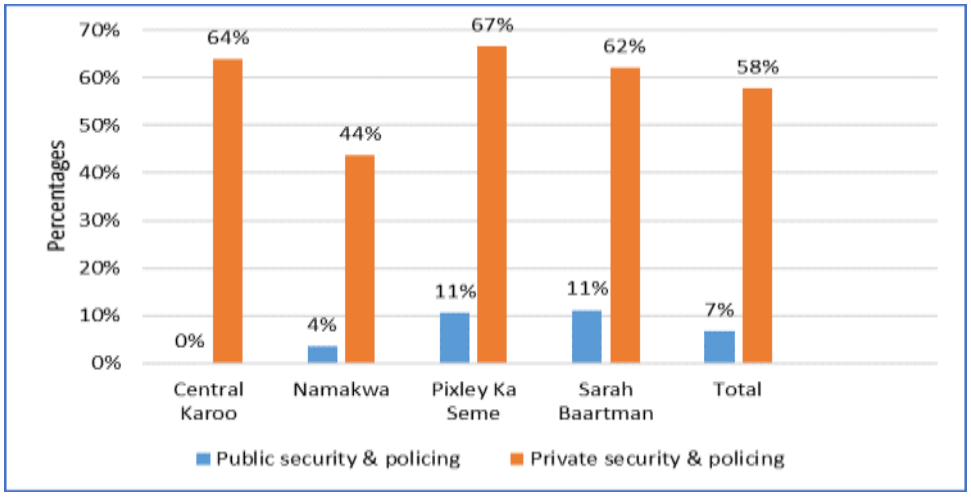


Figure 62. Use of private or public security and policing for innovations

Figure 63 indicates that the innovative enterprises in the four districts were made aware of new innovations mostly through informal networks (58%) such as, peers and colleagues, including traditional and indigenous knowledge practitioners. Management or specialist departments within the enterprise followed at 55%. Government or municipal service providers (12%) and formal networks (32%).were not popular sources of innovation information or awareness.

There were some variations among the districts in terms of sources of information or awareness of innovations. For example, while input suppliers were barely vital as innovation information sources in other districts, an overwhelming majority (82%) of the enterprises in Namakwa indicated that they receive innovation information from the input suppliers. Also, while informal networks were key innovation information sources for all the other districts, only 33% of the enterprises reported informal networks as crucial information sources. In sum, enterprises in Namakwa report being made aware of innovations typically by mainly suppliers of inputs or buyers / recipients of enterprise

products (82%), while Pixley ka Seme district enterprises were made mostly aware by management or specialist departments within their enterprises (47%). In Central Karoo enterprises were made aware commonly by both the management or specialist department as well as through informal networks. Sarah Baartman enterprises on the other hand were mostly made aware of innovations mainly through informal networks (76%).

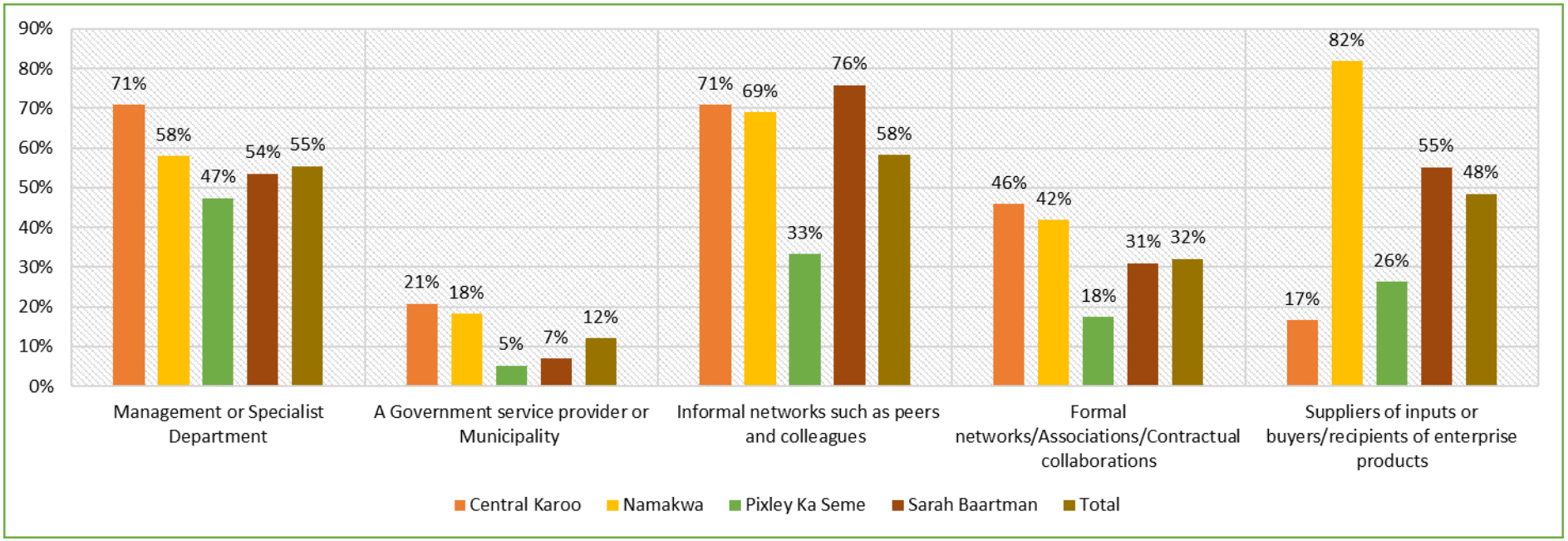
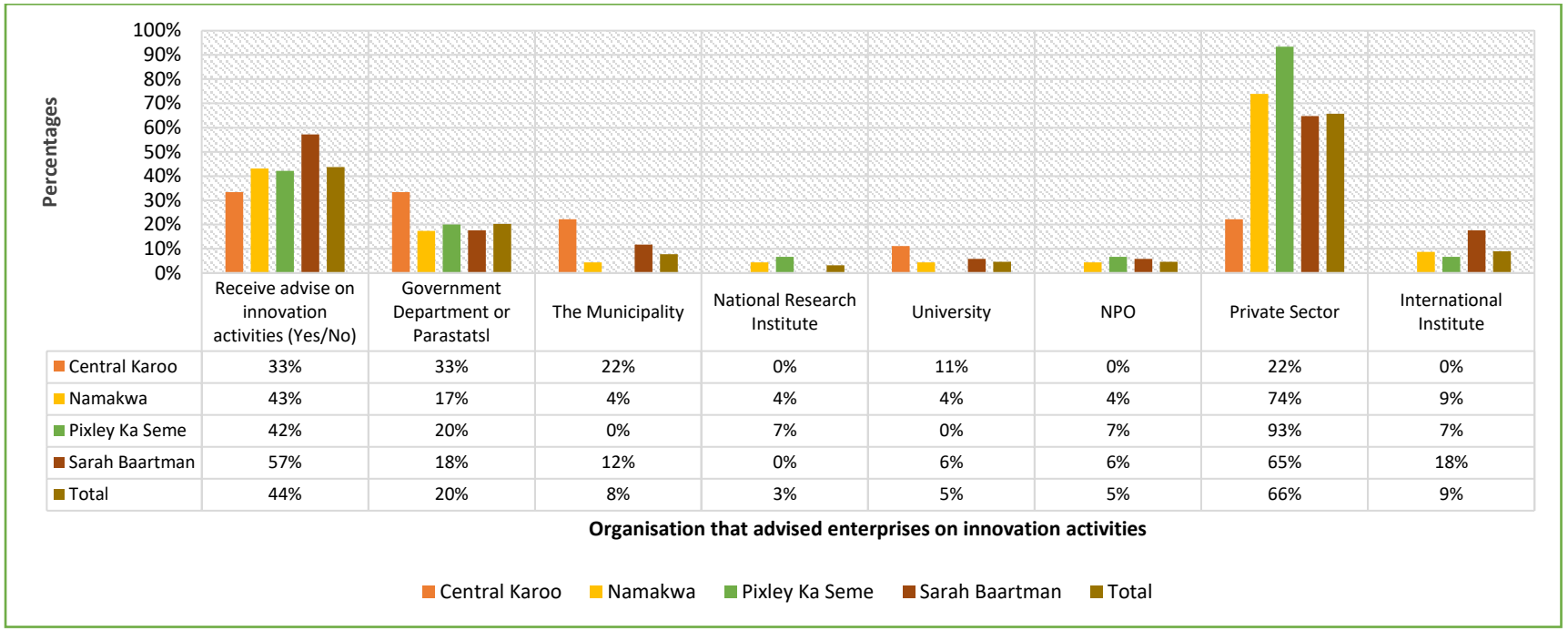


Figure 63. Sources of information or awareness of innovations

Figure 64 shows a range of organisations that advised innovative enterprises in the Karoo on innovation activities. The results of the survey reveal that less than half (44%) of the innovators in the Karoo received advise on innovation activities. In Sarah Baartman however, a higher number of enterprises (57%) were found to have received advice on innovation activities compared to other districts. With that said, when looking at the type of organisation or enterprise innovators in the Karoo received most advice from, the private sector leads at 66%. This is followed by a meagre 20% by government departments/parastatals, and 9% by international research institution. Universities (5%), the municipality (8%) and NPO's (5%) seem to have the least interaction with local innovators in terms of sharing of advice or information about innovation activities.

The private sector leading with advice on innovation activities is unsurprising as novelty is often synonymous with the private sector. The results thus support this assumption of novelty and new information and knowledge concerning innovation. What is of concern is the low percentages from the government departments/parastatals, municipality and the universities. Literature informs us that these are fundamental pillars in the systems of innovation, particularly the national system of innovation. We can thus deduce that, at a regional level, these are pillars need to cement a stronger presence in order to strengthen regional and local innovation systems for better socio-economic development.



	Receive advise on innovation activities (Yes/No)	Government Department or Parastatsl	The Municipality	National Research Institute	University	NPO	Private Sector	International Institute
Central Karoo	33%	33%	22%	0%	11%	0%	22%	0%
Namakwa	43%	17%	4%	4%	4%	4%	74%	9%
Pixley Ka Seme	42%	20%	0%	7%	0%	7%	93%	7%
Sarah Baartman	57%	18%	12%	0%	6%	6%	65%	18%
Total	44%	20%	8%	3%	5%	5%	66%	9%

Figure 64. Organisations that advised enterprises on innovation activities

6.5 Networking for innovation

Figure 65 shows that half of the enterprises in the Karoo (52%) reported that their innovation activities were dependent on their interactions or interlinkages with other enterprises or agencies. This indicates that networking plays an important role in innovation among enterprises. Central Karoo in particular had an overwhelming 82% of enterprises reporting that they depend on networking for their innovation activities.

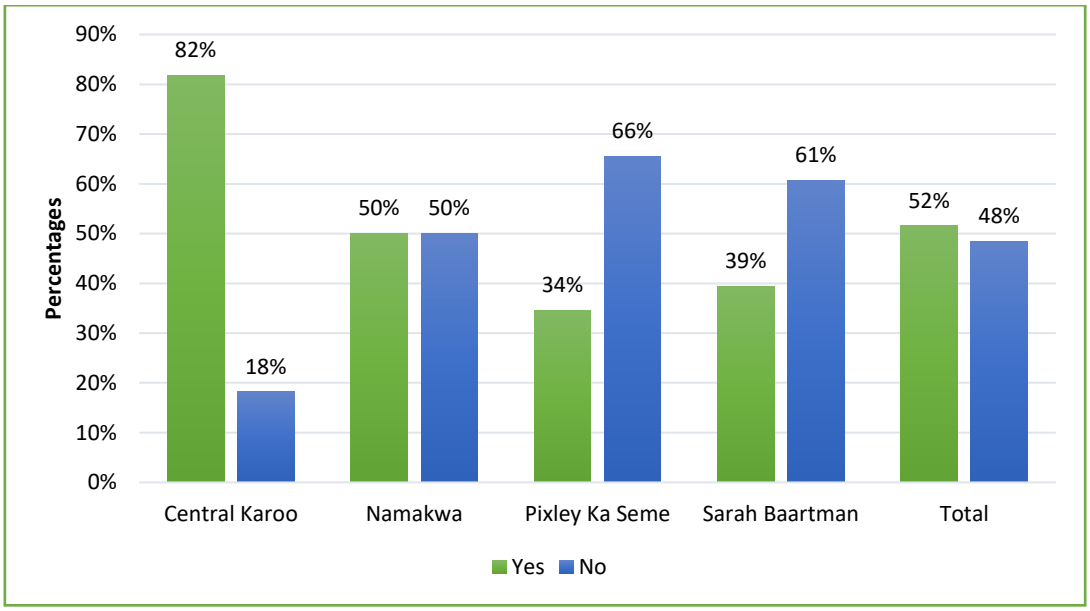
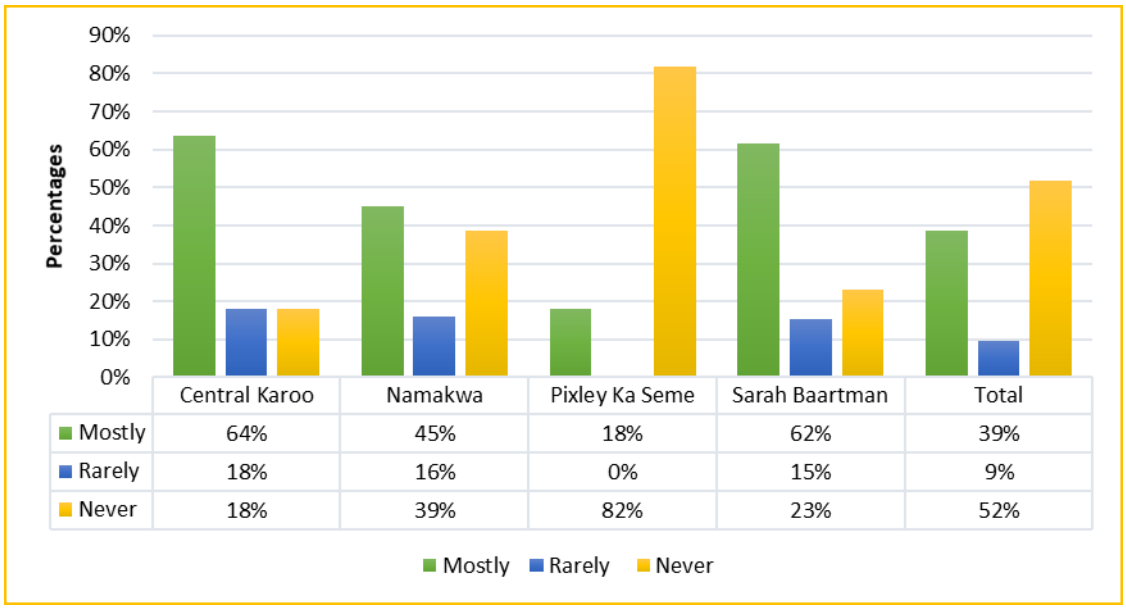


Figure 65. Innovation activities depend on interactions with others

According to many of the networking enterprises in the Karoo, 39% reported interactions mostly relying on formal agreement, while 9% of enterprises reported that sometimes, though rarely engaging on formal agreements (Figure 66). Most interactions (52%) were not based on formal agreements, but were informal. The survey results continue to

inform us that innovation activities often occurred within informal environments, those often not based on formal agreements.



	Central Karoo	Namakwa	Pixley Ka Seme	Sarah Baartman	Total
Mostly	64%	45%	18%	62%	39%
Rarely	18%	16%	0%	15%	9%
Never	18%	39%	82%	23%	52%

Figure 66. Networking/interactions for innovation based on formal agreements

Figure 67 shows the formal linkages among the innovative enterprises within and without their respective province. Overall, the map shows few linkages based on formal agreements. The linkages are not restricted to the districts the enterprises are located, but they often cross these administrative borders. There is also evidence of the enterprises located in the selected districts networking with enterprises located in the country's economic hubs of Johannesburg and Cape Town.

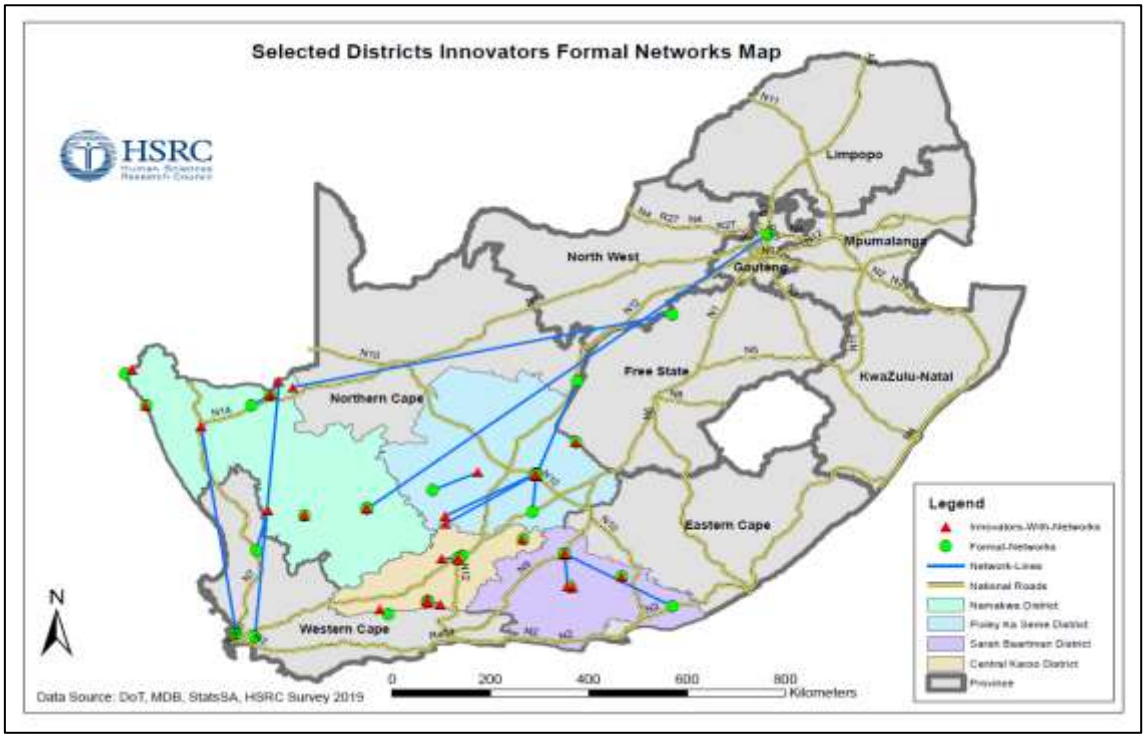


Figure 67. Formal linkages for innovation among enterprises in the four Karoo districts

Figure 68 shows the informal networks by the innovative enterprises in the four selected districts in the Karoo. The figure shows high levels of informal networking for innovation among the enterprises. However, the networking if often not with enterprises located in the respective districts, but often in other districts and provinces. In particular, the figure shows the importance of enterprises located in Cape Town in driving innovation in these districts. This is particularly the case for innovators located in the Namakwa district, as shown by the many arrows linked to Cape Town. Also key are the two metros in Gauteng, Johannesburg and Pretoria. The figure also shows that no linkages among these

enterprises are those located in other provinces such as KwaZulu-Natal, Mpumalanga, Limpopo, or even North West.

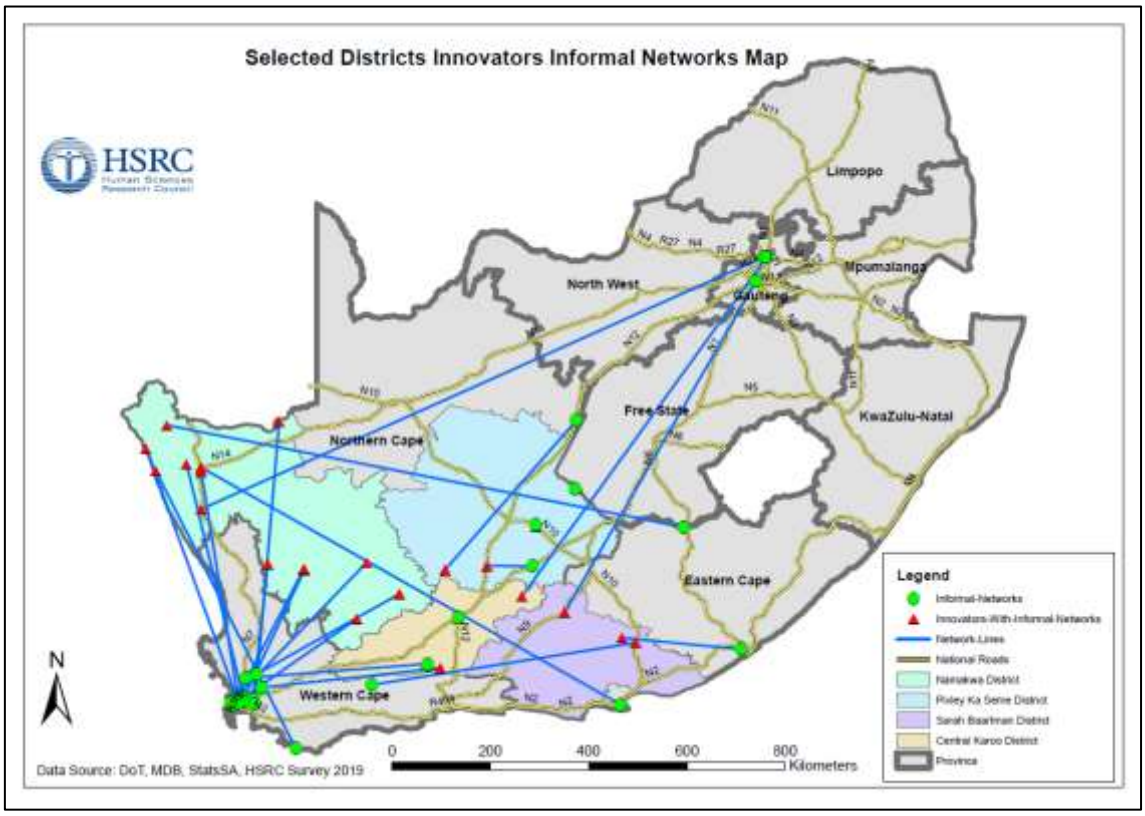


Figure 68. Informal linkages for innovation among enterprises in the four Karoo districts

Figure 69 indicates that within the selected Karoo districts, 42% of enterprises entered into joint innovation activities based on informal agreements, while 58% of the enterprises engaged based on formal agreements, contracts and binding rules governing these interactions. This suggests that once innovators establish a particular innovation activity they want to pursue jointly, i.e., invention, adoption, adaption and diffusion, documentation or contracts are needed to determine the rules, terms and conditions as

any two partners taking on a new business venture would. That is, once enterprises agree to a joint innovation activity, the survey results reveal that enterprises would rather enter into a formal agreement.

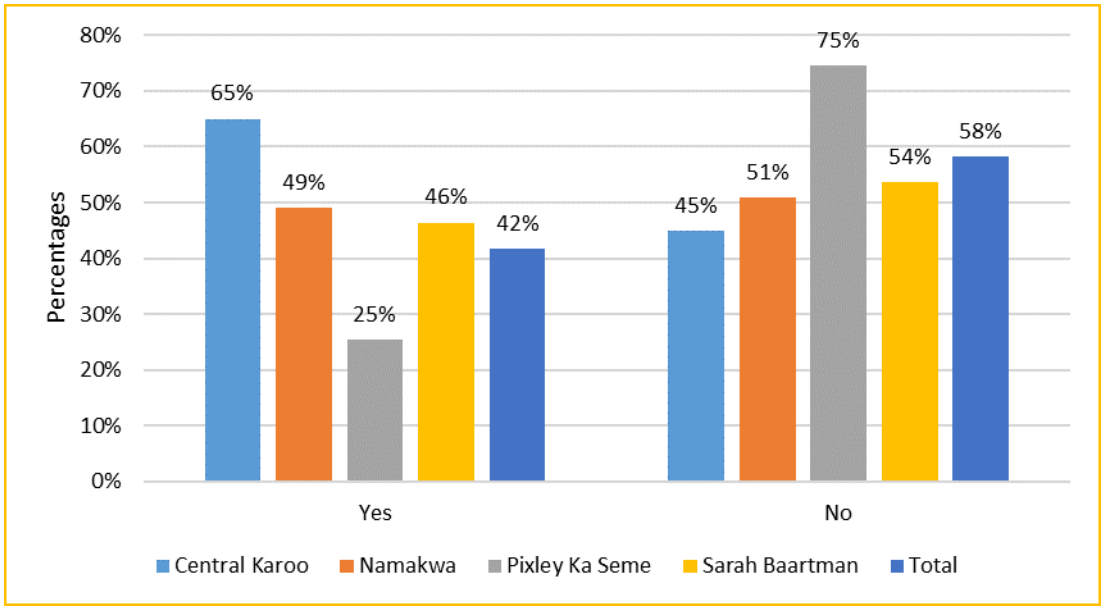


Figure 69. Joint innovation activities based on non-formal agreements

The networking activities have produced significant and positive outcomes. According to Figure 70, a majority of the innovators in the selected Karoo districts (72%) indicated that their networks were effective and produced positive outcomes. This suggests that, for the majority of the innovators, the arrangements to produce and share new ideas, processes and practices with other enterprises have achieved the stated objectives. Similarly, most of the innovators (64%) considered their networking activities efficient, which means that the networking produced benefits at no extra direct and indirect costs to the innovation network.

Networking serves great purposes for creating innovative regions and local areas. Through formal or informal networks, institutions and people with different ideas, skills, talents and expertise come together to share innovation, knowledge, risks and successes associated with pursuing innovation. The results of the survey thus support this as many innovators found their networks effective and producing positive outcomes.

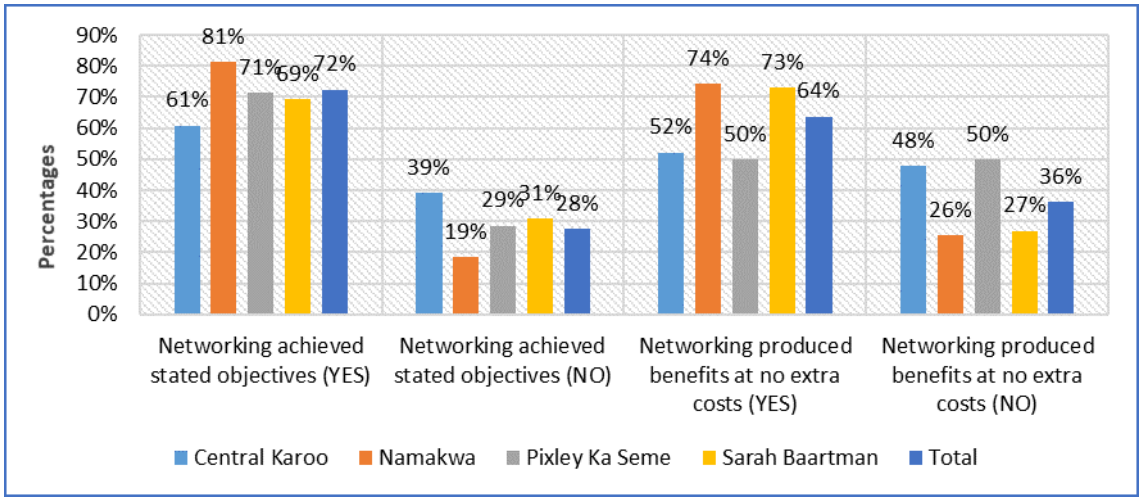
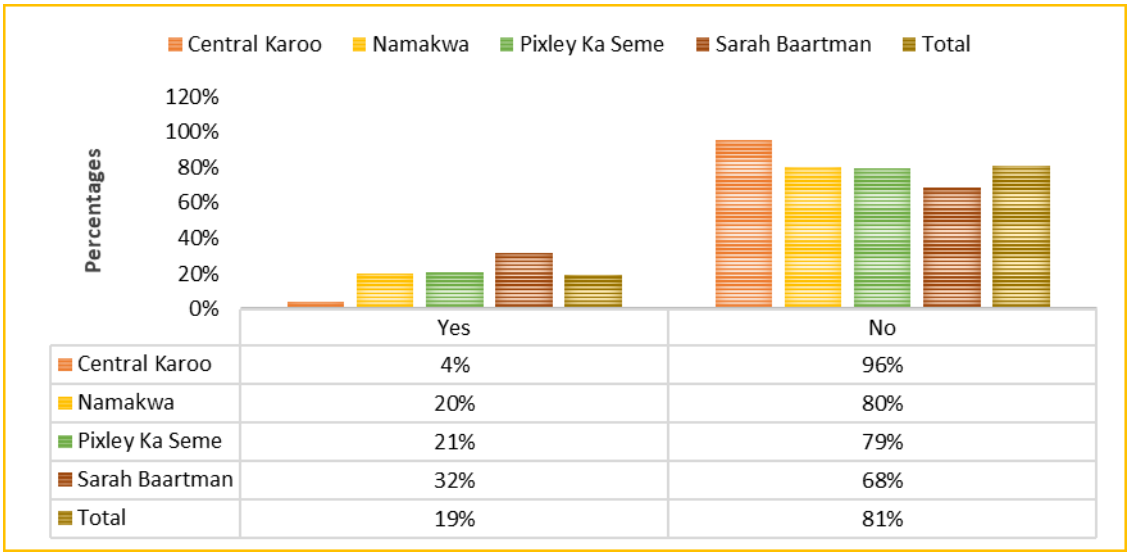


Figure 70. Effectiveness and efficiency of networking with positive outcomes

Figure 71 shows that an overwhelming 81% of enterprises profiled reported that there were no improvements made to the enterprises' innovations by recipients and only 19% of the recipients of the innovators' innovations made improvements or adaptions to suit their specific needs or situations. This indicates that like most innovators, recipients of the innovations only adopt and use them without any alterations.



	Yes	No
Central Karoo	4%	96%
Namakwa	20%	80%
Pixley Ka Seme	21%	79%
Sarah Baartman	32%	68%
Total	19%	81%

Figure 71. Improvements or adaptions of enterprise's innovations by recipients

6.6 Institutional support for innovation

The survey results indicate that many innovators (41%) within the region were not aware of the laws, policies and regulations that control innovation activities (Figure 64). In addition, only 38% were very aware and only 21% somewhat aware. However, when combined (very aware and somewhat aware), the results indicate that there are more innovators (59%) who were aware or perhaps have heard or read about laws, policies and regulations that control innovation.

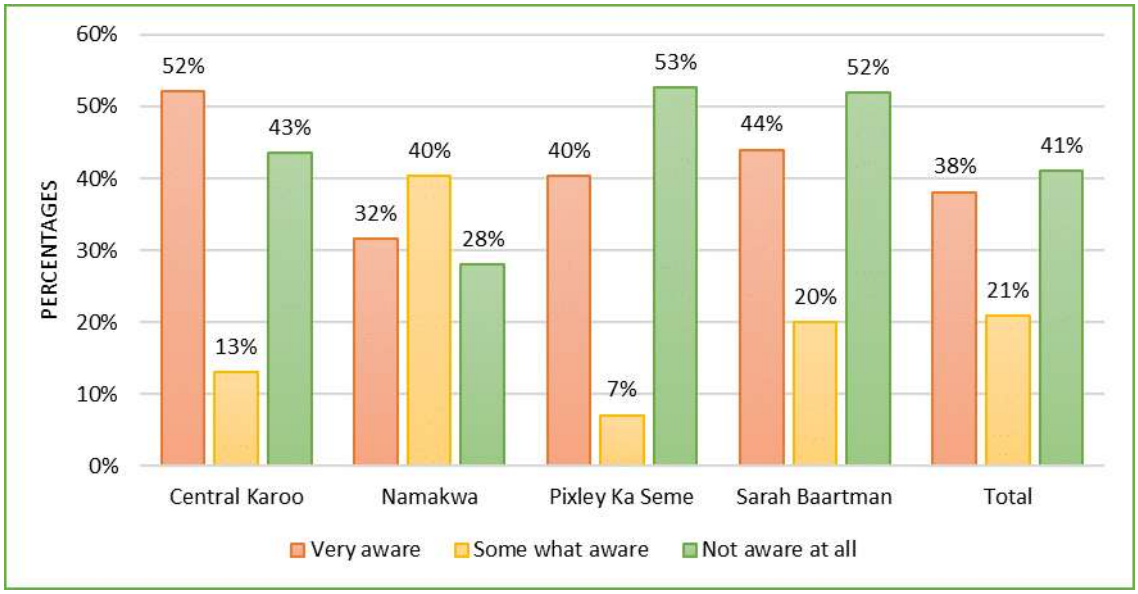
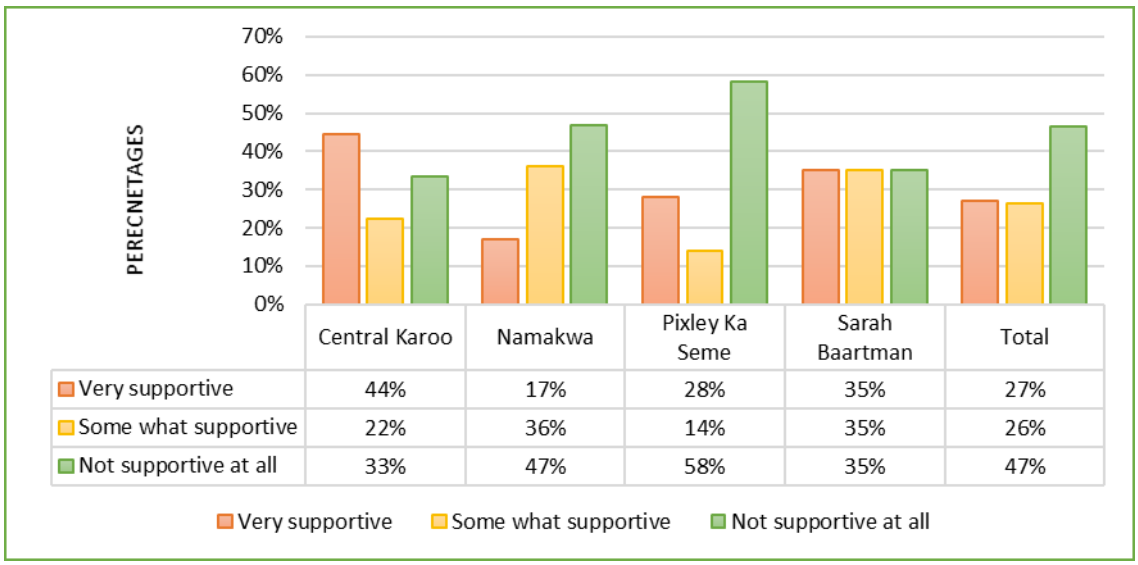


Figure 72. Awareness of the laws, policies, regulations and agencies that control innovation activities in their sectors

District results indicate that both in Pixley Ka Seme and Sarah Baartman, more than 50% of the innovators were not aware at all while in Central Karoo, 52% were very aware of the laws and policies. The results are thus very indicative of the importance of policy awareness within communities, bridging the gap and improving the exposure of innovators to the relevant information necessary to boost the sustainable growth of innovation in local areas. Essentially, exposure of policies and regulations by the relevant institutions and agencies to local innovators strengthens the impact of a regional innovation strategy.

Figure 73 indicates that many innovators (47%) in the Karoo viewed the legal policy and standards regulatory environment as unsupportive to innovations. In Pixley Ka Seme district in particular, more than half of the innovators (58%) indicated that the regulatory environment is not supportive at all. Furthermore, only 27% of the innovators in the four districts indicated that the legal policy and standards regulatory environment is very

supportive with only 26% stating it is somewhat supportive. These results are of concern. The regulatory environment concerned with innovations is fundamental to the success and failure of innovation in the region. Innovation laws and policies protect the inventors as well as the public who utilise the products thus; results indicating limited awareness and the unsupportive nature of the regulatory environment may stifle innovation in the long term. Policy makers thus need to revise policies and regulations, to create an environment that is conducive and supportive of innovation. This would require the participation of the innovators, so that the changes made are acceptable to them.



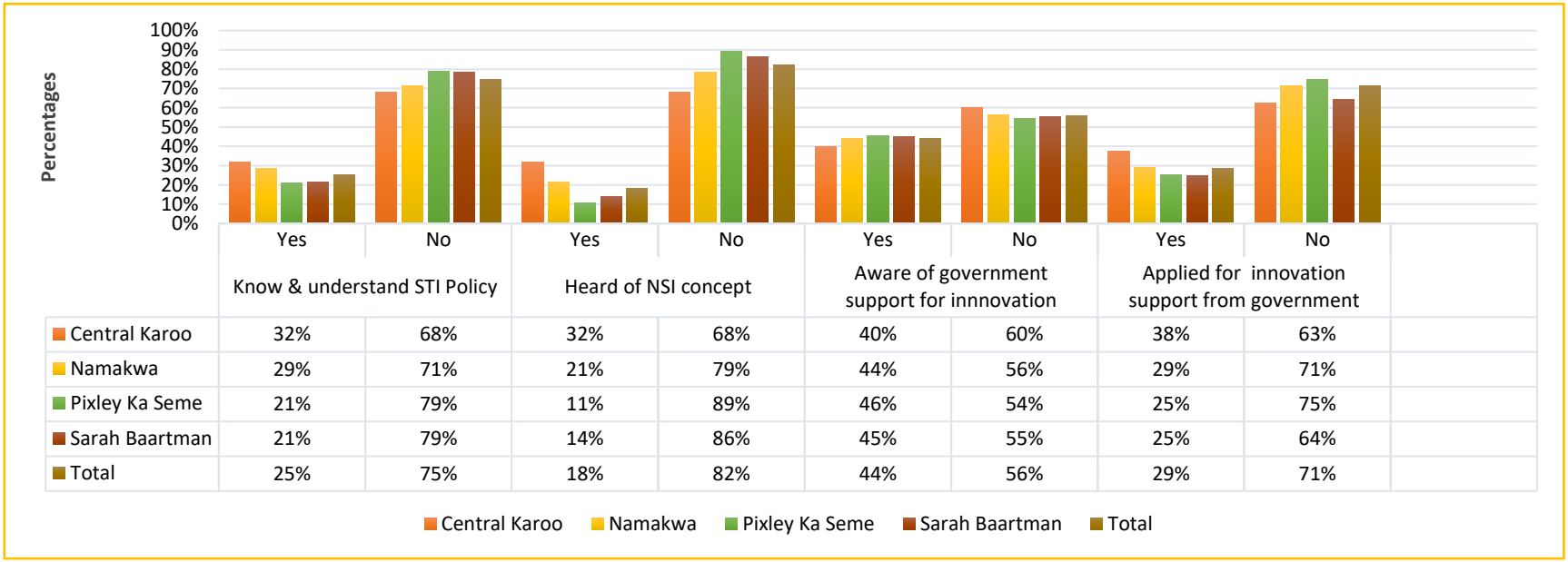
	Central Karoo	Namakwa	Pixley Ka Seme	Sarah Baartman	Total
Very supportive	44%	17%	28%	35%	27%
Some what supportive	22%	36%	14%	35%	26%
Not supportive at all	33%	47%	58%	35%	47%

Figure 73. Enterprise view of the legal policy and standards regulatory environment as supportive to its innovation activities

Figure 74 displays the results of enterprise's awareness and understanding per district, of the Science Technology Innovation (STI) policies, the National System of Innovation (NSI) and government support for innovation. The results indicate that an overwhelming

81% of enterprises have never heard of the term NSI, and that 75% did not know nor understand STI policy. Furthermore, the results suggest that of the 44% of enterprises who were aware of government support for innovation, only 29% have ever applied for innovation support from government.

It is imperative for innovators, particularly those in marginalized areas, to be aware of the support mechanisms available for them by government or government agencies. Innovation survives and thrives when there is awareness and access to the available support for innovation. The results thus suggest firstly that more attention needs to be paid in addressing the lack of awareness, popularising the policies as well as the NSI concept, which is the preferred framework for driving innovation in South Africa, as entrenched in the new White Paper on STI (DST, 2019). Secondly, the results demonstrate that there are constraints that many enterprises face in accessing support from government, beyond lack of information. That is, the ways to apply for funding support; the amount of paperwork and money required for applications (transport & application fees), may be a constraint for many in rural areas. As such, this implies the need for a holistic approach to improving government support to the small enterprises in rural areas, empowering them to access the support successfully.



	Know & understand STI Policy		Heard of NSI concept		Aware of government support for innnovation		Applied for innovation support from government	
	Yes	No	Yes	No	Yes	No	Yes	No
Central Karoo	32%	68%	32%	68%	40%	60%	38%	63%
Namakwa	29%	71%	21%	79%	44%	56%	29%	71%
Pixley Ka Seme	21%	79%	11%	89%	46%	54%	25%	75%
Sarah Baartman	21%	79%	14%	86%	45%	55%	25%	64%
Total	25%	75%	18%	82%	44%	56%	29%	71%

Figure 74. Understanding of STI policies, awareness, and access to government support for innovation

Figure 75 illustrates the extent to which the innovators have received subsidies or grants for innovation activities in the Karoo. The results illustrate that a most of enterprises indicated that they did not receive any subsidies or grants for their innovations across the different innovation activities (invention, adoption, adaption, diffusion). Only in Central Karoo do we see one quarter (25%) of the enterprises reporting to have received a subsidy or grant for adopting their innovation. The results suggest great opportunity for government to greatly supplement and support local innovations, as it is almost impossible for innovations particularly those of enterprises in rural or marginalised areas to withstand market challenges especially with risky activities such as invention

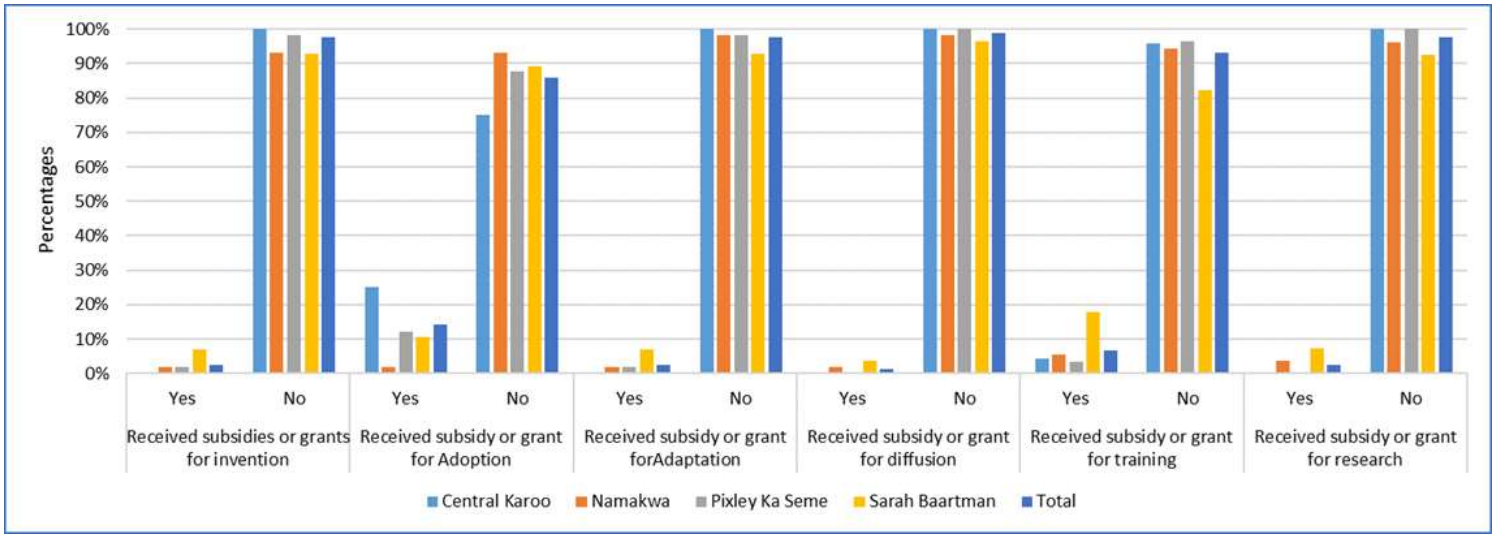
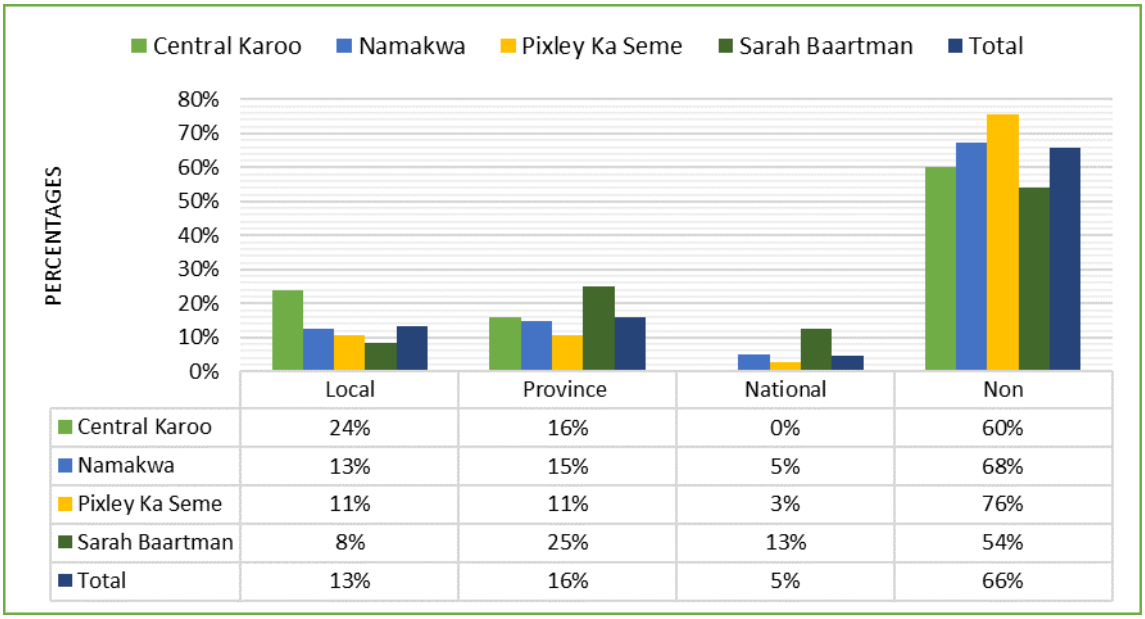


Figure 75. Grant or subsidy received from a Government department or agency for innovation activities

In addition, Figure 76 illustrates that 66% of innovators in indicated that they received no support at all from government, with only 13% indicating to have received most support

from local government, 16% from provincial government and only 5% from the National government.



	Local	Province	National	Non
Central Karoo	24%	16%	0%	60%
Namakwa	13%	15%	5%	68%
Pixley Ka Seme	11%	11%	3%	76%
Sarah Baartman	8%	25%	13%	54%
Total	13%	16%	5%	66%

Figure 76. Sphere of government where most support is received

The overall results in this section have demonstrated a great gap that exists between innovation and government support. Innovators have reported that their innovations have occurred but without much support from government. The role of government in the NSI is emphasized as a key pillar to the success of innovation. The same can be said at a regional and local level. Government support for innovation is imperative for the growth of innovation and the widespread impact of innovation. Government should provide the necessary information and incentives for innovators or potential innovators. Furthermore, putting in place the necessary regulations and measures to ensure innovation would produce positive and significant socio-economic impacts.

7 Insights from PERL Workshops

Table 16 shows that an average of 16 participants per district attended the PERL workshops. Attendance levels to the various PERL workshop varied, with some workshop attended well while others had poor attendance. Although the LIAT team invited and planned on attendance by many local actors and innovators, it did not transpire for various reasons. The main reasons was that most stakeholders were very busy during the period when the PERL were conducted. For example, most of the innovators who did not attend indicated that the November period was hectic in their schedules as they have produce more in preparation for the festive season. The research team kept in touch even those who missed the PERL workshops, sharing the results through emails, fulfilling the commitment pledged on during the survey. Overall, the participation levels of the attendees was high, even though the diversity of local innovators taking part in the workshops was poor. As a PERL workshop is interactive, all participants, even those that do not regard themselves as talkative, engaged in the sessions.

Table 16. PERL workshop attendance, local actor diversity and participation level

District	Town	Attendance	Diversity of local actors	Participation levels
Central Karoo	Beaufort West	46	Good	High
Namakwa	Springbok	14	Good	High
	Calvinia	7	Poor	High
Pixley ka Seme	De Aar	17	Poor	Moderate
	Victoria West	12	Poor	Moderate
Sarah Baartman	Blue Crane Route	18	Poor	High
	Dr Beyers Naude	13	Poor	High

Future PERL workshops should aim for a time that is not very busy to boost the attendance levels. Opening up the scope of invitations to the youth, even if not innovating yet, was also suggested. This is important, because the co-production of a vision for the

future, which a central tenet of the PERL workshop, should include the future leaders (youth).

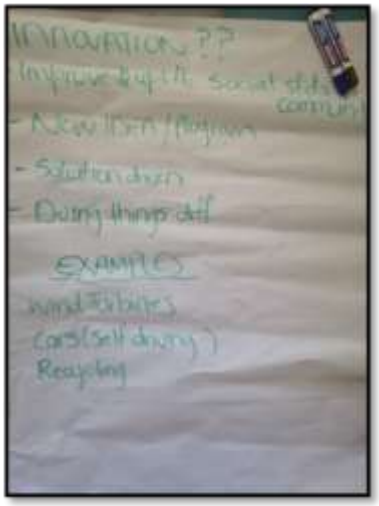
7.1 Participants' understanding and awareness of innovations

The PERL workshop participants were asked about their understanding of innovation, and most participants had more or less similar understanding of the concept of innovation. The participants associated innovation with change or creativity for addressing a particular local challenge. At the centre of their understanding is that innovation is to be solution driven, thinking out of the box and being creative towards finding solutions to pressing challenges. Although the wording was different at the various PERL workshops, the understanding of innovation was that it was always preceded by a problem. In general, participants were aware of the concept of innovation, but not everyone realised that innovation outside the firm or for social good can be regarded as innovative.

There were isolated notions that innovation is only innovation when it is profitable. Overall, participants and particularly innovators knew each other (although this was not the case in some local municipalities) indicative of some sort of network amongst innovators. The PERL workshop, besides being a learning, sharing and reflecting space, did initiate new relationships. Participants listed examples of local innovations they knew about but also learned about new ones being discussed during the PERL workshop. Most of the innovative initiatives discussed were in line with the enterprise findings, affirming the survey results.

The conversation around the concept of innovation evolved to factors that promote and inhibit innovation. As imagined, the impeding factors far outweighed the promotors. Some of the factors that promote innovators, according to the participants, were low education levels, poor access to funding, poor market access, inadequate institutional support from actors and political instability. It was highlighted that the funding and support that is provided only during initial phases of an enterprise's lifecycle contributes

to low business sustainability. Political instability was also cited at one PERL workshop as being demoralising. The political dynamics within the local municipalities hinder service delivery and unbiased effective dissemination of information. Innovators also shared low responsiveness of community members in absorbing or purchasing their innovations. The locals, in some cases, do not have buying power to support innovation initiatives due to lack of employment and poor local economy. These were highlighted using example from the local communities, which demonstrated that the learnings from the workshop enabled participants to introspect their networks, community and landscape broadly.



The presentation of the results was detailed and well received across the PERL workshops. The visual representation of the innovation spread added even more value as participants could see the distances the LIAT team travelled. It showed the enormity of the mapping exercise and the vast distances between innovators. This generated discussion about the spread of innovation as it did not appear to follow a logical flow. Some participants at one of the PERL workshops were so intrigued by the results that they wanted to know about those enterprises that were not profiled. During the discussions, the workshops attendees were in consensus on the need to grow innovation for socio-economic success, as the alternative would mean demise. Distances between

towns, complacency and the fear of risk were some of the reasons suggested by participants to make sense of the current low levels of innovation.

While there was overall acceptance of the survey results as indicative of the current state of innovation activity in the respective municipalities, there was also discussion on the pros and cons of the referral approach to identifying innovators. The exploratory and non-random sampling nature of a survey without a database is always going to face some questions about how representative it to the population, and whether or not a different approach who yield different results. Participants were informed that various means were used in establishing a database. This included desktop research, contacting various stakeholders, as well as other innovators in an attempt to develop a comprehensive database of innovators. Participants appreciated the clarification and were reminded that the PERL workshops were also an opportunity to extend the database if the LIAT team missed innovations/innovators that participants might be aware of. Also discussed was the issue of the criteria, and whether or not the criteria, particularly with regards to the time frame, excluded other pioneer innovators in favour of recent innovators, who are often imitators. The issue of period has been debated in the literature, with criticism of both longer and shorter periods. No consensus exist as yet, with different researcher adopting periods they consider appropriate for their contexts.

7.2 Developing a vision for innovation driven local development

After sharing understanding of innovation and demonstrating awareness thereof, participants deliberated on the evidence presented from the survey. At this stage, a common understanding of innovation was established and there was a general idea of how the innovation landscape looks. Building on this, the participants shared their vision of how the innovation landscape in the future should look to drive local economic development in their respective districts as well as the Karoo region. This was an exercise where participants were encouraged to dream, envisioning a future innovation landscape (innovations, sectors, networks, infrastructure, etc.) for their districts and

region. A summary of the respective PERL sessions and their visions according to participants is presented below:

Victoria West and De Aar

In Victoria West, the participants identified the transport industry as the sector with the potential of stimulating the local economy through innovation. It was their belief that besides network coverage, there is a huge potential for transport to grow in their area. The community of Victoria West already have a 'transport WhatsApp group' where information is shared. The participants mentioned that they already have their own Uber system via the WhatsApp group, and this can easily be upgraded to an APP. Participants immediately saw the potential of new entrants into the industry which would 1) increase entrepreneurs and reduce unemployment. 2) Improve road infrastructure, because if their transport reaches municipalities as far as Francis Baard, road infrastructure will improve as shorter distances are realised whilst the industry grows.

Central Karoo

The Central Karoo is a water scarce district that participants emphasized throughout the workshop. The Beaufort West municipality has already made use of the water purifying plant since 2011, which the municipal officials mentioned as something unique to the local municipality. While not novel, it is something that has brought about great relief for residents of the local municipality.

Following this, participants sought to suggest alternative ways in which the district can also capitalise on other resources such as solar energy for sustained economic development. Examples mentioned include solar farms, which participants felt could be the leading industry in the district. In addition, manufacturing was also mentioned as a sector that could thrive in regions such as the Karoo, e.g., turnery, agro-processing, and the use of artificial intelligence for precision agriculture. Participants expressed that manufacturing can curb the issue of unemployment while producing local products.

Springbok and Calvinia

Employment and changing the long-term socio economic conditions were highlighted. Participants in Springbok felt it would be best addressed by these three innovations:

Sarastoga snails. It is just past the piloting phase. Because the business is relatively new, it does not have fulltime employees yet, but uses casual labour. The owner is hands-on and does most tasks as it is not unmanageable yet. As the business grows so will the number of hands needed. Currently they have 3000 snails but intend to expand to 1 million on 2ha of land. The benefit of farming with snails is that they are less affected by conditions related to climate change than livestock farming. It is cultivated as an edible delicacy. The eggs can be sold as caviar. The mucin is used in beauty and hygiene products. It also has the potential off a tourism spin, as it hopes to offer tourists a spa experience. Tourists can come to the farm and have a snail placed on their skin. The mucin of the snail is believed to have skin regenerative properties.

Namakwa tutors. An enterprise operating in the education sector. It was established two years ago. Its core service is providing private secondary school tutoring to learners. It is able to provide sustainable employment now and in the foreseeable future. It intends on going paperless by implementing E- Learning. It was identified as a HILIC as it impacts the socio-economic landscape of the region by increasing secondary to university through put.

Y2K driving school**.** This enterprise is a driving school. With the use of a simulator, it prepares drivers for possibilities on the road and builds confidence in doing so. The business has employees but the intention of the enterprise it to become a college. It has been in operation for 11 years.

The Calvinia PERL identified climate change and its impact as challenges that need innovative responses. It looked at what is in existence and the possibility of mitigating and adapting to challenges such as the ongoing drought.

Eco toilet system. A project between stakeholders such as Leliefontein and Soebatsfontein Communities, Conservation International (South Africa), South North and the Namakwa District Municipality. The toilets use operates with greywater but also separates the waste.

Community level mulching. Underway in Nieuwoudtville. Certain invasive alien vegetation is removed and turned into a mulch. The benefit is that soil keeps moisture, erosion is reduced and water guzzling trees are removed. This could be extended to more communities, the impact is noticeable and affects all.

Buy back centre**.** In its piloting phase in Williston but also happening in Sutherland. Waste collectors are able to trade recyclable waste for money or wood. The initiative helps those unemployed to generate a small income and cleans the town. In Sutherland waste is collected and traded for wood which is used to generate heat during the cold winters in Sutherland.

Sarah Baartman

While agriculture is the dominant sector with most innovations, discussions in the Dr Beyers Naude workshop led to the importance of having viable infrastructure as the foundation for local innovation. The importance of ICT infrastructure in areas such as the Karoo cannot be over emphasised as this infrastructure facilitates, supports and enables many more innovators to invent/create, advance and even share their innovations. It was expressed that ICT as well as education around ICT, software, programming, has the potential to uplift small towns. Small towns within the Karoo can benefit immensely from citizens with such skills. Thus coding was emphasized, as a highly valuable skill that is needed as such needing to be taught at schools as an essential skill for the future. The Robert Sobukwe Museum, which is also a craft tech club where young people in the township are taught software and programming skills, was mentioned as an example of a potential institution to educate young children on coding and other similar skills as it is already training some youth around technology. In addition to this, local TVET colleges

can also be used as spaces that can provide coding subjects, innovation studies or serve as ICT infrastructure for local people to utilise.

Some of the infrastructure provided is from international service providers who bring along their own resources while local people are not utilised. Unfortunately, according to the participants, municipalities in the Karoo perceive optic fibre as too expensive to transport despite its importance going into the future.

It was observable that once participants understood innovation as something that starts as a problem solving process, participants sought to improve the innovation landscape by making various suggestions. One of the activities suggested included collaboration between the youth, innovators and government officials to improve the current landscape. An example included the setup of an open innovation forum or club that can possibly meet every month to keep the innovation momentum going, sharing of information and inspiring more youth to innovate to solve local problems. Local officials also agreed to join in the forums once established. In addition to this, innovation awareness campaigns using the LIAT tool were thought to be good ideas that could create an innovation awareness particularly for youth or other enterprises wishing to gain from the knowledge.

Local officials further expressed that for innovation to succeed in the Karoo, capacity for innovation is needed first at local government. Officials need to know and understand innovation in order to support and guide innovation in the Karoo thus expressing appreciation for the PERL workshop which has not only served as a learning platform but an opportunity to meet their local innovators and reflect jointly.

During the workshop, a participant raised a concern stating that “innovation needs to be about working together, helping each other and not for keeping it for oneself”. This was a crucial point raised as it speaks to the core of the objectives of the LIAT and DSI’s innovation for inclusive development, which seeks to foster inclusive socio-economic development through innovation. Indeed, innovation also speaks primarily to the sharing

and diffusion of innovation where the poor and marginalised have access to innovations that can help address developmental challenges such as access to clean drinking etc. (Habiyaremye et al, 2019)

7.3 Evaluation of the PERL workshops by participants

An important component of the PERL is that participants give valuable feedback about the PERL workshop proceedings, and overall LIAT approach. This is crucial, as it allow for continuous reflections and development of the tools. Overall, participants reported that they considered innovation as a central tool that can be utilised to improve the way in which businesses operate, thus assisting in stimulating LED. Participants in the different PERL workshops highlighted that they understood how crucial it is to network and interact with fellow innovators and stakeholders to share experiences, knowledge and ideas in order to deal with challenges.

The general take home message as accentuated by participants was the value of local actors working together, despite different sectors or innovation levels. Participants appreciated the opportunity the workshop gave them, as actors from different backgrounds were able get together to share varied experiences, ideas and knowledge on innovation. Overall, the overwhelming majority of the participants were happy with the value addition of the LIAT in general, and the PERL workshops in particular. Other take home lessons as indicated by participants included: learning that one can be innovative by adopting and adapting someone else's original idea. Some viewed the process of p-HILIC identification as a highlight. Some also learned that the public sector does offer support/ assistance. The workshop experienced good levels of participation, the participants demonstrated ability to grasp the LIAT concepts quickly. This was evident in their articulations during discussions and group presentations. It showed that the LIAT team relayed the concepts in simple terms that were understandable in a short space of time.

Another benefit of the PERL workshop is that it creates a platform that allows for decreased distance between stakeholders. Given the territorial distances between key actors, the platform gave some, the opportunity to address pertinent issues. The LIAT team, through skilled facilitation, navigated between pre-existing matters outside of the scope of the workshop, to steer it to purposeful engagement. This is reflected in the comments and feedback that was given on an official form. Some participants reported it being so useful that they will use the new knowledge to inform peers.

Herewith a brief synopsis of the evaluation questions and comments:

What was your understanding of innovation before attending this workshop?

The respondents highlighted that their understanding of innovation was mostly centred on creativity and something new being developed. The specific definitions that respondents gave differed, while others highlighted important elements of innovation such as adoption, adaptation and diffusion.

Some of the comments made:

"I now have an understanding of what innovation is. I would like to be more involved in workshops like this not for my own benefit but so I can support my community"

"Helps an innovator think outside of the box"

"I have learned more about innovations and will go out to the communities to talk to them about it"

Was the presentation on the purpose of LIAT and the conceptual definitions useful to you?

Majority of participants, indicated that conceptual definitions were adequately explained. They valued the approach and the manner in which these were explained.

How can the idea of innovation make a valuable contribution to socio-economic development in the district?

Majority of the participants indicated that it could contribute to skills development, job creation and reduced unemployment.

Was the presentation on the LIAT study findings about innovation activities in the district useful to you?

Each respondent stated that the presentation was useful, it helped them to know of people in their district who have abilities to help them, how they can better develop new products; it gave them a clear idea and was a good motivation.

What was the key lesson about innovation activities that you consider most important from the presentation?

The main lessons drawn from the workshop differed among actors. However, many of the respondents indicated that the key lesson learnt is to improve communication with local communities in order to understand the local needs and it will help them to come up with innovative solutions or produce more innovation. Other participants learnt that trust and mutual interest are very important. Also featuring strongly was the concept of teamwork, which some felt was reflected in the LIAT team's approach to the entire research.

Can you identify any specific areas where you think innovation could play a role in your future operational activities, the district and how could you enhance innovation activity?

The respondents acknowledged the important role of innovation and highlighted areas within the local municipalities where innovation can add value.

"Solar energy can play an important role by enhancing and making people use different resources to improve the technology"

"Getting current and applicable knowledge to our people"

"Utilizing wheat and maize straw to produce panels for housing and furniture"

"Harvesting solar energy, store it and generate electricity"

Specifically, what do you consider to have been the most important information coming out of this workshop? In other words, what is the key take home message that you will share with your colleagues in the next day or two?

The contribution and the ways in which innovation can lead to enhancement is well understood by some of the participants. These were some of the take home thoughts:

"Types of innovation"

"Innovation is everywhere in our surrounding"

"Job creation through solar"

"There is a big demand for a system where people can get support that will help them move forward without losing time"

"Innovation is a key factor in improving business and ways to improve economic opportunity"

"Study yourself and search what can you do that will make a different within the community"

"Let's sit down and see how we can make a difference in our town without waiting for the government to do"

Do you consider your attendance at this workshop to have been a valuable use of your time?

The workshop was a valuable interaction for the participants. They seem aware of the relevance and potential of innovation and the likelihood that if taken up effectively innovation can create new opportunities and make improvements to LSED. Some of the participants highlighted that this workshop has encouraged them to make a difference. One particular response we found interesting read as follows:

"You have broadened my mind concerning the concept of innovation. I intended to leave after lunch, but was appetized to know what the afternoon session will entail and did not leave"

8 Conclusions

This report has presented a socio-economic overview, the innovation orientation and nature of innovation for four Karoo districts (i.e., Central Karoo, Namakwa, Pixley Ka Seme and Sarah Baartman). The Karoo is predominantly rural with urbanised areas, and is currently facing a number of challenges, such as high levels unemployment, poverty and inequality, as well as challenges in accessing basic services. While the analysis has shown improvements in some of these indicators, the rate has been often slow, and has failed to significantly change the welfare of the people since the year 2000. In addition to this, the districts face a dire water crisis that has been prevalent in many of the communities of the Karoo. As such it is worth noting that innovations in the districts are helping enterprises adapt to the current water challenge situation. While the key economic sectors are mining, community services, agriculture and trade, which currently create jobs and contribute more to the district economies, there is growing potential in area of renewable energy (wind and solar), tourism and the knowledge economy (e.g., SKA, SA Observatory, etc.).

The analysis demonstrated that the Karoo is at Level 1 of innovation orientation, which implies that the region is aware and acknowledges the importance of innovation in its strategic documents. However, there is little evidence that the municipality plans to invest in and use innovation to improve service delivery or identify and implement projects to create jobs, or improve economy. There is therefore a need for the region to move beyond articulating the importance of innovation to the actual investments to change the course of development in the municipality. The survey results have indicated that there

is a relatively high level of innovation activity occurring in the Karoo region. For example, 280 of the 436 enterprises that were visited met the criteria to be considered as innovators. It is therefore important that, should there be any innovation intervention or strategy, it should seek to build on the innovation capacities that exist in the Karoo region. The innovative enterprises were mainly involved in adopting production process innovations, with very limited inventions. This suggests the need for improving access to information and support for these enterprises to link up with producers of such modern production technologies, who are often located outside the country. It is also important that investments be made in promoting both basic and applied research to cultivate conducive environments for inventions and adaptions.

In pursuit of effective regional and local system of innovation, it is not only the role of government that is crucial, but that of other collaborate institutions and agencies. This is to ensure diffusion of knowledge and innovation through effective networking. The results thus demonstrate that promoting networking, both formal and informal, are an important element of improving innovation performance. As literature has shown, innovations occur in clusters of knowledge and idea exchange, and rarely in individual settings. It is also important that access to resources and supportive policies are promoted. The insights from the PERLs indicates that forums of knowledge and ideas exchange are conducive conditions for innovations. Although the survey results do not show high numbers of active networking, innovators during the PERL workshops realised its importance. The exchange of ideas and inputs at the workshops showed how being in a network is helpful for innovation to occur. As a result, most workshops concluded with the resolution to start local innovation forums. The p-HILIC framework impressed most officials and they requested it in order to use it in the LED office for scrutinizing grant applications. The Karoo region is large, sparsely populated and has challenges but with innovators, institutional support and active networking, the region's challenges could become its advantage.

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Annexures

Annexure A. Analytical framework for assessing STI-content of strategic documents

STI-content analytical framework									
Municipality	*Strategic document reviewed*	*Innovation mention [None, well defined, poorly defined] [Give examples of relevant statements of mention]*	*Frequency of Innovation mention [How many times is innovation/ statements related to innovation are mentioned?]*	*Is there evidence of innovation focus & prioritisation beyond mention/ lip service? [in terms of resources allocation – physical, human & financial resources for innovation] [Give examples]*	*Evidence of innovation in internal municipal processes, e.g., innovation in incidence reporting & information management system, incentives for innovating officials, innovation-oriented KPAs, etc.*	*Evidence of innovation in projects identification & implementation [P-HILICS approach: is innovation or innovation potential a key identification criterion? Is innovation prioritised in project implementation ?*	*Innovative participatory approaches to include the poor and marginalised in decision making process (inclusive innovation); innovation in coordinating local LED stakeholders*	*Evidence of innovation monitoring & evaluation*	*Other comments, e.g., website ease of access, quality, availability of updated documents, etc.*
A	IDP (latest)								

	LED – Strategy (latest)								
	SDF (latest)								
	Other (e.g., annual reports)								

Annexure B. Local Economic Development Innovation Orientation (LEDIO) instrument

ORIENTATION OF ORGANISATION TOWARDS INNOVATION

Questionnaire number	

SECTION A: GENERAL INFORMATION OF MUNICIPAL OFFICIAL

A1. Age:	**years**

A2. Gender:	Male	1	Female	2

A3. Position or designation (in relation to your post):	

A4. Number of years in this position:	

A5. Highest level of education (equivalent to):

Grade 9 or below	1	Diploma or Higher Certificate	4
Grade 10 or 11	2	Bachelor Degree	5
Matric/ Grade 12/ National Senior Certificate	3	Post-graduate qualification (honours, masters or PhD)	6

READ THE QUESTIONS WHICH FOLLOW AND CHOOSE AN APPROPRIATE RESPONSE OUT OF THE FOUR OPTIONS GIVEN

SECTION B: INNOVATION ORIENTATION

- ***Answer all questions as per your views.***

	1	2	3	4
B1. Does this organization incorporates a culture of learning into its strategies?	☐ The organisation's strategies do not incorporate a learning culture.	☐ The organisation's strategies incorporate a learning culture, in this regard, are communicated verbally.	☐ The organisation's strategies incorporate a learning culture, in this regard, are entrenched, actively pursued and often reviewed.	☐ The organisation's strategies incorporate a learning culture, in this regard, are subjected to continuous evidence-based evaluation and improvement, and learning from this is shared externally.
B2. Does this organisation have performance targets for the learning and innovation in line with the organisation's strategies?	☐ Organisation performance targets are limited in this regard.	☐ Organisation performance targets, in this regard, are in line with its strategies.	☐ Organisation performance targets, in this regard, are actively pursued and often reviewed.	☐ Organisation performance targets are continuously subjected to evidence-based evaluation and improvement, and learning from this is shared externally.
B3. Do the organisation's rules, regulations and procedures enable learning about new or improved approaches and technologies?	☐ The organisation's rules, regulations and procedures are not enabling in this regard.	☐ The organisation's rules, regulations and procedures are enabling, but applied irregularly.	☐ The organisation's rules, regulations and procedures are entrenched and often reviewed.	☐ The organisation's rules, regulations and procedures are continuously evaluated, improved upon. Learning from this is shared externally.
B4. Does this organisation allocate financial resources specifically for learning and experimenting with new or improved approaches and technologies?	☐ Financial resources for such activities are limited.	☐ Financial resources are adequate, but the allocation occurs on an irregular basis.	☐ Financial resources are dedicated on an on-going basis and initiative is taken to obtain additional funding.	☐ Financial resource needs are continuously evaluated. Initiative is also taken to obtain funding for the external sharing of learning.
B5. Does this organisation put physical resources** in place to enable learning and the introduction of new or improved approaches and technologies?	☐ Physical resources for such activities are inadequate.	☐ Physical resources are adequate, but the allocation occurs on an irregular basis.	☐ Adequate, appropriate and dedicated physical resources are put in place and initiative is taken to improve upon and expand these resources.	☐ Physical resource needs are continuously evaluated. Physical resources are made available and used to share learning with external partners.
***For example - equipment, internet, infrastructure, etc.*				
B6. Does the organisation allocate human resources specifically for the introduction of new or improved approaches and technologies?	☐ Human resources for such activities are inadequate.	☐ Human resources are adequate, but the allocation occurs on an irregular basis.	☐ Dedicated persons are assigned and initiative is taken to expand the human resource base for such activities.	☐ Human resource needs are continuously assessed. Human resources are made available and used to share learning with external partners.

B7. Does this organisation hire staff and assign roles for the introduction of new or improved approaches and technologies?	☐ The organisation is struggling to recruit staff with the needed skills.	☐ Hiring procedures seek to fill vacant positions and staff members perform the tasks that they were hired for.	☐ Procedures are in place to hire staff with the needed skills. The skills of existing staff members are aligned to the introduction of new or improved approaches and technologies.	☐ Hiring and staff aligning procedures are continuously evaluated. The organisation seeks to hire the best qualified persons and orientate the roles of staff members towards sharing knowledge and experience externally.
B8. Does this organisation incentivise staff members based on performance targets for learning and the introduction of new or improved approaches and technologies?	☐ Staff members are not recognised and rewarded for such activities.	☐ Staff members are recognised and rewarded on an irregular basis for achieving performance targets.	☐ An incentive system is in place which provides regular recognition and rewards to staff in line with performance targets.	☐ Staff incentive systems are continuously evaluated and improved upon. Staff members are recognised and rewarded for sharing knowledge externally.
B9. Do departments within the organisation collaborate with one another in learning and in terms of the introduction of new or improved approaches and technologies?	☐ Inter-departmental collaboration is limited in this regard.	☐ Inter-departmental collaboration, in this regard, occurs irregularly.	☐ Departments actively seek to collaborate with one another toward results-driven implementation*.	☐ Inter-departmental collaboration is continuously evaluated and improved upon, and departments collaborate with one another to share learning externally.
B10. Does the organisation collaborate with external partners in order to learn and introduce new or improved approaches and technologies?	☐ External partnerships are limited in this regard.	☐ External partnerships are in place, but participation is irregular.	☐ External partnerships are actively sought and are dynamic in terms of improving the impact of the organisation's activities.	☐ External partnerships are focused on evaluating, externally promoting and sharing learning in relation to new or improved approaches and technologies.
B11. Does the organisation have tools or systems in place to record, store and retrieve learning and knowledge about improved ways of doing things?	☐ Such tools or systems are not in place.	☐ Methods for recording, storing and retrieving such knowledge are unstructured and manual.	☐ Tools or systems are in place for the recording, storing and retrieving of such knowledge and often reviewed.	☐ Tools or systems, in this regard, are continuously evaluated and improved upon. Knowledge is categorised and contextualised, and shared externally.
B12. Is the organisation open to new ways of doing things?	☐ The organisation does not succeed in this regard.	☐ There is limited success in this regard.	☐ The organisation is making progress in this regard.	☐ The organisation is increasingly succeeding in this regard. Reflection is evident, and successes and experiences are shared externally.