The Potential Impacts of Hydraulic Fracturing on Khoisan Peoples' Sense of Place: The case of Karoo Region, South Africa

By

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DECLARATION:

In accordance with Rule G5.11.4, I hereby declare that the above-mentioned treatise/ dissertation/ thesis is my own work and that it has not previously been submitted for assessment to another University or for another qualification.

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Dedication

This dissertation is dedicated to my mother who continuously believe in me no matter the obstacle, you are indeed my pillar of strength. I also dedicate this dissertation to my inner child, you did it and that's all that matters.

Abstract

Hydraulic fracturing is a practical solution to minimising production of fossil fuels and to boost the South African economy. However, this development comes at a cost to the society, environment and heritage of the Karoo, which is home to majority of the Khoisan community. Developments such as hydraulic fracturing are barely understood by local communities therefore this study tried to determine the potential impacts of hydraulic fracturing on Khoisan people's sense of place in the Karoo region, to also establish their perceptions, attitudes, opinion and knowledge on hydraulic fracturing, to facilitate and improve understanding.

A mixed method approach was employed to gather relevant information from participants. The qualitative data collection used semi structured interviews to gain participants perceptions, attitudes, opinions and knowledge on hydraulic fracturing, whereas quantitative used questionnaire survey which was administrated to gain socio-demographics and sense of place of Khoisan people (*N=50*) using survey based psychometric approach to examine the relationship between Khoisan people and sense of place on proposed hydraulic fracturing in the Karoo region (Cradock). Primary data was employed to gain in depth raw data directly from participants and secondary data from literature that already exists. The purposive and snowball sampling technique was used to draw Khoisan participants from the Karoo region (Cradock). Data acquired was analysed using SPSS v26 and Microsoft excel.

The results concluded that most Khoisan participants (*N= 43*) are not aware of what hydraulic fracturing is and therefore there is a need to be taught about the development. The (*N= 7*) of the participants who have an idea of what hydraulic fracturing is had attended a workshop that was facilitated by the AEON research institute, others learnt about it on the internet and others were informed by someone who either learnt from the internet or attend the workshop. The study also concluded that the Khoisan people have a strong positive sense of place (**α**= 0.922) with the Karoo region therefore going ahead with the proposed hydraulic fracturing will cause massive damage and could possibly lead to solastalgia and loss of sense of place.

The recommendation of the study was to involve all stakeholders who will be part of the development of hydraulic fracturing from government, research institutes to oil and gas companies to thorough research, educate and inform local communities in the Karoo.

Therefore, it is essential for the government to protect the Karoo culture and heritage, local peoples sense of place by communicating with local communities on such development and assist in holding these companies reliable for any misconducts.

Keywords: hydraulic fracturing, sense of place, Khoisan, place attachment, place identity, place dependence.

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Acronyms

AEON- ESRI	:	Africa Earth Observatory Network – Earth Stewardship Science Research Institute
GDP	:	Gross Domestic Product
GHG	:	Greenhouse Gases
HDF	:	Hydraulic Fracturing Development
IDP	:	Integrated Development Plan
SGLC	:	Southern Group Land Committee
SKA	:	Square Kilometre Array
SOP	:	Sense of Place
SPSS	:	Statistical Package of Social Sciences
TKAG	:	Treasure the Karoo Action Group

Chapter 1: Introduction

1.1 Introduction

A new game charger for energy development known as hydraulic fracturing has surfaced, allowing countries to produce their own oil and gas reservoirs to improve their economy. Even though, this technology has been around since the 1940s (Gandossi and Von Estorff, 2013) nonetheless, implementation of the actual extraction gained popularity in the 2000s (Vermeulen, 2012). Van Tonder *et al.,* (2013); Knudsen (2012); and van Wyk (2014) defines this technology (hydraulic fracturing) as the extraction of natural gas from the shale reservoirs whereby liquids are pumped at a high pressure in a horizontal manner to expand and crack into the shale bedrock to extract natural gas.

The extraction of natural gas has been commonly practiced in developed nations such as the North America, Canada, New Zealand and Europe. As they highly depend on this technique to boost their local economy through job creation, increasing local revenue and contributing to the Gross Domestic Product (GDP). However, concerns associated with hydraulic fracturing seems to be more from the environmental perspective: groundwater pollution or contamination, environmental degradation, loss of fauna and flora (van Tonder *et al.,* 2013; Knudsen, 2012; Havemann, 2013; Healy, 2012; Ellis *et al.,* no date), socio-economic perspective such as: health issues (Balise *et al.,* 2016; Colbourn *et al.,* 2014; Resick *et al.,* 2013; Watterson and Dinan, 2015; McDermott-Levy and Garcia, 2016), exploitation of vulnerable communities (Webber *et al.,* 2014; Perry, 2012; Ewen *et al.,* 2012), poverty reduction and job creation (de Wit, 2011) and increase in crime rate (Ruddell *et al.,* 2014; Measham *et al.,* 2016; Komarek, 2018; Street, 2018; Bartik *et al.,* 2019). In a developing nation such as South Africa, different concerns might arise from the proposed development of hydraulic fracturing technique. Considering that South Africa is a different case study with its unique historical background when compared to other countries already practicing hydraulic fracturing, such as the United States with over 300 000 natural gas wells (Liden *et al.,* 2017).

In South Africa, hydraulic fracturing was explored in the Karoo region in the 1960s by SOEKER a state-owned company where an estimation of 485 trillion cubic feet (tcf) of shale deposits was found (de Wit, 2011; Vermeulen, 2012; van Wyk, 2014) however, the natural gas was not extracted at that time. According to Twine *et al.,* (2012) and Vermeulen (2012) this amount of available gas in the Karoo makes it the fifth largest gas reservoir globally. As recent as 2008, the South Africa government developed interest on the extraction of natural gas to minimize the use and production of coal. Since, the government came forward with proposed hydraulic fracturing technique, companies associated with hydraulic fracturing from around the world have shown interest in investing on the development of this technique by submitting their application for fracking exploration rights. These companies include Falcon Gas and Oil, Royal Dutch Shell and Bundu Oil and Gas (Netshitshive, 2014; Steyl and Van Tonder, 2013). However, environmental groups and activists (Southern Group Land Committee (SGLC) and Treasure the Karoo Action Group also known as (TKAG)) and community members opposed the development of this technique as it involves several concerns to the environment and the people (Peek *et al.,* 2014; Netshitshive, 2014). The main concerns being chemical disposal, public health issues, air pollution, groundwater usage and contamination (Cooley, 2012; Netshitshive, 2014; Healy, 2012; Chisebe, 2017; Davis and Hoffer, 2012; Kirkland, 2010). These concerns led to a debate on the practicality of hydraulic fracturing in South Africa to produce cleaner energy. If this hydraulic fracturing development will be sustainable to the South African communities, environment and economy for the long-term produce of natural gas.

South Africa, highly depends on coal production for generating electricity and job creation. Approximately 90% of South Africa's domestic demand of energy sources is based on coal production (Sthel *et al.,* 2013; Munro, 2015). However, in 2008 the country's electricity production capacity was cut by 20%, when the whole country was left in the dark. The energy crisis nearly crashed the transmission system of South Africa also known as the national grid (Goldberg, 2015). The crisis caused havoc in the production (economy) as most places had

to shut down. According to Goldberg (2015), during the national energy crisis, the state-owned company (Eskom) had to come up with quick solutions to the problem, which was cutting power in other areas while others were operational also known as load shedding. Eskom had to balance the production of coal, therefore had to reduce power demand and increase power supply. However, the Department of Mineral and Petroleum Resource Development mentioned that the coal production will not be sustainable in the long term, hence the introduction of hydraulic fracturing as the appropriate solution (Mineral and Petroleum Resource Development, 2017).

Hydraulic fracturing development could be the most suitable solution to the energy crisis South Africa is facing with the low supply and high demand of coal production, which is causing too much pressure on the national grid. The National Planning commission (2012), estimated that by year 2030 the power production of natural gas will be supplied all over the country. The Mineral and Petroleum Resource Development, Minister Zwane addressed the media stating that if hydraulic fracturing is given the greenlights, it will improve many socio-economic issues (for example: increase employment and local revenue even though we still lack experience and have shortage of skills) and environmental issues (for example: reduction of carbon footprint and emission of greenhouse gases) faced by the country (Etheridge, 2017). Conversely, has been inadequate local research and documentation on the impacts of this technology, as the majority of the research that was conducted by the task team which was appointed by the Department of Mineral Resources was based on the United States of America and other developed nations that have been implementing these techniques for over a decade (van Wyk, 2014). Therefore, comparing a scenario on a developed nation such as the (USA) and a developing nation such as South Africa, can cause irregularities to the future development of hydraulic fracturing in South Africa. Correspondingly, South Africa faces different social, economic and environmental issues when compared to the USA (de Wit, 2011). With the country's background of racist segregation historical past of inequality and

unfair distribution of resources fracking might benefit the rich more than the disadvantaged vulnerable groups such as indigenous people.

Khoisan people also known as the indigenous people (First Nations) of South Africa, reside in the Karoo region where the hydraulic fracturing is proposed to take place. The Khoisan community were the first residents of the Cape of Good Hope, before the settlers colonized the Cape in 1650s (Van Wyk, 2016). These Dutch settlers forced the Khoisan community to relocate to the Karoo region through war that the Khoisan community lost to the settler, that is when the Khoisan their authority, livestock and land to the colonizers in the Cape (Penn, 2005; Fauvelle-Aymar, 2008; Schrire, 1980; Marks, 1972). The Khoisan population has been left out for centuries by the people of South African and the government. As this community is the most vulnerable, marginalized and excluded community in the country, by lack representation and inclusion especially on the ethnic groups of South Africa, therefore had to settle with being identified as Coloured people (Penn, 2005). The majority of the Khoisan community reside in the homelands of the Karoo (land of the dry). The Khoisan community views the Karoo as their home, this is due to their lengthy stay for decades, after the displacement from the Cape because of the war between them and the Dutch settlers, which forced when to relocate to the Karoo. Their lengthy stay has created an emotional bond with the Karoo region which has resulted to the term called sense of place, which is known as an emotional bond an individual has towards a particular setting (Tuan, 1997; Stedman, 2003).

Sense of place is a comprehensive terminology that is viewed as an emotional connection one or a group has with a place or surrounding environment, the satisfaction, affection and experience they exposed to in that particular environmental setting (Tuan, 1977; Williams and Stewart, 1998; Shumaker and Taylor, 1983; Greider and Garkovich, 1994; Stedman, 2003). A place is more than a physical setting but rather emotional connections, meanings and experiences that one is exposed to in that particular setting (Stedman, 2003; Altman and Low, 1992; Proshansky, 1983). These emotions are influenced by the length of residence, the depth of experience people have to a particular environment, and social and cultural influences

(Altman and Low, 1992; Williams and Stewart, 1998; Relph, 1976; Stedman, 2003). This concept tends to be dynamic and can be influenced in a positively or negatively towards place (Manzo, 2003). The positive influence is associated with lengthy residence, emotional connection, meaning and positive experience with place (Stedman, 2003; Williams and Stewart, 1998; Manzo; 2003). A negative influence could be the lack of beneficiary such as employment, lack of emotional connection, no meaning and negative experience, which can be influenced by natural disaster, environmental degradation and developments that changes the complete scenery of the area. These negative experiences can lead to loss of sense of place also known as solastalgia. According to Albrecht *et al.,* (2007), solastalgia as the psychological pain and suffering shaped by the changing environment on a setting, particularly a place one is deeply connected to or a place one calls home. In this case, the Khoisan people call the land of the dry (Karoo) their home through their rootedness to the place which has developed through their connection, meaning and their experiences over the years. The emotional bond can be negatively impacted by to the proposed development of hydraulic fracturing, as it could potential degrade the environment through constructions to accommodate the development, heavy traffic, and increased population (Mentor, 2012). This can cause negative impact on Khoisan peoples' sense of place towards the Karoo region and lead to loss of solace, which is destress caused by environmental degradation caused by potential development of hydraulic fracturing in an area which could potentially change its natural setting and scenery.

This chapter of the research will focus on research problem and research question which further assisted in coming up with proper aims and objectives of the study. It will also outline the description of the study area (Cradock) which is situated in the Karoo region, while it provided the suitable methodology that was employed in the study to guide through data collection. While including the significance of the study, ethical consideration and structure of the research chapters.

1.2 Research Problem

Globally, hydraulic fracturing has been considered as the future for 'sustainable' energy production. This development is viewed as a cleaner source of energy when compared to other fossil fuels such as coal because of its minimal carbon dioxide omission (Kirkland, 2010; Munro, 2015; Cortney, 2012; Wang *et al.,* 2014; Bocora, 2012). South Africa to date highly depends on coal for energy production, which contributes extensively to the depletion of Ozone Layer because of the emission of greenhouse gases it produces to the environment. Coal has a high carbon footprint when compared to natural gas production which is the proposed development. According to Cortney (2012) and Tucker and Van Tonder (2014) this energy source could play a significant role in the energy production sector as the country is facing a massive challenge in energy supply. Based on research studies conducted in the developed nations (Canada and United States of America) (Chisebe, 2017; van Wyk, 2014), hydraulic fracturing seems to be highly profitable and economically reasonable for South Africa. However, most studies that were conducted were based on the economic (Bocora, 2012; Parker, 2010; Rogner, 1997; Xiphu *et al.,* 2012) and environmental (Healy, 2012; Chisebe, 2017; Havemann, 2013, Knudsen, 2012; Vermeulen, 2012; Van Tonder *et al.,* 2013) impacts associated with natural gas production. A limited number of research has been conducted based on social and psychological issues that might arise from the proposed hydraulic fracturing technique on indigenous communities and people, especially in a developing country such as South Africa.

the Karoo region, an area where natural gas was spotted by SOEKER a previously state-owned company. The region is where most of the Khoisan population is residing, the Khoisan people moved to the Karoo region after they were displaced from the Cape to the dry of the land (Karoo), when the settlers permanently moved to the Cape of Good Hope during the 1670s when the Khoisan lost the Frontier war to the settlers (Penn, 2005). After being displaced by the colonizers the Khoisan people gained a sense of place of the Karoo after years of residency, as sense of place takes years to develop (Stedman, 2003). If the proposed

hydraulic fracturing does take place in the Karoo, the loss of sense of place and solastalgia (Albrecht *et al.,* 2007) might occur. For the purpose of this research, the study mainly focused on the perceptions, attitudes, opinion and knowledge of hydraulic fracturing to gain an understanding of the development as well as the potential impacts of hydraulic fracturing on Khoisan Peoples' sense of place, in the Karoo region.

1.3 Research Question

The general questions that arise in relations to the research is:

- Will hydraulic fracturing have an impact on Khoisan peoples' sense of place?
- What are the perception's, attitudes, opinion and knowledge the Khoisan community/people have on hydraulic fracturing?
- What are the impacts of hydraulic fracturing on Khoisan people?

1.4 Research Aim and Objectives

1.4.1 Aim

The aim of the study is to ascertain the potential impacts of hydraulic fracturing on Khoisan people's sense of place in the Karoo region, and knowledge on hydraulic fracturing, to facilitate and improve understanding of the proposed hydraulic fracturing development.

1.4.2 Objectives:

The study seeks to:

1. Explore Khoisan peoples' perception, attitudes, opinions and knowledge on hydraulic fracturing
2. Examine the relationship between the Karoo region and Khoisan peoples' sense of place

1.5 Description of Research Areas

Cradock is a small town that falls under the Karoo Basin. The Karoo covers approximately 700 000km^2 which is equivalent to 35% of South Africa's surface area (Dean and Milton, 1999).

The basin consists of three provinces, namely; Northern Cape, Free State, Eastern Cape and Western Cape and further expands to Namibia. The Karoo basin is a semi dessert also known as an arid area where agriculture and game farming is a dominant practice.

Cradock forms part of the Chris Hani District in the Eastern Cape and its local municipality is Inxuba YeThemba Municipality (The Beacon of Hope) (IDP, 2020). According to Zungu (2017) Cradock was established in the 1814s by the Europeans settlers who were settling all over the country after the Cape Colony 1650s. The Europeans used the town for farming purposes such as (agriculture and game farming) which is one of the economic produce of the town to date. Cradock is known as one of the town to farm mohair, wool and sheep for commercial purposes (Mkhize, 2012; Luck, 2005; Brandt, 2013).

The Cradock area was home to the Khoi and San who were known as the herders and hunter gathers. Today, the Khoisan community stays in the township areas of Cradock (Michausdal and Langelihle) which were the only townships in the areas during the Apartheid Era, where black and coloured people were relocated to as part of segregation.

Cradock has a population of 61 percent black, 23 percent White and 26 percent Coloured (IDP, 2020). Within the Coloured population there are Khoisan members however, due to the country not recognising the Khoisan ethic group and because of Apartheid they are identified as Coloured (van Wyk, 2016).

1.6 Methodological Considerations

This section explains the steps which were considered when conducting the research. Methodological consideration focuses on the methods and research designs used to direct the study. De Vos *et al.,* (2011) and Neuman (2013) define methodology as an investigation used to solve problems in a form of codified series of detailed steps used to achieve objectives of a study being researched on. For the purpose of this study, a mixed method approach was used collect data from 50 participants (Khoisan people) who reside in Cradock. These

participants were interviewed on their perceptions, attitudes, opinion and knowledge on hydraulic fracturing, and also measuring their sense of place in connection to the area.

1.6.1 Research Design

The research design is considered as a plan on how a researcher intends on conducting the research while emphasising on the conclusion based on the aims and objectives of the study that is researched on (Denscombe, 2008; Leedy and Ormrad, 2001; Babbie and Mouton, 2001). Therefore, the aim of research design is to assist in avoiding the collection of irrelevant data to the study.

This section focuses on the methodological approaches used to in the study research which are: mixed method approach, as it provided qualitative and quantitative data to the study which lead to a solid conclusion while illuminating biasness. The qualitative research method used comprised holding semi-structured one-on-one interviews with the participants (Khoisan people) in order to gain an in-depth understanding of their perceptions, attitudes, opinions and knowledge, and opinions on hydraulic fracturing.

The quantitative research method was used for the survey questionnaire as part of the psychometric approach, the approach was used to examine the relationship between the Karoo region surrounding environment and Khoisan people, in order to measure their sense of place in connection to the Karoo region. Therefore, method was suitable for establishing the relationship between the Karoo region and the Khoisan people's sense of place.

1.6.2 Target Population and Sampling Procedure

According to (Bless *et al.,* 2006; De Vos *et al.,* 2011), target population entails individuals (participants) or objects who represent a certain research criterion from which a sample can be drawn from. In this research, the target population consisted of Khoisan people residing in the Karoo region. This study required participants who recognise themselves as Khoisan's and have been residing in the Karoo region where hydraulic fracturing has been proposed to take place.

Sampling method, is a representative of a particular group being researched. In this study the Khoisan people residing in the Karoo region are the sample of the research under study. The two sampling methods namely; purposive sampling and snowball sampling were used to sample suitable participants when administering the questionnaire and conducting the interviews. For research purposes, the purposive sample was the Khoisan people as they well represented the sample required, and snowball sampling was used for each Khoisan participants who is suitable for the study sample to refer the researcher to other participants with the suitable representation. The sample size was measured to 50 Khoisan participants, this number could limit biasness and sampling error.

1.6.3 Data Collection

In this study research, two kinds of data were used to gather information in relation to the potential impacts of hydraulic fracturing on Khoisan people's sense of place, these are namely; primary and secondary data. Primary data is referred to as first hand data, where the researcher gathers information directly from the participants using a semi-structured interviews and observation. The secondary data, such as published and unpublished articles, journals, news report, IDP, government gazette, laws and regulations to assist the study to achieve information on the study.

1.7 Data Analysis

The data collected for both qualitative and quantitative method was collected using a questionnaire. And later analysed using Microsoft Excel and SPSS (Statistical Package of Social Sciences) v26. These the analysis were used to produce data in graphical and tabulated charts, including correlations format.

1.8 Significance of Study

The South Africa government has proposed to undertake the hydraulic fracturing technique to enhance the country's economy. However, minimal research has been conducted on possible social and psychological impacts of hydraulic fracturing from a local perspective, but rather

from an international perspective from developed nations. Therefore, this research tends to fill the gap of potential social and psychological impacts on Khoisan people that might exist due to the proposed hydraulic fracturing. The social and psychological impacts include sense of place which is referred to as a bond that a particular individual or group has on a unique environment or setting. The term sense of place is derived from the urban design, town planning, human geography and environmental psychology (Stedman, 2003; Manzo, 2003).

Therefore, this study will append into the body of environmental psychology, as this field of study has not gained much recognition and exposure in the academic field of South Africa as it has in other nations (Boudet *et al.,* 2014). This is due to minimal understanding of psychological issues especially those associated with developments, change of scenery and environmental degradation. Particularly because these environmental psychological issues can lead to distress caused by massive development such as hydraulic fracturing. One can conclude that this lack of awareness can be caused by the ignorance of psychological issue such as mental health and illnesses which is still a topic most people residing in rural towns still lack knowledge, awareness and understanding.

Furthermore, this research could contribute to government bodies to consider the inclusion of sense of place when conducting an Environmental Impact Assessment under the social impact section. The inclusion of sense of place will provide an understanding of the relationship, connection and emotional bond people have with their surrounding environment in the EIA report before proceeding with developments such as the proposed hydraulic fracturing in community areas.

1.9 Ethical Consideration

The research utilized verbal and written communication to interact with Khoisan community members. The ethics was guided by the Nelson Mandela University Ethical guidelines to ensure that the questions being asked are not harmful, discriminative or invasion of participant's privacy and that the researcher provided the relevant documentation with

necessary procedures and permission allowing the research to be conducted. Therefore, participants provided the researcher with information on a voluntary basis. The study assured that participant's personal information and identities were not revealed, promoting confidentiality, anonymity and trustworthiness.

1.10 Structure of Chapters

This dissertation consists of five chapters and are structured as followed:

Chapter 1: Introduction and Background

This chapter provided an introductory section of the research which laid out an overview of the research topic and stated the research problem followed by the aim and objectives including the research question. Additionally, this chapter briefly asserted the methodologies employed and the significance of the research.

Chapter 2: Literature Review

This chapter provided a review of existing literature from sources which debated on potential impacts of hydraulic fracturing on Khoisan peoples' sense of place. The chapter added conceptual backgrounds of the topic such as socio-economic impacts, sense of place and Khoisan background related to the development of hydraulic fracturing.

Chapter 3: Methodology

This chapter provided methodologies that were used in the study to answer the research question. These methodologies included a mixed method approach for data collected, sampling methods both purposive and snowball sampling as well as the data analysis used to analyse the data collected in the study.

Chapter 4: Analysis and Interpretation

This chapter represented the analysis and interpretation of the potential impacts of hydraulic fracturing on Khoisan peoples' sense of place, acquired data collection and the findings emanated from the research.

Chapter 5: Discussion, Recommendation and Conclusion

This chapter drew up conclusive conclusion based on the findings emerging from the study and also provided possible solutions or recommendations to facilitate and understand impacts associated with hydraulic fracturing on Khoisan peoples' sense of place in the Karoo region.

1.11 Conclusion

Hydraulic fracturing comes with its own benefits and concerns. However, concerns seem to exist more than benefits. The Majority of the concerns are associated with environmental impacts and social impacts. Even though, social and psychological impacts have been under studied when compared to economic and environmental, especially in the South African perspective. This chapter has provided a research background of hydraulic fracturing and where its stands in the South African context. Furthermore, presented the problem statement, aims and objectives, research methods which was used to conduct the research. Lastly, presenting the structure of the dissertation chapters. Therefore, this introductory chapter has directed the theoretical framework chapter which provides an in-depth theory foundation for this research.

Chapter 2: Literature Review

2.1. Introduction

The majority of existing studies based on the development of hydraulic fracturing are mostly concerned with the environmental and economic impacts of this technology, however delivers inadequate amount of studies on psychological impacts of hydraulic fracturing technique on indigenous communities and the inclusion of their sense of place, which is also significant in the body of knowledge.

Sense of place, is an emotional bond, affection and connection that an individual or a group interaction towards a particular environment (Manzo, 2003; Williams *et al.,* 1992; Kaltenborn, 1998; Low and Altman, 1992), in this case the Karoo region (Cradock). Sense of place develops over time through experience, relationships, community involvement or participation and functionality (Manzo, 2003; Hay, 1993).

With regards to this broad definition of sense of place, this research chapter aims to review existing literature, to produce an overarching understanding of the potential impacts of hydraulic fracturing on Khoisan people's sense of place. Therefore, the literature review will focus on first world countries that are already practicing hydraulic fracturing and review where South African energy sector stands, this section will also investigate the public perception of hydraulic fracturing and its potential impacts on socio-economics of Karoo region where the proposed technology will take place. This literature review is important to guide us through the research problem of the study being undertaken. Therefore, it will focus on the history of Khoisan people in South Africa with the approach of addressing hydraulic fracturing psychological impacts (sense of place) and its subscales.

2.2. Historical Background of Hydraulic Fracturing Development

Hydraulic fracturing also known as fracking is a technique used to extract shale gas from a classified shale rock. During this process sand, water and chemicals such as liquid nitrogen,

diesel, liquid hydrocarbon and carbon dioxide are horizontally injected into the shale rock at a high pressure to fracture the rock beneath the earth's surface to access gas (Davis, 2012; Knudsen, 2012; van Wyk, 2014; van Tonder *et al*., 2013). The technique involves, natural gas flowing to the earth's surface from the fractured rock and is stored in wells for energy production (Anderson and Theodori, 2009; Healy, 2012).

The existence of oil production through Shale development, dates way back. The first recorded shale gas exploration dates to 1800s, where numerous drilling pilot studies were utilized to access natural gas from the reservoirs (Forbis and Kear 2011; Mentor, 2012). After a decade, around the 1940s the technology was utilized to fuel oil and gas wells in the United States (DOE US, 2011). A continuation of this technology occurs throughout the 1980s to the 2000s when Mitchell Energy and Development Corporation jointed all fracturing methods which gave birth to the USA oil industry (DOE US, 2011; Chisebe, 2007). Until the recent years whereby the hydraulic fracturing technique improved its technology, which has made extraction of shale gas easy and accessible even in areas that were not economically viable for support.

Internationally, there is a record of over 700 shale gas wells which are located within 142 identified basins with majority of them belonging to the United States (Liden, 2017). The United States has extensive experience on the extraction of shale gas, as it is known to have the largest shale gas reservoir and gas production in the world. Deweese (2010); Fracfocus (2012) asserts that in the US alone, approximately 35 000 shale gas wells are fractured yearly as hydraulic fracturing technique continues to drastically improve. Deweese (2010) continues to state that in the US over the past 11 years the hydraulic fracturing technology has been able to generate an estimation of 40 percent of countries electricity. Therefore, with these increasing trends of hydraulic fracturing, it is promising for the future of clean energy. Moreover, this gas extraction has a promising collective role in improving the international energy security.

2.2.1. Hydraulic Fracturing in other Countries

In the United Kingdom, hydraulic fracturing was introduced in 2007 by the licenced company called Cuadrila Resources, this company estimated roughly 5.6 trillion cubic metres of oil and gas which is far less when compared to the estimated 485 trillion cubic metres from the South African Karoo Basin. This exploration is situated in Lancashire, Bowland. The British governments reason for exploration is to assist in improving GDP and minimising gas imports. In 2011 the United Kingdom had started with organising development of hydraulic fracturing; however, they experienced a tremor of 2.3 (Richter Scale) which then lead to suspension (Cho, 2015; Jaspal and Nerlish, 2014). However, in 2012 the suspension was lifted and went ahead with the exploration.

In Germany, the government had mentioned intentions in exploring the development in 2010, however citizens were against it. So, they started their own antifracking group (Gegen-Gasbohren), to make sure that Germany government does not approve hydraulic fracturing as they believed it is harmful to the environment and the people. According to Schirrmeiste (2014), citizens continued to protest for the suspension of the development but later the German government continued with the exploration.

In France, the environmental groups contested the implementation of hydraulic fracturing which made it the first country to face strong opposition of the development (Weile, 2014). As the government was planning on drilling on the Paris Basin which is on farming land. Citizen continued protesting the development, however the France government went ahead and drill without public participation. The public took the matter to court, on the bases of inclusion of public participation on such developments (Griffith, 2011) especially with regards to concerns on environmental pollution and degradation caused by hydraulic fracturing.

2.2.2. Hydraulic Fracturing in South Africa

In South Africa, hydraulic fracturing was introduced in 2008, however suspended in 2011 by Minister of Mineral Resources. Due to the sparked noise from the environmental activist groups (TKGA) and the public on the concerns they raised on the impacts of hydraulic fracturing and ancillary activities associated with the development (Glazewski, 2013). These immersed oppositions mentioned by the public were heard by the minister hence the conclusion of suspending the development. This made the South African government to employ a task team to research on the impacts of the development from all spheres this be; social, geology and hydrogeology, economy and environmental. The appointed task team was Department of Mineral Resources, Environmental Affairs, Science and Technology, Water Affairs, Energy, SKA South Africa, The Petroleum Agency of South Africa, Water Research Commission, Council of Geoscience and ESKOM (Department of Mineral Resources, 2012). Their task was to study the impacts both negative and positive of hydraulic fracturing from social, economic and environmental impacts across all five provinces that fall under the Karoo Basin. After the submission report by the Task Team, the government continued with the suspension of hydraulic fracturing in 2012 (Donnelly, 2012). In year 2012, hydraulic fracturing was mentioned in Parliament as being the game changer which proved that the government was for hydraulic fracturing.

2.3. Where the Energy Sector Stands in South Africa

South Africa is a country that depends entirely on fossil fuels for energy, that is coal-fired based plant power. Approximately 90 percent of electricity is produced by coal (Giglmayr, 2013). Since coal has been the dominant producer of energy in South Africa, it has remained dominant even after the high demand of electricity and minimal supply which led to load shedding. In 2009, approximately 250 million tonnes of coal were mined to supply the country, only about 180 million tonnes were used in the country and the rest (60 million tonnes) was exported (Environmental Economic Accounts, 2012). In 2002, the country reserved approximately 55 billion tonnes of coal, with this amount of coal at that time, it was predicted

to last for 200 years or more. But, in 2008 after the introduction of load shedding the prediction decreased to 121 years which was mostly based on the rate at which the coal was being utilized and extracted (World Bank 2008). Domestic electricity prices over the year have been sustainable and affordable however, during COVID19 the electricity tariff has increased due to a high demand of electricity during lockdown and the Medupi power station explosion which impacted production and supply.

According to Econometrix (2012), South Africa produces approximately 60 percent of coal and mostly being electricity. Its dependence on coal makes it one of the world's largest coal user country. However, ESKOM also operates in diesel fuelled gas to assist with energy supply as hydropower is limited in the country due to the size of the rivers (Karanitsch and Hydro, 2011). Because, the country is facing water scarcity especial the Karoo region, the Department of Energy had come up with the solution to use other sources for energy production, namely; diesel fuelled open gas turbines, coal, nuclear and renewable energy by year 2030 (Karanitsch and Hydro, 2012). Republic of South Africa (2011) states that this solution will assist in minimising the production of greenhouse gases into the atmosphere by roughly 40 percent by year 2025.

In addition to minimising the emission of greenhouse gases and paying fines for not cooperating with polluters pay principle, ESKOM believes the implementation of hydraulic fracturing makes more economic sense (Econometrix, 2012). Hydraulic fracturing produces far lesser carbon emission when compared to coal. The US Energy Information Administration (US EIA), 1999 mentioned that natural gas produces approximately 117 000 carbon dioxides per billion Btu of energy whereas coal produces 208 000 per billion Btu. Hydraulic fracturing seems to be more feasible and sustainable regarding carbon emission when compared to coal. At the moment South Africa depends on imported oil from Nigeria, Kuwait and Qatar. because the country does not have sufficient oil reservation to assist with local energy demand. According to Giglmayr (2013), there is limited amount of gas that South Africa produces from offshore of Mossel bay, and gas import from Mozambique and Namibia. As for

renewable energy is concerned, through solar, biomass and wind energy which was developed in 2010. Solar energy is used for pumping water for disadvantaged communities. This programme is steered by Department of Water Affairs. There is also a production of energy through wind farm which is based in Port Elizabeth, this project was introduced in 2010 (Sustainable Energy Africa, 2015). Nuclear power which was introduced in the country in 2011, with the intentions of increasing nuclear electricity production by approximately 9000 MW (Adam and Fig, 2011). At that point South Africa has access to 2000 MW from nuclear energy, through innovation and technology this capacity can increase to producing more energy.

The development of hydraulic fracturing is associated with negative and positive impacts; therefore, the next section of literature review will focus on the socio-economic impacts of hydraulic fracturing.

2.4. Socio-economic Impacts of Hydraulic Fracturing

Socio-economic status incorporates both the social and economic aspects to understand the current existing environment of a community. As for the economic aspects, it focuses entirely on income and employment. Whereas, social aspects are inclusive of the socio-demographics such as gender, age and ethnic group.

Hydraulic fracturing development is always associated with an influx of population which needs to be catered for by the host community or town, however, this put strain to the already existing development in the area namely on services such as, housing, education, medical and community services. According to Jacquet (2009), accommodation is one of the services that is mostly required by migrants when moving to host area, therefore increase in accommodation and cost of living because of the demand. This then give rise to the local people not being able to afford the services due to increase prices. Because of the development host towns experience a concept called “boomtown’.

As development starts, many socio-economic impacts rise, one being increase in cost of living, where services are no longer affordable to locals. Traffic increases due to trucks heading off

to the drilling site and back, and more people traveling in and out of these towns which could possibly lead to air and noise pollution (Christopherson and Rightor, 2011). During drilling phase or construction of wells, more jobs are created, however these jobs are mostly on contract bases which means the local will possible have temporal employment. Therefore, there could be a rise in employment because of the development.

Therefore, local communities have a potential to benefit from a social and economic aspect of hydraulic fracturing development. According to Raimi, 2012; Jacquet, 2009; Christopherson and Rightor, 2011 even though, these benefits can be temporal because of construction phase, nonetheless jobs will benefit the community.

2.4.1. Infrastructure Development

During construction phase of the development where the host town is being expanded to accommodate hydraulic fracturing development. Community member normally raise complaints regarding road damages, traffic caused by trucks, noise and dust pollution (Randall, 2010). However, more concerns rise from trucks when they cause road damage and pothole due to peak transportation to and from drilling site. This might place more strain to the local government in paving the roads, this could raise a serious issue as South African government is generally struggling to maintain potholes in local areas, due to limited budget. According to Christopherson and Rightor (2011), the best solution to solve this issue of pothole is to build toll gates or etolls, to make the drilling companies pay levies for their damages on the road. However, this will then negatively impact the locals as cost of living increases.

2.4.2. Job Creation

The hydraulic fracturing development has potential in creating short and long-term job opportunities, for both local and national. Job available for locals are usually temporal jobs and only a few locals get employed. Even though, the number of people employed depends on the scale and pace of the drilling process (Jacquet, 2011; Fernando and Cooley (2016) This can be proven otherwise, as the hydraulic fracturing industry is very unpredictable. But,

this industry can create more stable or permanent jobs by introduction skills development programmes related to the industry for local residences. When focusing on the phases of the development, the clearing phase normally employs more people, normally local residences. According to Jacquet and Stedman (2011); Fernando and Cooley (2016) there are more direct employment during the development phase which is the clearing and construction of the wells, followed by a fewer number of direct employment during the production phase where they drill. Normally during drilling phase there are few to no local workforce, this is because skilled people are required those who have years of experience in drilling oil and gas industry. Therefore, production phase has fewer employees who get to work long-term.

2.4.3. Tourism Sector

Hydraulic fracturing sites are usually situated in rural towns where farming is one of the contributors to local economic development and tourism being another. Majority of these small rural town that have oil and gas reservoirs have tourist attraction scenic aesthetic. However, the hydraulic fracturing development process present enormous human activities as mentioned above. (Rumbach, 2011) states that these human activities associated with hydraulic fracturing are truck traffic, road damage, air and noise pollution. The mentioned human activities can negatively impact the visualisation and tourism of the area. When people from outside the area visit rural town for tourism purposes they book local accommodation however, because of demand accommodation prices must increase (Rumbach, 2011). This can cause tourist opting for other destination town and not the host town. This can cripple the tourism sector of the local economy, as accommodation becomes too expensive for outsiders and locals cannot afford, therefore, could decimate the tourism sector.

2.4.4. Agricultural Sector

The agricultural sector, can negatively be impacted by oil spills into the water and killing livestock and crops. This could have a massive negative impact even on the health of the local communities and surrounding areas that use the same water supply. Rural town especially from developing nation are known to be food insecure meaning that they cannot afford to meet

their daily dietary food intake (Averbeke and Khosa, 2007). Therefore, smallholder subsistence farming which is mostly practiced in small rural town become their solution to achieve food security by meeting their daily food intake (Aliber, 2005; Food and Agriculture Organization FAO, 2011). This have been a solution for food production for rural household consumption and to sell for harvest to make extra income. But, with the hydraulic fracturing development the agricultural sector will face decimation due to water pollution caused by oil spills. Therefore, lead to food insecure community and damaged agriculture and the economy because of the development.

2.4.5. Water Pollution

Water is one of the fluids used to fracture the shale rock formation in order to extract gas. This development process requires approximately 90 percent water including other fluids such as chemicals and sand. According to Energy from Shale (2012), water used for fracturing the shale rock can be from the dam, river, ocean or lake. The required amount of water to drill is approximately 11 million litres used. As South Africa, Karoo region is a water scarce area this development will lead to complete disastrous drought. Not only is drought a concern for host towns but also, spills at the surface and subsurface, which could infiltrate or runoff into the aquifers in rainy days (Riha and Rahm, 2010). Leakages and improper installation of wells and cementing will potentially raise concerns. These leakages and spills can end up contaminating water which could potentially lead to health hazards for animals, local ecosystems and humans' lives. In South Africa, majority of the citizen depends on government for provision for health care which means people cannot afford health care as it too expensive. Therefore, opt for public hospital which are the only one found in rural towns in South Africa, also these public hospitals are always full. Health hazards in connection to hydraulic fracturing can cause lung cancer and asthma. (Balise *et al.,* 2016; Colbourn *et al.,* 2014; McDermott-Levy and Garcia, 2016). Therefore, in order to minimise or prevent water contamination and health issues, the hydraulic fracturing stakeholder should be transparent, properly install the drilling cemented logs, take extra precaution, do regular maintenance and minimise usage of

toxic fluids. The government needs to play significant role in issuing fines to hydraulic fracturing companies through polluters pay principle to ensure they are fined for negligence.

2.4.6. Air Quality

The implementation of hydraulic fracturing is known to be environmentally friendlier when compared to fossil fuels, however, when compared to conventional gas emission, hydraulic fracturing releases more greenhouse gases (GHG) as it operates in diesel energy therefore producing more Carbon dioxide (CO_2) emission (IEA, 2021). The more wells being drilled the more emission it produces destroying the Ozone layer, atmosphere and air quality. The whole process of hydraulic fracturing is detrimental to the environment, from transportation by releasing methane to diesel which realises CO_2, unfortunately CO_2 last for decades in the atmosphere when compared to methane however, damage is still being do not in the atmosphere therefore impacting air quality (IEA, 2012). Truck depend of diesel for fuel, and diesel being one of the polluter of the quality of air especially in close proximity communities. According to Armendasiz (2009), communities closer to hydraulic fracturing development struggle with air pollution such as smog-forming compound, toxic air chemicals and greenhouse gases by the development.

2.4.7. Hydraulic Fracturing and Boom-Bust Paradigm “Boom and Bust town”

Boom Impact Model has been widely used in towns where hydraulic development was implemented. This model was used to evaluate the socio-economic environment of a host town. In the 1970s the Boom and Bust was highly studied this was during the peak of hydraulic fracturing in the United States of America (Jacquet, 2009). Boom and Bust usually take place in rural towns where an influx of rapid population floods the towns because of hydraulic fracturing development. This development creates opportunities and challenges to the local community and municipality. Due to lack of experience in such development, local municipality are not aware of the challenges that come with hydraulic fracturing development in their towns (Jacquet, 2009). Even preparing for the rapid population local municipality can never be sure about the amount of people that need to be catered for, as the oil and gas industry is very

volatile. According to Gilmore (1976) small rural town are only equipped on managing 5 percent of annual growth rate while additional growth rate of fifteen percent can collapse the housing, labour market and financing of public facilities to accommodate the rapid population influx. Jacquet and Kay (2014) state that hydraulic fracturing development does takes place in areas closer to large metropolitan, these areas seem to limit the boom and bust theory as they have diverse economies. Furthermore, Jacquet and Kay (2014) allude that research that focused on places that experience the boom and bust did not pay attention to the communities' views on hydraulic fracturing development. The boom and bust paradigm faced several scholarly criticisms as the theory focused on researching after the development and not before or during (Jacquet and Kay, 2014).

The boom and bust paradigm in local communities usually pay attention to the positive economic impacts and ignore the negative impacts which are environment and social issues, the reason could be that they are not aware, or they dismiss them. The uncertain arise with these developments as it might bring negative economic impacts that are accompanied by positive impacts; Local communities and municipality finding hard to adjust to what the development demands; Long-term residence in conflict with new residence and the local municipality (Jacquet and Kay, 2014). These are some of the challenges that boomtowns come with to rural communities and local municipality must face. Some of the negative impacts associated with boomtown model include; increase in crime, drugs, rapid population, prostitution and human trafficking. (Jacquet and Kay, 2014). Others could be cultural change or shock; some rural residence take time to adapt to cultural change therefore these are some of the challenges locals face due to hydraulic fracturing development. challenges that local communities face; declining social cohesion (Brasier *et al.,* 2011), loss of sense of place

2.5. Public Perceptions on Hydraulic Fracturing

The recent publicity on the development of hydraulic fracturing in the world has created controversy amongst individuals, with those that oppose, support it and those who are neutral. Concidine *et al* (2010) assertion that public member who support the development of hydraulic

fracturing are members that want the economy to thrive through increase in local revenue, production of domestic oil and gas and transition from greener energy. As for the opposing members, who are more concerned with environmental and social impacts such as health issue associated with the development on communities especially those residing closer to the hydraulic fracturing site (Stedman *et al.,* 2012; Osborn *et al.,* 2011). The public perception plays a crucial role in decision making of planning whether to go ahead with the development or not. The inclusion of both public perceptions and opinion give rise to understanding how much the public understands about the development or even knowing what still need to be addressed regarding this development to the public. By assist policy makers in establishing suitable regulations and researchers in communicating potential impacts with the public (Clarke *et al.,* 2012).

A study conducted by Boudet *et al.,* (2014) which surveyed Americans (N= 1061) perception on development of hydraulic fracturing. The finding were women who classify themselves as democrats and spent more time reading newspapers, are more informed about current affairs and are aware of environmental impacts of hydraulic fracturing; strongly opposed the development, however, public members who hold tertiary degree, who are older, watch more television and believe in positive economic impact of hydraulic fracturing support the development (Boudet *et al.,* 2014). The findings above are an indication of a well-informed society when compared to other developing nations. Boudet *et al.,* 2014 did not examine the cultural impacts of hydraulic therefore could have had a different outcome. But also, Boudet *et al.,* 2014 did not mention if the American public that participated in the survey were Native American or people of colour, the indication was only Americans.

When studies are being conducted with regards to perceptions and opinion of the public on hydraulic fracturing development. The inclusion criteria normal consists of:

2.5.1. Socio-demographic of the Public

(Ho *et al.,* 2011; Ansolabehere and Konisky, 2009; Siegrist *et al.,* 2007; Visschers and Siegrist, 2013),

With regards to socio-demographic characteristics, the inclusion of age, gender, income bracket, ethnic group, political positioning and education level. This play a crucial role in public participation especially for developments such as hydraulic fracturing. Where one can conclude that men are mostly for hydraulic fracturing when compared to women, older people are supportive of hydraulic fracturing development when compared to the youth, with regards to income bracket and higher education hydraulic fracturing development is usually opposed, as education is associated with awareness.

2.5.2. Affective Imagery

(Boudet *et al.,* 2014; Slovic *et al.,* 1998; Lorenzoni *et al.,* 2006; Leiserowitz, 2006),

Affective imagery is mostly associated with what is the first thing that comes to mind when you think of hydraulic fracturing. With this type of imagery, it usually has to do with how people perceive hydraulic fracturing. From environmental degradation through clearing of area, to construction and impacts on wildlife and landscape formation. Other perceive affective imaginary from an economic perceptive by considering job creation, development in the area. Some associate it with crime and infrastructure damages. Affective imagery can be influence by picture or images that people see from the internet or from listening and reading about the impacts of development then one gets to conclude on the decision to whether oppose or support the development, hence, “the first thing that comes to mind”.

2.5.3. Geographical Proximity

(Jacquet, 2012; Devine-Wright, 2005; Swafford and Slatter, 2010)

Residence who reside closer to the hydraulic fracturing sites when compared to the others are more likely to oppose the development as they are closer to the area, therefore their attachment and connectedness to the area stronger when compared to those residing further away. The reason residences who stay closer to the proximity of the well oppose it is also because they get to be exposed to all the impacts from noise, dust and air pollution to environmental degradation and water contamination, they are usually exposed to health

issues related to the development and its ancillary activities. Residence who residing further away from the site are hardly bothered by the development, as they feel that they do not have direct impacts to the development.

2.5.4. Media Use

(Krismsky, 2007; Driedger, 2007; Williams, 2011)

Hydraulic fracturing consists of positive and negative impacts. However, the negatives suppress the positive, as positive is associated with economic impacts. But through propaganda that exist in the media houses this could be perceived otherwise. Television usually covers less information which consists of emotional content when trying to convince viewers on particular events whereas newspapers are detailed informing and educating readers. However, the internet such as social media is very dominant at sharing conspiracy theories about any developments including hydraulic fracturing. Therefore, the media that shares environmental and social impacts opposes the development whereas the media that shows economic impacts supports the development. The media is always trying to convince society.

2.5.5. Familiarity

(Slovic, 1987; Brooks, 2013; Boudet *et al.,* 2014).

Public that is familiar with the hydraulic fracturing development, in other words they are more exposed to reading and hearing about it oppose the development whereas the public that are not familiar in hearing about this development support it. With familiarity, it could go otherwise, where public can support it even though they hear and read about it often. Therefore, this goes with individual perception, opinion and preference.

The mentioned above characteristics that influence public perception on any development but in this case hydraulic fracturing are usually considered when conducting data to gain knowledge on the public view on development. this is done to assist researchers, policy makers, advocates to assist in understanding the phenomenon.

The following section will outline the history of the Khoisan community in South Africa.

2.6. Khoisan History

Two thousand years ago the Khoi and the San were the first people in South Africa (First Nations). They practised pastoralism by herding animals (Korana and Nama) this was through grazing and arable farming for crop production (Marks, 1972; van Wyk, 2016). However, the settlers where then exposed to the Cape of Good Hope when they were passing, they then used the Cape as their resting station. In the 1652s the Dutch East Indian Company (Vereenigide Oostindische Compagnie) spotted the station (Cape) and used it as a resting station for refreshment purposes where they would restock on produce for their trip ahead. According to Marks (1972); Penn (2005); Wylie (2007) the Table Bay was used as colony by the Dutch colonist to supply produce, they did this by acquiring land. The Dutch colonisers brought along their slaves, settlers and soldiers from the East and Netherlands to the Cape, where they stationed and later became colony of the Europeans (Marquardt, 2007; Elbourne, 1922; van Wyk, 2016). During this conventional colony the Dutch were exposed to the First Nations (Khoi and the Sans) of South Africa.

After the arrival of the Dutch (Jan Van Riebeeck) decided to exploit the Khoi (herders) and San (hunter and gatherers) people then threaten them to take their land and herd (Barbieri *et al.,* 2014; Oenn, 1995; Boswell and Thornton, 2021) before the exploitation started the Dutch demanded the slaves to gather for food and freshwater. As the Dutch were settling they had an agreement to have a good relationship with the locals (Khoi and the San), the Dutch settlers and the Khoi had a trading agreement of cattle for fresh meat, however that trade did not last. In 1657, Jan Van Riebeck decided to take the twelve contractors and make them farm owners, so they can produce food for them (Van Wyk, 2016; Veracini and Verburyst, 2020; Gabie, 2008). These farm settlers located at Liesbeek River, however by the time Jan Van Riebeeck was relocated to become commander approximately 40 citizens (farmers) were already discovered, with their women and children. Over the years the citizen farmers grew and spread out locating in other areas. That was when the war erupted between the Khoi and the Dutch

in the 1673 because of the appropriation of land (Penn, 1995; Maposa *et al.,* 2013; Van Wyk, 2016). The Khoi felt that they were restricted from moving around freely and having access to graze their cattle seasonally, as they were nomadic, and they normally moved freely. The Khoi were nomadic and did not accustom to land ownership. However, the Dutch farmer felt it was unfair for them as they had an agreement regarding ownership with the commander therefore no one is allowed in the territory. In 1659 and 1673 the Khoi tried to gain back their territory by attacking the Dutch farmers, but the attack was not a success therefore lost the battle and men (Van Wyk, 2016; Veracini and Verbuyst, 2020). This led Khoi to being servants and slaves, as they had lost man power against the Dutch. In the 1600 the Dutch had full control of the Western Cape and the Khoi were displaced to the land of the Dry (Karoo Region), this was when the Khios joined the San people (Barnard, 1992; Fauvelle-Aymar, 20088; Barbieri *et al.,* 2014). The joined forces were strategic enough to try and gain what is theirs, by attacking back the Dutch. The Khoisan and the Sans, looted and burgled the Dutch farm houses, murdered them the same way they murdered their people and stock raided (Barbieri *et al.,* 2014; van Wyk, 2014). Some of the Khios who stayed behind and became shepherds and/or labourers when the others were displaced to the Karoo, those Khios were also attacked. However, the Khios who stayed behind became friendlier with the white farmers but that changed when they realised that the Europeans were after their land (Veracini and Verbuyst, 2020).

In the 1713, there was the epidemic of smallpox at the Cape Colony, the breakout spread all over the colony both the Khios who settled in the Cape and Dutch/ Europeans contracted the virus (Barnard, 1992; Low, 2004; Van Wyk, 2014). The Cape Colony residence has no medication or natural resistance to the virus, the virus was spread all over by the survivors. According to Garman (2001) the smallpox virus in the 1755 and 1767 almost eliminated the Khoi and San population. As for the Khoi and San survivors converted into Christianity and westernisation, adopting the western cultures and the language (Afrikaans) (Van Wyk, 2016; Chebanne, 2010).

The land of the Khoi and the san people were dispossessed by the apartheid government, their culture and heritage destroyed. Even in the post-apartheid, the government has not given them back their land (Maposa *et al.,* 2013; Chebanne; 2010). As the Khoisan people are not recognised officially by the post-apartheid government. This is seen in the ethnic group category where the Khoisan group is not listed, however Coloured is, this is all done under the present legal institutions. This could also be an indication of post-apartheid government protecting the legacy of the apartheid government. As no changed have been implemented even after 27 years of democracy. In the new democratic South Africa, the Khoisan population is still not clear (Stavenhagen, 2005). Even though Constitution of 1996 adds reference to the Khoisan community, they are still not recognised by the constitution as the first nations of South Africa.

2.6.1. Ethnicity of Khoisan

The Khoisan name is grouped, the original terms are Khoi and the San people which are two completely different people. However, the San which are known to be the hunters and the gathers and the Khoi who are herders. In 1928, the two ethnic groups were created to differentiate the two by a scholar call Leonard Schultz who used the terms to represent both groups however, in the todays world the terms were grouped into one (Khoisan) (Van Wyk, 2014). Both the Khoi and the sans shared the same generic ancestors, history with the Europeans and cultural values. However, scholars separate the two groupings because of their different lifestyles. The today groups that exist under the Khoisan are the Griqua, Cape Malay, Nama, Cape Khoi and Koranna. According the Barnard (1998) the oldest human DNA is found in the Khoisan people which confirms their indigeneity. Under the apartheid government the Khoisan group was forced to be classified as Coloured people on their dompas (Veracini and Verbuyst, 2020; Fauvelle-Aymar, 2008). Failure to obey by those rules led to imprisonment.

2.6.2. Khoisan Language

In the post-apartheid government of South Africa, the Khoisan identity is still stripped off. Especially when pertaining Khoisan languages, South Africa has eleven official language which include all 9 Nguni languages, Afrikaans and English (Van Wyk, 2014; Barnard, 1993; Dlali and Chebanne, 2019). The post-Apartheid government adopted the Apartheid history by excluding their languages still to date. However, the democratic South Africa have the Khoisan identity in the coat of arm with the phrase (|XAM). The number of people who speak fluent Khoisan language are relatively small because of the decline or language speaker, majority of the Khoisan population are fluent in Afrikaans as it was a dominant spoken language in the Cape Colony (Seiboko and Allison, 2020; du Plessis, 2020; Güldemann, 2014). According to Pakendorf *et al* (2017) the language decline is strongly associated with the colonial era that the Khoisan community experienced, that is when Khoisan people adopted the westernised language (Afrikaans). The Khoisan traditional languages are or already extinct due to less people speaking and writing it. The languages are not fully extinct as some Khoisan people from the Northern Cape can speak and write it fluently a very good example is Ouma Katrina Esau and Simon Sauls the last people preserving the oldest Khoisan language, which they have even written a book and they are teaching young children in their neighbourhood to speak N|uu (Seiboko and Allison, 2020). The Khoisan Radio Station in Schmidtsdrift with approximately 5 000 listeners. Even Khoisan leaders have limited to no knowledge of their indigenous language, this goes even further to their names, majority of the Khoisan people have Afrikaans and English names, a very good example is Chief Hennie van Wyk (Chebanne, 2012; du Plessis, 2020). As majority of the Khoisan member were given these names so that it can be easier for their oppressor to call them (van Wyk, 2016). Colonialization negatively influenced the Khoisan Languages that still to date some of the Khoisan people cannot speak it at all unlike the Nguni people who are fully understand and speak their indigenous language.

2.6.3. Khoisan Land

Khoi and San people have been known as living the Nomadic lifestyle of moving freely around the country to graze their cattle and hunt. However, when the Europeans colonised the Cape of Good Hope they took advantage of the Nomadic lifestyle of the Khoi and San and used the approach for land ownership. Furthermore, this caused a huge impacted on the Khoi and the San people as they couldn't move freely as they did prior to the settler locating in the Cape Colon (Verbuyst, 2016; Sato, 2018; van Wyk, 2014). Because the Europeans exploited the Khoi and San Approach and they ended up owning most of the Western Cape and privatised their land. As the Khoisan Identity is being revived under the post-apartheid government reclaiming their ancestral land has become important. This has given rise to the Khoisan community in claiming their ancestral land under The Land Restitution Act of 1994, which allows communities and individuals who lost their last after 1913 or during the apartheid laws to submit their land claim for compensation (Van Wyk, 2014; Penn 2017; Mills, 2007). Currently this Act has favoured black people more than the indigenous Khoisan people as it had minimal practical result on Indigenous people of South Africa even though they were the first inhabitants of South Africa before the Nguni people and the settlers. As the Land Restitution Act of 1994 only mention year 1913 and excludes the years before that, it shows that the intention is to continue oppressing the Khoisan people as it excludes them from claiming what was theirs, this is a huge impact on the Khoisan people as land plays a crucial role in their identity (Everingham and Jannecke, 2006; Klaasen; 2018; Voss, 2021). This has put pressure on Khoisan leaders therefore the Khoisan claim that took place in February 2012 - September 2015 in Pretoria Union building was put in place in October 2021, under the Traditional and Khoisan Leadership Bill (Mokwena *et al.,* 2020; Laband, 2020; Erasmus, 2006). This Bill has raised so many eyebrows especially to the black communities as it excludes them from accessing or claiming land. These communities claim that its unconstitutional as it lacked public participation from 9 South African provinces and also its

exclusive of other ethnic group the same way the Khoisan communities has been excluded from decision making and society.

2.6.4. Khoisan Socio-Economic Status

The Khoisan community has tried their best in overcoming the oppression they still face today. From a socio-economic perspective, according, to the van Wyk (2016) the San and the Nama still face poverty as they are listed as one of the most poorer tribes when compared to the others (Cape Khoi, Cape Malays, Griqua, and Koranna). Majority of them are still located in rural communities where they are stigmatized by other Khoisan members and society who feel more superior. Some of these Khoisan members still work as domestic workers, gardeners, shepherds and labourers in homesteads others on farmland (Penn, 2017). The vulnerability of the Khoisan groups to poverty, alcoholism, drug abuse, prostitution, discrimination and with high suicidal cases (Maposa *et al.,* 2013; Chebanne, 2012). Khoisan women face more concerning issues such as gender-based violence, this group is also exposure to HIV/AIDS with an alarming rate of infected members with high unemployment rate amongst the group (Chebanne, 2010; Gabie, 2018). With the exclusion of Khoisan people on Employment Equity, black communities benefit more compared to the Khoisan (Van Wyk, 2014; Henneberg and Van den Berg, 1990). The situation even worsened during COVID19 pandemic, where everyone was affected but Indigenous groups were the ones mostly affected by the pandemic. Especially those living in the deep rural areas with no jobs and grant. There are however some of the Khoisan member who live good corporate lives and are under the middle class and upper-class income bracket, however, majority is still at the low income and no income bracket.

With such economic exclusion in Khoisan community under post-apartheid, their sense of place could possibly be impacted. The following section focuses on sense of place its subscales (place attachment, place identity and place dependence) and how this will be impacted by hydraulic fracturing.

2.7. Sense of Place

There are numerous terms that define a relationship between the environment and people. However, sense of place is the well-known term that ore suitable in defining the relationship between the two variables that being people and the environment. Sense of place can be viewed as an umbrella concept that consist of three subscales that further describes a relationship between humans and the environment (Jorgensen and Stedman, 2001; Shamai, 1991). According to Jorgensen and Stedman (2001) provides the most general term of sense of place, which is the value attached to an environment by an individual or group. He further elaborates that sense of place is not instilled in an environment, however, is found in how a person understands of an environment to suit them. Montgomery (1998) defines sense of place as experience people have with place whether it is in a physically or emotional form all together. Relph, 1976; Hay, 1998; Taun, 1977 associate sense of place with perceptions and emotions that human being has through lived experience with a physical setting. Sense of place can be viewed as a cognitive, spiritual and emotional in an environment this view is perceived and interpreted by humans (Jorgensen and Stedman, 2006; Taun, 1997). Sense of place can be developed by individuals through interactive and living experiences (Russell *et al.,* 2013). Sense of place differs from disciplines, in sociology and environmental psychology, sense of place is defined as being attached to the environment, identifying with the place, depending on the physical setting (Stedman, 2002). In this disciplines sense of place has been described as in connection with the environment and perceive place as. However, human geography defines it as, meanings that area associated with place (Taun,1990). In ecosystem management, is the attitudes towards a particular setting (Hausmann *et al.,* 2016). Hay (1998) states that sense of place and place attachment differ from each other. He further elaborates that sense of place is influenced by geographical context such as residential status, cultural and ancestral connection to place. Stedman (2003) conducted a study in the Northern Wisconsin landowners residing in the lake, the finding was that there is a relationship that exists between sense of place and the physical features of local environment.

A person can have a strong sense of place or weak one, this dependence of the influences of subscale that fall under sense of place. A strong sense of place can experience detrimental loss of sense of place which could possibly lead to solastalgia. A terminology defined by Albrecht *et al.,* 2007; Albrecht, 2006 as suffering or pain cause by environmental changes, be that it may, displacement, environmental degradation, wildfire in a forest or development such as hydraulic fracturing. Loss of sense of place can sometimes be avoided by implementation of environmental awareness and stewardship. Others could be through social cohesion and engagement, by working together to fix or restore what has been damaged. Not that individual with weak sense of place would not experience loss of sense of place but it be effect won't be the same when compared to someone with a strong sense of place towards an environment (Jorgensen and Stedman, 2006).

Sense of place is constructed on a concept that is aligned with a place not only being a physical setting but also a creation of memories, emotional bonds, experiences physical satisfaction, thoughts and meaning (Relph, 1979; Sack, 1977; Tuan,1975). The strength of these meanings is entirely depended on the depth of experience and amount of time spent in the area (Smaklone, 2008). There is an existing debate amongst scholars on sense of place and its role on the physical environment. Greider and Garkvovich (1994) claim that SOP is a social construct concept whereas other scholar believes that the two (sense of place and physical environment) cannot be separated, as the physical environment provides these experiences that influence sense of place. For example, a study conducted by Stedman (2003) on landowners residing on a lake in Northern Wisconsin, were found to have a relationship between the physical environment and sense of place on the area. Sense of place is influenced by the subscales, namely place attachment, place identity and place dependence, and that these subscales overlap each other. It is crucial for one to understand that while subscale (place attachment, Place dependence and place identity) are constituents of sense of place, they are also separate from one another. The following subscale of sense of place is place attachment.

2.7.1. Place Attachment

Altman and Low, 1992 defines place attachment as a positive emotional bond that expands over a period between person or a group to their specific physical environment which comprises of emotional gratitude. Riley (1992) focused on place attachment as emotional connection a person and a site which is beyond judgement, perception or preference. Place attachment includes an interaction of emotions, behaviour, affection and knowledge (Altman and Low, 1992). Hwang *et al.,* (2005) refers place attachment to expression related to emotional and symbolic meaning. Place attachment can be used in developments such as hydraulic fracturing to assess positive emotional bond to place, this concepted of place attachment can be used to conduct studies before and after development. To predict any negative bond that still exists after and during developments. Place attachment is commonly used in tourism, parks and recreation studies

Place attachment literature, it shows that age can be associated with place attachment (Cuba and Hummon, 1993) that an older general views place in a different manner when compared to a younger person (Rowles and Watkins, 1993). Therefore, older generation can have strong sense of place compared to younger generation, also older generation do not enjoy frequently relocating as much younger generation would. Length of residence can be predictor of sense of place depending on age group the individual belongs under. Residences who have stayed longer in a physical setting tend to have a positive lace attachment also compared to those with lessor years of residence (Relph, 1976; Taun 1977; Manzo; 2005). However, opposing this variable was a study done by Stedman (2002); Manzo; 2005 the study showed no correlation between length of residency and place attachment. But, place attachment can be negative towards place for other people. Place attachment develops is not limited to individual and multiple individuals in a place setting, hence community place attachment (Christensen and Burchfield, 2013; Kyle *et al*., 2005). Therefore, place attachment is not limited to one individual connection to place.

2.7.2. Place Identity

The dimensions of self are most associated with place identity, having a symbolic meaning to a place what you see yourself as. Self-regulating yourself in an environment that you feel emotionally connected to (Moore and Graefe, 1994; Proshansky, 1978). This dimension develops through lived experiences in a physical setting or place (Cheng *et al.,* 2012) this is not limited to one experience from a local place but also from other places that one has had a similar experience to (Therkelsen *et al.,* 2010). The satisfaction that one gets from a local place but also gets the same satisfactory experience at another can develop a strong place identity (Uzzell *et al.,* 2002; Lalli, 1992). This means with place identity; place satisfaction is not only limited to one place. Hernandez *et al.,* (2007) explains that a person lived experiences whether in the past or present influences their personal identity through memories, values, attitudes and preferences (Lengen and Kisternman,2012) caused by places used by people to separate themselves from each other from experiences and perceptions individuals have in a place of resident (Proshansky *et al,* 1983) this is based on what people think, feel and see. The features of personal identity which include and reflected by the physical setting through its personal and social meaning (Proshansky *et al.,* 1983; Buchecker 2005; Twigger-Ross and Uzzel, 1996). This dimension is connected to cultural values, belonging and person's ability that one can reconstruct, hence why they say place identity is unstable. A study conducted Swiss indicated that despite the urbanisation the place is experiencing residence still identify themselves to the area (Buchecker, 2005; Steele, 1988). Overall, place identity is dimension associated with self that describe a person's personal identity in connection to a place through a park the represents local heritage or a smell of a river in summer can be used to describe symbolic meaning or personal emotional ties under place identity.

2.7.3. Place Dependence

Place dependence is associated with a comparison between a current existing situation and an alternative that might occur for development of an achievement. The best way to explain

functional attachment is by using the description *"the Karoo is the best place for what I like to do*" and "*no other place can compare to the Karoo*". According to Thibaut and Kelly (1959), place dependence is not always positive, as one may not like the job they are doing in that place. However, the well-known definition by Stokols and Shumaker (1981) how a place can help one achieve their goals considering other alternatives to satisfy needs. These goals can be associated with job. Another example would be communities that depend on farming to generate income and improve local economy, that in another way of looking at place dependency.

With place dependency everything is associated with achieving a goal in a physical setting. In other words, it is a goal oriented behavioural dimension (Stokols and Schumaker, 1981). Place dependency is characterised by two components namely being; available opportunities to achieve my goal at current location in comparison to other alternative available (Pretty *et al.,* 2003).

2.7.4. Sense of Place and Hydraulic Fracturing

Since sense of place is widely defined as attachment, meaning and level of satisfaction an individual or group holds towards a physical setting (Stedman, 2002). Hydraulic fracturing development has the potential to disrupt ones' sense of place which can change the views or believes on hydraulic fracturing, this can even influence one into opposing the development. A study conducted in the United Kingdom, Wales by Wright and Howes (2010), on the residents' perception of wind farms discovered that residents who view their surrounding area as "mentally restorative" were to be expected to vote against the wind farm development. There are also studies that positively influence people sense of place to support development. A study conducted on the off-shore wind farm in the United States found that majority of the official in New Albany Shale supported hydraulic fracturing (Stedman, 2002). Sense of place can be negative and positive towards development. The positive SOP is seen when the development is beneficial to the community and negative when it not. Beneficial can be associated with positive economic, environment and community or social impacts. However,

if that is not the case results will indicate negatives sense of place towards development. In other words, place dependence can place a role to influence positive SOP towards development, vice versa. Even though the sense of place subscales are interlinked they also are separated making each one independent for example; and individual can be attached to a physical setting but not achieve goals from the area, also one can have place identity but not feel attached to the environment (Jorgensen and Stedman, 2006).

Scholars interest on how the energy development can potentially disrupt an emotional bond one has with a place, which could lead them to opposing the whole development and develop negative beliefs associated with the development. For instance, a study conducted in Wales (United Kingdom) found that residents who oppose the proposed wind farm development associated their communities' physical environment with being a mentally restorative space (Devine-Wright and Howes,2010). Devine-Wright (2011) conducted research in Northern Ireland on public perception of tidal energy development, his finding was that individuals with place meanings agreed with the development of tidal energy and those with positive place attachment had support for the development. Basically, residents were supportive of the development as they believed it will improve the lives of their community. Therefore, Dive-Wright concluded that energy development is not place enhancing and not inherently disruptive, especially when associated with improving place meaning which residents are highly attached towards. Another study conducted in United Nations by Firestone *et al.,* (2018) found residents supportive of offshore wind power development. A study by Silva and Crowe (2015) found that residents were supportive of the unconventional natural gas development in the New Albany Shale, as residents view it as a strengthening tool towards their social identity. It is also believed that sense of place can be associated with both negative and positive beliefs on development. A study conducted by Vorkinn and Riese (2001), observed the association between environmental concerns and place attachment concerning the proposed development of hydropower in the countryside of Norwegian. The study found that respondents who had a strong place attachment to the natural environment potentially

impacted by the hydropower development had negative beliefs whereas those strongly attached to the municipal had positive beliefs towards the hydropower development in the areas. A study by Carlisle *et al.,* (2014) on solar development found that there were no significant impacts on place meaning and place attachment, however there was negative and positive perceived impacts on characteristics associated with increased traffic, and job creation which were their strongest predictions of attitude. According to (Brown and Raymond, 2007; Sangaramoorthy *et al.,* 2016) earlier studies conducted on energy development, natural resource and sense of place used qualitative interviews and focus group data. Though, recent studies by (Devine-Wright, 2011; Firestone *et al.,* 2018) have incorporated quantitative which includes employ variables to examination explicit hypothesis concerning sense of place. Stedman is one of the scholar has been influential in scholars adopting this approach of incorporating quantitative research into sense of place (Stedman, 2002).

2.8. Conclusion

The literature review section above demonstrated the background history of hydraulic fracturing development. It further investigated on the countries where hydraulic fracturing is implemented and narrowed down to South Africa, on the energy sector and the proposed hydraulic fracturing development being suspended due to the concerns. It latter focus on public perception of hydraulic fracturing and its components that influence decision making of the public. The chapter delved into the Khoisan history, language, land and socio-economics status and then unpacked sense of place and its subscales, and sense of place and hydraulic fracturing.

Chapter 3: Methodology

3.1. Introduction

This chapter focuses on the research methodology and design that guided the research on the impacts of hydraulic fracturing on Khoisan peoples' sense of place. The main purpose of this chapter is to outline the methodology employed and how the research was conducted. It further explains the steps adopted to collect data and the manner in which data was analysed and interpreted. This chapter outlines the following: the research design, methodology, kind of data, target population, sampling design and procedures, data collection (primary and secondary data), data analysis techniques and ethical consideration.

3.2. Research Design

A research design is an action plan a researcher follows which is guided by the research question, aim and objectives concerning empirical data which leads to a solid conclusion. Involves decision making of the research problem, target population and methodology utilized (Babbie, 2007). Blaikie (2000) states that research design is a comprehensive description and explanation of technical decisions implicated in planning, implementing and processing data of a research project. Research design emphasises the final results and steps that were used to guide the researcher to come up with a solid conclusion of the researched study (De Vos *et al.,* 2011; Neuman, 2013; Creswell, 2017). Although, research design offers a methodological foundation and explains the process to collect accurate data findings, it also assists in achieving the main research aim, objectives and answering the research question. A well-planned research design helps avoid unrelated evidence to the research. This study employed a mixed method approach to guide the data collection of the study.

3.2.1. Mixed Method Approach

A mixed method approach is defined as investigation where the researcher uses a combination of qualitative and quantitative methods to identify a relationship between two or more variables to gain a better understanding and provide an opportunity to understand the

phenomena from the participant's perspective (De Vos, 2011; Creswell, 2017; Hayvaert *et al.,* 2013). This approach allows the study to gain an understanding which is acquired by analysing the participant's feelings, perceptions, behaviours, opinions, attitudes and thoughts (Chisaka, 2000; Bless and Higson, 2000) on hydraulic fracturing and the impacts of the hydraulic on Khoisan's people's sense of place. The research mainly focuses on interactions with the selected individuals in their natural setting to obtain required information. The study employed an in-depth analysis of the data collected. In addition, a mixed method approach finds to identify specific variables within the context of the study.

Even though this approach observes the relationship between two variables, it does not mean that one influences the other, instead these methods (qualitative and quantitative) integrate and complement each other. This allows a holistic approach to the research problem and objectives, making it a stronger research design that yields more reliable and valid finding by eliminating biasness (Neuman, 2013; Descombe, 2014). This contributes to having a meticulous conclusion of the study being researched. Therefore, the method allows the researcher to gain insightful information on complex questions by providing strengths that balances the weakness of the both methodologies (Qualitative and quantitative) (Descombe, 2014; Chisaka, 2000; Hayvaert *et al.,* 2013). This form of data collection allows the researcher to collect in depth information and numerical data of the study. According to Greene *et al.,* (1989) and Fielding and Fielding (1986) cited in Creswell (1999), mixed method approach refers to a single study data collection, analysis and findings using one method from qualitative and quantitative research to answer the research question. Data in mixed method approach can be collected through qualitative (by using text describing participant's opinions, attitudes, knowledge and perspectives on the impacts of hydraulic fracturing) and quantitative (through statistical application by measuring participant's sense of place and socio-demographics (Creswell, 1999).

Despite the existing disadvantages of this approach~~,~~ but remains costly, time consuming and requires more resources for data collection (Ivankova *et al.,* 2007; Almalki, 2016). If this

method is not implemented appropriately it can lead to biasness and untruthful conclusion. However, the benefits of using a mixed method approach is to provide a robust and rigorous conclusion for the study and different relations within the same research (Creswell and Clark, 2007).

This research employed a mixed method approach as it provided an opportunity for incorporating in-depth insight and unique strengths to provide a solid conclusion. A mixed method approach consists of two research methods (quantitative and qualitative) which will be discussed further as they were employed in the research.

3.2.1.1. Qualitative Methodology

Qualitative research methodology was employed in this study. This research method was utilized to obtain a deeper understanding of social phenomenon (du Plooy-Cilliers *et al.,* 2014; Given and Winkler, 2014). The data was collected in face-to face interview situations by interacting with the 50 participants in their setting to gather their perceptions, understanding, knowledge and attitude on hydraulic fracturing. According to Atieno (2009); Abdullah *et al* (2001); qualitative research includes fieldwork as primary tool to collect data. However, the researcher must physically attend to the proposed study site (Karoo region, Cradock) to record and observe behaviour of the participants (Khoisan people). This approach provides why a certain thing is done the way it is. According to Given and Winkler (2004), qualitative data focuses on epistemological obligation to a human-based approach to research. The main purpose of this approach is understanding the dynamics of psychological and social issues and expressing them in words instead of a numeric format (Neuman, 2013; Creswell and Creswell, 2017). Qualitative approach is subjective as it relies mostly on an interpretative social reality to obtain holistic understanding of participant's experiences, in this case the Khoisan.

This research method attempts to broaden or deepen our understanding of how things came to be the way they are in our everyday world. In this context, qualitative approach assisted the researcher in answering all the questions about the nature and phenomena from participant's

point of view (du Plooy-Cilliers *et al.,* 2014) on hydraulic fracturing. This method allows the researcher to ask general and broad questions also known as inquiry approach (Creswell and Clark, 2007), it stresses on the significance of understanding human behaviour and their ways of thinking and reasoning. Qualitative research focuses mainly on how individuals make sense of their world, life and experiences (Atieno, 2009). Even though it requires resource intensive, time consuming and costly. The advantages associated with this research approach is that it produces finding based on validity and are less inauthenticity (Creswell, 2017; Babbie, 2007; Neuman, 2013), which allows a research to develop a more accurate understanding of perceptions, attitudes and knowledge of hydraulic fracturing that arise from the participants and possible impacts of hydraulic fracturing on Khoisan's people's and their sense of place. This approach is mostly suitable for a small population representative, to gain in-depth understanding of the situation being studied.

According to Neuman (2000), this method displays, analyses, interprets and summarises words. In addition, a qualitative research approach also utilises interviews with participants using questionnaires to understand and explore their attitudes, opinions, feelings behaviour and perceptions on hydraulic fracturing and the potential social impacts of hydraulic fracturing on Khoisan people's sense of place. This study saw the researcher conduct one-on-one interviews which were guided by an open-ended and close-ended questionnaire in order to understand the participant's experience, attitudes, opinions and frame of reference on the impacts of hydraulic fracturing on their sense of place.

3.2.1.2. Quantitative methodology

A quantitative research approach uses numerical measurements which utilizes mathematical methods to analyse the data collected, as well as statistical analyses to examine the phenomena under study (Descombe, 2014; Alversia, 2011; Babbie, 2010; Conrad *et al.,* 2014). This approach allows the abstraction of data from participants into statistical representation such as tabular and graphical rather that textual (Brief, 2012; De Vos *et al.,* 2011). In quantitative research, a researcher or researchers can test a theory that is well

illustrated through a hypothesis and draw a solid conclusion in relation to the hypothesis, this can be successfully implemented if proper guidelines are taken into action when observing and analysing data (Neuman, 2013). The purpose of this research methodology is to collect quantified data which is highly structured. Therefore, data is collected and analysed using mathematically based methodologies. In social sciences, this methodology collects data using "measuring instruments" (De Vos *et al.,* 2011), these instruments are structured interview schedules, scales, checklists, indexes, structured observation schedules and questionnaires.

For the purpose of this study a questionnaire was used to guide the interview, in order to gain an understanding of Khoisan people's sense of place in connection to the Karoo region and perception attitudes, opinion and concerns towards hydraulic fracturing. What limits this approach is that it may degrade human individuality and the ability to think. The qualitative method is empirical research that seeks to establish relationships between two or more variables in a statistical format (Descombe, 2014; Ivankova *et al.,* 2007). This approach is suitable for research that requires a large sample size, such as this research of 50 Khoisan participants from (Cradock) Karoo region, Eastern Cape province where the proposed hydraulic fracturing site is located, and where most of the Khoisan people reside. However, quantitative research has its own advantages and disadvantages. The advantages consist of large sample size which means it can cover a large geographical area and plays a significant role in problem solving for policy makers and public officials (Creswell and Creswell, 2017; Babbie, 2007). On the other hand, the disadvantages of this research method are viewed as not being scientific as a result the data obtained from the study can be influenced by prejudice and personal bias by the researcher. In addition, this method limits participants from being liberal about their thoughts, opinions and feelings in other words their views cannot be expressed accordingly. According to, Adbdullah (2001) this method has a high rate of non-responses from participants as it consists of a large sample of participants who have a right not to participate to the research as stated on the consent form.

3.3. Target Population

According to Burns and Grove (1997); Draugalis and Plaza (2009), a target population is an entire collection of participants that meet the assigned criteria of a study a researcher is focusing on to extract solid conclusions. The target population for the study consists of Khoisan population group (Indigenous people) from the age of 21 and above, who reside in the Karoo region (Cradock). These participants provided their perception, attitudes and knowledge on hydraulic fracturing, and allowed the researcher to measure their sense of place.

Are characterised by what a researcher desires his sample to incorporate in the study (Rees and Howells, 1997). The participants were all adults (21 years and above) who were available when research was conducted, all the participant spoke either English or Afrikaans, which are languages the researcher was familiar with and understood. Participants who fall under Khoisan ethnic group. According to Rees and Howells (1997), the exclusion criteria for a research is characterised by what a participant desires to possess, that can negatively influence the accuracy of the results. Therefore, in this researched study the people who do not fall under the Khoisan ethnic group were excluded, as they are not part of the indigenous group (First Nations) of Southern Africa, individual whose age group is between 0 – 20 years were excluded as they might not share enough information that is required.

3.4. Sampling Design and Procedure

Sampling Design is the primary component of data collection in scientific research, this form of design plays a fundamental role in ensuring that data is adequate to draw appropriate conclusion from. This design requires a process of representative selection of an entire population to gain research information about the phenomenon of interest. In other words, a small sample size observation can present an overview of what can be anticipated from the total population being studied. The purpose of sampling was to achieve representativeness, meaning the sample should be assembled in such a way that represents the entire population from which the sample is drawn (Jennings, 2001).

According to Singh (2015), a sample represents characteristics of a sub-section of the population selected to participate in a research. Sampling is used in both qualitative and quantitative research (De Vos *et al.,* 2011: Neuman, 2013), however in this research the focus will be on qualitative sampling. In qualitative research, sample size has no regulations as it depends on credibility, results and aim of the study.

Sampling tends to be feasible for research purposes, as its seldom possible to cover the entire population of interest (Yates, 2004 cited in De Vos *et al.,* 2011). In this case, sampling the entire Khoisan ethnic group is rarely possible but selected representation sample can be reached. Sampling can result in more accuracy, in-depth information gathered, time efficiency, and cost effective when compared to studying the whole population (census) (Neuman, 2013). There are two types of sampling design that exist in research. Firstly, probability (random) sampling and lastly, non-probability (non-random) sampling (Polit and Hungler, 1995; Royse, 2004; Sedgwick 2013). In this study, a non-probability (non-random) sampling was used, as it was more suitable for answering the research question and objectives.

3.4.1. Non-probability (non-random) sampling

This study employed non-probability (non-random) sampling as it is more of a qualitative research. In other words, it mostly results from one or two events. Therefore, it is highly unlikely that these events are selected randomly. Gravetter and Forzano (2018), claim that non-random sampling includes unintentionally selecting participants from a population. In non-random sampling, selecting participants for this method means that the odds of selecting a participant are unknown meaning that there is no equal opportunities for participants to be selected (Unrau *et al.,* 2007; Singh, 2015; Alvi, 2019; Salkind, 2006; De Vos *et al.,* 2011), since the researcher is not familiar with the members of the population and the population size that exists. In non-probability sampling, samples are selected based on accessibility and convenience (Etikan *et al*., 2016), even though it can be viewed as subjective. There are various types of non-probability sampling techniques namely, sequential sampling, deviant sampling, theoretical sampling, key informant sampling, voluntary sampling, purposive

sampling and snowball sampling (Teddie and Yu, 2007). However, this study will only focus on the two chosen sampling techniques, namely purposive sampling and snowball sampling, as discussed below.

3.4.1.1. Purposive sampling

Purposive sampling is a technique that depends entirely on the researchers' judgement on the selection of participants (Singh, 2015: Rubin and Babbie, 2005). This means the researcher decides which participants are suitable to achieve the research question, aims and objectives of the researched study (Etikan *et al.,* 2016). Monette *et al.,* (2005) puts that, this sampling technique offers researchers the rationale to form generalisations from the sample of the research. He further elaborates that these generalisations can be in a form of any nature from logical, theoretical to analytic generalisation (Monette *et al.,* 2005; Palinkas *et al.,* 2013). This sample can offer a wide non-random sampling method that a researcher can select from. Even though it can raise judgements and unbiasedness.

The researcher purposively selected Khoisan population as the sample, because they demonstrated characteristics and representation of the population which benefited the purpose of the researched study. Furthermore, the researcher chose members of the Khoisan population who reside in the Karoo region (Cradock). Therefore, this sample was purposefully selected as it served an understanding to answer the research question of the study (Singh, 2015; Royse, 2007). Therefore, purposive sampling was assisted by snowball sampling technique.

3.4.1.2. Snowball sampling

This sampling technique was employed to select the Khoisan people who were used as the participants in the study. This technique is executed to recruit future participants from existing ones amongst their connections (Etikan *et al.,* 2016; Alvi, 2016). The reason for this sampling technique was because the researcher found it difficult to get access to the population and the phenomenon of the study was relatively unknown and limited access to select the suitable participants as there was inadequate awareness of the sampling frame. Therefore, using this

technique helped identify the Khoisan member as they were hard to reach. From Cradock the gatekeepers (Khoisan Chief) therefore provided a list of provided a list of participants who had given consent to voluntarily participate in this study. The Chief referred the researcher to the first participant (Khoisan member) who then located the other members of the population with the suitable inclusion criteria of the study, who also recruited others. As it was unethical to obtain cell phone numbers of the participants. The more the sample size increased, enough data was collected to be beneficial for the study. Snowball sampling technique can be hard to identify sampling error that might have occurred in the study (Neuman, 2014; Sarantakos, 2012). Therefore, to prevent it sampling error from occurring, the researcher increased the number of participant. This did not prevent the researcher from obtaining the relevant information suitable for the study and from the inclusion criteria of the selected participants.

3.5. Sample size

The accuracy of the qualitative data is also influenced by your sample size. Neuman (2014) states that, when sampling a larger population, a small sample need to be represented and when sampling a smaller population, a larger sample need to be represented. In larger sample size this method provides accuracy, and more representative of the population even though this alternative can be costly and time consuming (Neuman, 2014; Grinnell and Williams, 1990). Sample size is controlled by resource availability, reliability, heterogeneity and homogeneousness and probability or non-probability sampling (Neuman *et al.,* 2003; Huysamen, 1994; De Vos *et al.,* 2011; Bless *et al.,* 2006). In this study the sample size was limited to Fifty (50) participants. This number of participants was suitable for the study to minimise sample error (Welman *et al.,* 2005; Grinnell and Williams, 1990). The 50 participants were the only available Khoisan members who were willing to participate in the interviews.

3.6. Data Collection

Burns and Grove (1997) as well as Zohrabi (2013), define data collection as a systemic manner of gathering information which is appropriate to the research question. For data collection purposes, various procedures exist which include; diaries, questionnaires,

observations, tests and interviews. For the purpose of this research data was collected using primary and secondary data to obtain the research aim and objectives and answer the research questions. This section, however, will further explain the processes and procedures used to collect the data.

3.6.1. Primary Data

Primary data is original data that is collected from first hand sources. This data is accumulated using case studies, questionnaires, interviews, surveys and observations. The main aim of collecting primary data is to provide necessary solutions to research problem. However, this form of data collection possesses its advantages and disadvantages. In terms of advantages, the data can be acquired in various ways, namely through surveys, emails and interviews where relevant and original data is gathered to the study being researched. Such data possesses raw and current information, as it provides the researcher with relevant views to the study being researched. In relations to the disadvantages this form of data collection can be time consuming and costly when designing the questionnaire in two different languages (English and Afrikaans) (Neuman, 2013; Ajayi, 2017; De Vos *et al.,* 2011).

The primary data was collected using a semi structured interview guided by a questionnaire. This allowed the researcher to examine the participants for more in-depth information to yield rich data (Neuman, 2014). The research questionnaire was designed around the aim, objectives and research question, which included a range of instruments in which the participants responded to questions that guided the researcher. Questions were asked in relation to the Khoisan participant's demographic status, opinions, perceptions, attitudes, beliefs and knowledge on the impacts of hydraulic fracturing and experiences on their connection to place (sense of place).

The questionnaire (Appendix B) which was used to the guide the researcher incorporated closed-ended and open-ended questions. Firstly, close-ended questions allowed the participant to respond using the answers that were listed on the questionnaire. Secondly, open ended questions allowed the participant to provide in-depth information on their

understanding, knowledge, attitude, perceptions and opinions on the impacts of hydraulic fracturing and their experiences on the connection they have with their surrounding environment (sense of place).

The structure of the questionnaire is divided into five sections.

Section A, was designed to obtain socio-demographic data of the participants which included their age, gender, place of birth, length of residence, number of household members, income, employment status, highest education level obtained, community involvement and land ownership.

Section B, included close ended questions on sense of place. This section was divided into three sense of place components namely place attachment, place identity and place dependence, this section was adopted from Stedman (1997) and Williams and Roggenbuck (1989). To answer the questions a five-point Likert scale was used to extract information from the participants. The Likert scale ranged from strongly agree (5) to strongly disagree (1), with neutral (3) being the middle range. This section mostly included the emotional bond or connection one has to the surrounding environment, and how they identify and depend on the surrounding place or environment (sense of place). Furthermore, a correlation was done between the subscale of sense of place and other variables from socio-demographics to see if they correlated and influenced sense of place

Section C was based on open-ended questions where participants were asked on their perceptions, attitudes, opinions and knowledge on hydraulic fracturing and if the municipal official had addressed the community about the proposed hydraulic fracturing technique.

Section D was based on social impacts, this section used open-ended questions where participants were questioned on the form of energy sources they use, their access to water, their ancestral connection on the Karoo and how they think the development could impact their daily livelihoods.

Lastly, in section E, participants were asked about the kind of support they needed to ensure that they are informed about future developments, and who should provide them with such information, and provided positive and negative comments on the nature of hydraulic fracturing that were not included in the questionnaire.

The questionnaires were distributed to sampled Khoisan participants (50) who met the inclusion criteria of the targeted population group that are residing in the Karoo region (Cradock).

For the study, only 50 participants were available to answer all the questions administrated on the questionnaire. Each interview lasted for 30 – 40 minutes depending on the amount of information each participant had to share with the researcher.

3.6.2. Secondary Data

Secondary data is data collected through a third party (Ajayi, 2017), meaning that this form of data collection is utilized to gain existing data that is already collected by the primary source from previous research and made available to researchers to utilize in their own studies. Secondary data collection provide insight into a research problem which assists in identifying the research gaps of the research being study. According to Davis-Kean *et al.,* (2015), the advantages of secondary data is affordable and time consuming. In relations to disadvantages, secondary data may have presented outdated or inaccurate data and can raise concerns of copyright and authenticity (De Vos *et al.,* 2011). In this study, secondary data was collected using resources such as books, published and unpublished articles, journals, newspapers, archival materials, regulations and law, constitution of South Africa, internet sources, company reports, government gazette, Integrated Development Plans and Stats SA.

3.7. Data Analysis Techniques

Data analysis is the significant part of a research, this is where data collected is summarized and interpreted. The purpose of data analysis technique is to examine data by utilizing

statistical or analytical tools to identify useful data for the study being researched on (Alhojailan, 2012). This study utilized two techniques to analyse data collection. In particular, quantitative and qualitative data analysis techniques.

3.7.1. Qualitative Technique

Qualitative technique by nature produces descriptive results, therefore this research method utilizes words to elucidate the results of the data collected. In this study, qualitative data was used for analysing and interpreting data from the questionnaires. The data collected was then coded to develop an interpretation of data. This technique is whereby stories, meaning, and theories are learnt from the data collected. In order to analyse the data for the study, the researcher first had to organize the data using patterns to report a comprehensive story from the data that was gathered. The selected patterns were compared to theories that already exist using inductive reasoning. With the use of inductive analysis, the researcher managed to concentrate on patterns based on the data that was collected during the study, these patterns were represented on the analysis using graphs, tables and charts.

3.7.2. Quantitative Technique

Quantitative data produces quantities or statistical results, therefore this research method utilized codes to represent numerical analysis, and therefore a series of statistical analysis was performed using Statistical Package for Social Sciences (SPSS) v26. This windows program enables data entry and storage, employs statistical analysis, uses retrieval strategies, and descriptive statistical analysis for instances, frequencies, percentages, charts, tables, scales, graphs and averages. SPSS allowed the researcher to report clearly and concretely on the findings of the impacts of hydraulic fracturing on Khoisan people's sense of place in the case of the Karoo region. Graphs, tables, scales and charts were used to classify trends, show proportions and the distribution of values and to compare visually the relationship between hydraulic fracturing and Khoisan people's sense of place, the connections between socio-demography and sense of place, sense of place and hydraulic fracturing, and social impacts and hydraulic fracturing.

3.8. Validity

Welman and Kruger (2001) describe validity as a mechanism that ensured that the process implemented to collect data, has collected the intended data successfully. Validity refers to the extent to which an empirical measure adequately reflects the real meaning of the subject under investigation. Furthermore, Welman and Kruger (2001) define validity as an instrument to ensure that the processed used to collect data of the research studied has collected the suitable data effectively. Laxton (2014) states that validity is associated with the accuracy of the results of a researched study and evidence of causes and consequences relationship. In this study, the following step were taken to guarantee that the data being collected was valid:

1. A comprehensive literature review was conducted.
2. The purpose of the study was thoroughly explained to the participants before conducting the interviews.
3. All questionnaire was completed.
4. Tracking system was used, participants had their own code. For example, participant number 1 (P-1).
5. Confidentiality and anonymity was assured to the participants before conducting the interviews. This allowed the participants to be frank during the interviews, hence trustworthiness

These abovementioned steps ensured that the interviews were conducted in an environment acceptable to the participants, and hence ensured that the process was trustworthy.

3.9. Reliability

Reliability is associated with the consistency of data collection, this would mean that the same results occur whenever the same technique is utilized (Zohrabi, 2013). In this study, reliability was achieved by making sure that:

1. Confidentiality and the anonymity of the participants was used, this ensures that the data collected is precisely for the study being researched.

2. Sampling error and biasness were prevented by increasing sample size.
3. Through carefully and accurately phrasing questions for the participants to avoid ambiguity.
4. Cronbach alpha coefficient (internal consistency) was used in section B for reliability coefficient purposes and for internal consistency on Sense of Place. Cronbach Alpha is used for a more suitable Likert scale purposes, as for this research a Likert scale was adopted to measure sense of place. This method is used for correlation purposes, in this case if the correlation between the items from Likert scale are positive the coefficient will also be positive.

3.10. Ethical Consideration

Pera and Van Tonder (1996) refers ethics to be the correct way of behaving. Ethics is viewed as a division of philosophy that addresses code of conduct for people or for people to follow, as it guides the standards and norm of people's everyday behaviour (Akaranga and Makau, 2016). Therefore, ethics relates to researchers (those conducting the research) and the people being researched (participants). The ethical clearance was obtained from Nelson Mandela University which gave the researcher permission to collect data from the participants in Cradock. The ethical approval was received in September 2021 by the Research Committee with the reference number of H21-SCI-GEO-001.

All parties involved in research must have a mutual understanding involving cooperation, trust, expectations and promises. Babbie (2001) states that parties involved in research needs to be mindful of what amounts to be appropriate and inappropriate in research. The researcher was aware of responsibilities, guidelines, obligations and rules when conducting a study. Therefore, the researcher had the responsibility to ensure that the rights and well-being of participants are protected at all costs.

The study used written and verbal communication, which could involve emotions, to interact with different Khoisan community members. As such, the questions asked intended not to

harm, discriminate or invade the privacy of the participants. Participants were not forced to provide information against their will, nor where they classified according to their race, colour and language. Hence, they were allowed to provide information freely and on a voluntarily basis. The study ensured and guaranteed that the participants' identities and information provided was not be revealed and was only used for the purpose of the study, thus guaranteeing anonymity and confidentiality. At the centre of the ethics, the study ensured that the necessary permission and procedures to conduct the study were obtained to ensure that traditions and beliefs are well respected.

This study had to conduct the research with no invasion of privacy, harm, prejudice, discrimination but only justice and fairness. Participants were not forced to provide information they were not comfortable to share. Hence, provision of information was voluntarily. The participant was aware of their rights, hence the informed consent form that was distributed before the interview was conducted. The study guaranteed rights to anonymity and confidentiality, informed consent and respect for participants.

3.10.1. Permission

The researcher received permission from the gatekeepers (Chiefs) to conduct research in the areas. The approval or permission was granted by the Nelson Mandela University, Human Research Ethics Committee (Annexure B) with reference: [H21-SCI-GEO-001). The research approval allowed the researcher to interview the Khoisan participants of Karoo Region (Cradock), the approval was granted for three years on the basis of renewal each year.

3.10.2. Informed Consent

According to Eysenbach and Till (2001), the informed consent form is an indication of applying ethical consideration to research participants. The researcher had printed out informed consent forms for all participants who agreed to be interviewed. The participants had to sign the form, which was a contractual consent that they willingly partake in the study. This form

was both in English and Afrikaans, for those who couldn't read or write it was read for them prior to the interview.

3.10.3. Anonymity and confidentiality

For this study research, anonymity was achieved by having codes for each participant these codes indicated which province the participant is from and which number the participant is. For example, participant's number 4 was have code (P-4). Therefore, no identification was revealed. The information gathered for the study was not be used anywhere else but for this study. Participants were guaranteed anonymity and were explained about the assigned codes to ensure that they remain anonymised.

3.11. Conclusion

This chapter provided information regarding the process involved in gathering data on the sense of place of the Khoisan community and their knowledge perception on hydraulic fracturing in the Karoo region (Cradock). A mixed method approach was utilised to acquire data. A questionnaire which consisted of both qualitative (face-to-face, open-ended interviews) by interacting with participants in a particular setting to obtain data, as well as quantitative research (questionnaire) by identifying variables in the study for correlation and reliability coefficient.

The following chapter will detail the data analysis process of the information acquired during fieldwork.

Chapter 4: Research Findings

4.1. Introduction

This chapter provides the analysis of the data acquired in the field. The chapter represents the socio-demographics of the Khoisan members from the Karoo region (Cradock area). The results of the descriptive analysis are presented in this chapter. The chapter further represents the analysis of sense of place with the inclusion of all three subscales namely; place attachment, place dependence and place identity. This is followed by the representation of Khoisan participants perceptions and attitudes towards hydraulic fracturing in the Karoo region. The impacts of hydraulic fracturing on Khoisan people are then discussed and lastly recommendations of the potential impacts of hydraulic fracturing on Khoisan peoples' sense of place is expanded on.

4.2. Socio-demographics

This section of the study represents the research finding on socio-demographics of the participants under study. These finding are presented using tables and graphs to summarise the data and later interpreted and discussed further to gain more understanding from the participants of the study. The socio-demographics of the study play a crucial role in determining the extent to which influence the Khoisan participants responses. For the purpose of this section, the variables included are age, gender, place of birth, length of residence, number of household members, average monthly household income, highest level of education obtained, amongst others. The figures and tables below outline the summarised socio-demographic variables in relations to age, gender, place of birth, length of residence, number of household member, and so on from the Karoo region.

4.2.1. Age Group

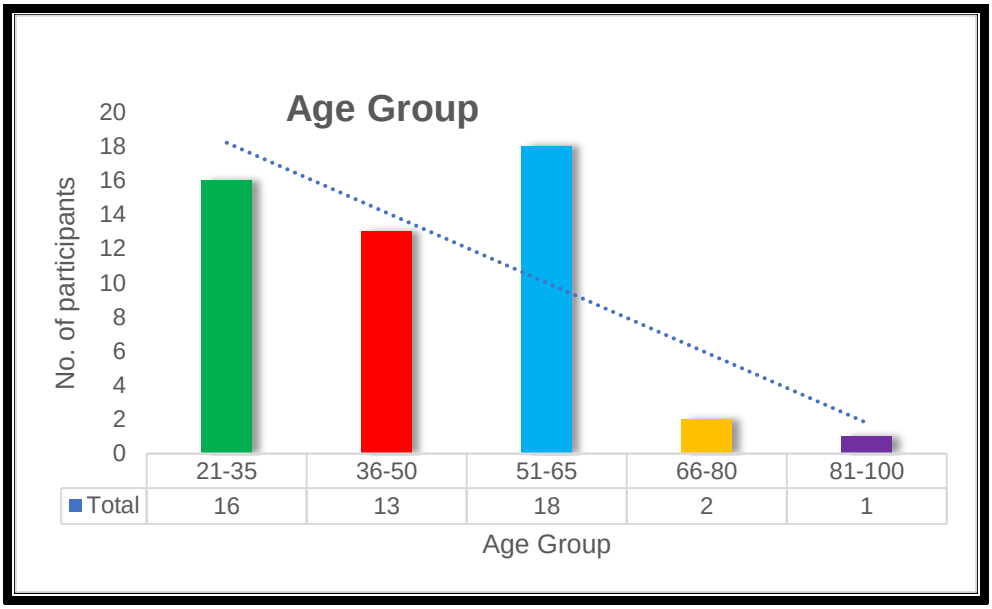

***Figure 0-1*: Age Group of Participants (n=50)**

This research drew participants from the Karoo region (Cradock). Figure 4.1 above shows the results of the age group of participants within the participant number of (N=50). This figure shows that the majority of the participants are between the ages of 51 to 65 years which is 36% (18) of the Khoisan population interviewed. The data acquired also indicated that there are young people between the age of 21-35 who identify themselves as Khoisan and do not fall under the Coloured people racial description which the government uses as one of the racial descriptions that exists in South Arica, with the others being Black, Indian, Asian and White. The Khoisan exclusion on the South African government racial census does not stop them from embracing their original race. This is mostly found amongst the old age group which is over 50 years of age as they managed to learn more about their family history and background when compared to the younger generation which is known to have less interest with their historical backgrounds. Williams and Kitchen (2012) research on sense of place suggests that variables such as age group can temporally influence sense of place.

4.2.2. Gender

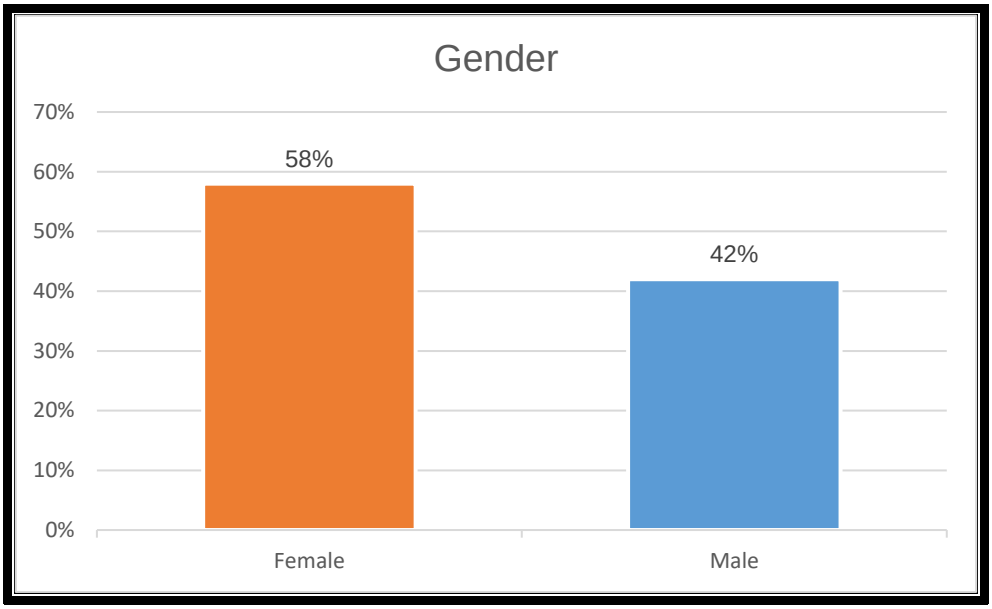

***Figure 0-2*: Gender of Participants**

The illustrates shown above on Figure 4.2 outlines the proportion of Khoisan men and women participants who engaged in the potential impacts of hydraulic fracturing on Khoisan peoples sense of place study sample. It is evident that the gender of the participants is mostly dominated by females. The research finding indicate that females represented 58 percent (29 participants) of the sampled population while men accounted for 21 percent. Women who are mostly head of the households in the area identify themselves as Khoisan. Surprisingly, in the area the some of the Khoisan Chief were women. Unlike, in ancient times where Chiefs were known to be males and not females. In this case, females were also appointed to be chiefs. This indicated that equity can be met somewhere, and that traditions or culture can be changed were women can be given such roles to rule and not only do domestic household duties only for example, cleaning, cooking, laundry and taking care of children while men were regarded as the providers also known as breadwinners. According to Statistics South Africa (2020), the South African population is dominated by females with the population of 30.9 million when compared to males (29.22 million), this is evident in the IDP of Inxuba YeThemba Municipality for 2020 - 2021) which indicated that there are more females (33 950) compared to males (33 720). The dominance of females in this data collection could be influenced by the

referrals using snowball sampling techniques or the days in which the data was conducted. Where more female participants were available compared to the males. Hence the study had more females compared to males.

4.2.3. Place of Birth

Place of Birth	Percentage (%)
Angola	8
Bedford	2
Cape Town	4
Cradock	60
Free State	2
Graaf Reneitt	2
Hout Bay	2
Humansdorp	2
Middleburg	4
Gqeberha / Port Elizabeth	2
Roadside (Eastern Cape)	2
Schmidtsdrift (Northern Cape)	8
Springbok (Northern Cape)	2
Total	**100**

Table 0-1: **Place of birth of participants**

Participants were asked about their place of birth, as some if the participants were not born and bred in the area of study but rather elsewhere and then relocated to the Karoo region in this case Cradock area. Table 4.1 above indicated the place of birth of the Khoisan participants. Majority of the Khoisan participants are from Cradock area, which is 60 percent

of the participants of the study that are born and bred in Cradock. Whereas the rest are from out of town, province and country. Fascinating enough, 8 percent of the participants were born in Angola then migrated down to South Africa for greener pastures. While others are from the Northern Cape in Scmidtsdrift (8 percent) and Springbok (2 percent), Northern Cape is known for having more Khoisan members mostly San people who proudly identify themselves as the Sans. Others born in Eastern Cape in Middleburg (4 percent), Port Elizabeth (2 percent) and the rest are from the Free State and Western Cape province.

4.2.4. No. of Household Members

Household Size	Percent (%)
1	2
2	10
3	12
4	30
5	8
6	14
7	6
13	18
Total	**100**

Table 0-2: **Number of household members**

The Khoisan participants were also asked about the number of household members residing in the compound. Reason being was to determine the composition of the household in terms of total Khoisan members living in the compound. Table 4.2 shows the household size of the participants which ranges from 1 to 13 members per household which is an average of 5.1 members per household. Thirty percent of the household members have 4 household

members which is the majority in this study. While 18 percent reported having 13 family members in one compound. Other household had two or more children. With a high number of household members this means that there are more expenses as there are more heads to feed.

4.2.5. Income Status

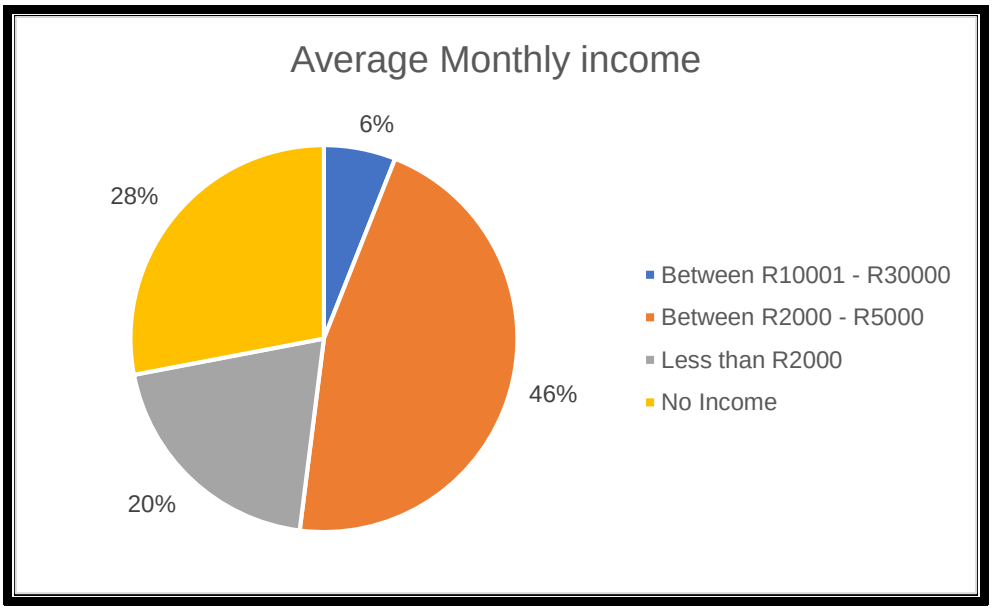

***Figure 0-3*: Average Monthly income**

The participants average monthly income shown above in Figure 4.3. Participants were asked to indicate their level of income according to relevant cohorts. This study divided income bracket into 3 groups, namely those who earn R10 001 to R30 000 or more per month, between R2 000 to R5 000 per month, those earning less than R2 000 per month and no income per month. About 6 percent of the participants earn between R10 001 to R30 000 these participants were mostly the self-employed or were civil servants in municipal employment. Those earning between R2 000 – R5 000 were mostly the retirees or engaged on formal employment. As for the 20 percent of the sample earning less than R2 000 per month, they received a social grant, child support grant, old age grant, disability grant holders and/or held casual jobs. There are 28 percent of participants with no income at all, not even COVID grant as some were not aware of it and others have been rejected on both COVID19

Relief applications. Some participants were not sure of the exact income as they had part time jobs and informal activities such as informal hawking, coiffeurs, and so on. Others sometimes do not have access to any form of payment or stipends. Considering the above, it indicates that monthly income in the study area is extremely low. According to the IDP of Inxuba YeThembe Municipality (2020) there are approximately 761 number of households who fall between R1 to R 4000 household income bracket and 1997 households with no source of income. This indicates that there are households who depend on hand out or go to sleep in an empty stomach, considering the number of households with no income.

4.2.6. No. of residential years in Cradock

***Figure 0-4*: Length of residence of participants in Cradock**

The participants were asked the length of residence in the Karoo region (Cradock). Their length of residence ranges from 3 years to 75 years. This shows that some of the participants recently moved to the area others have resided in the area for a few years, some were born in the area then moved away for job opportunities elsewhere, only to return to the area. The sample size indicates that none of them moved to the area during Covid19 but moved to the area before the pandemic, while others were born and bred in the area. This is evident in the participants with more than 25 years of length of residency and who have never left the area. This is an influencing factor in their sense of place, as length of residence is one of the key

factors that influence one's sense of place (Stedman, 2002; Williams *et al.,* 1993; Jorgensen and Stedman, 2006). Fourteen percent of the participants have resided in the area for 8 years, followed by 12% of the participants resident in study area for 21 years. The longest length of residency is 75 years.

4.2.7. Educational Attainment

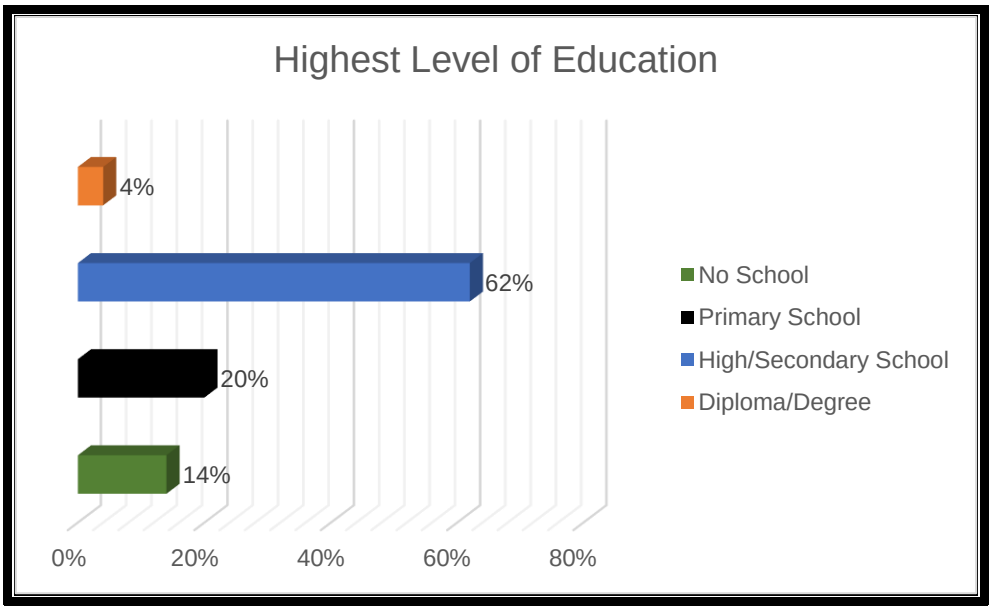

***Figure 0-5*: Highest Level of Education**

There is this perception that the Khoisan community members are associated with illiteracy and low level of education (van Wyk, 2016). However, this is not the case for this study as figure 4.5 above indicated that the participants have some level of formal education. The range of educational levels are indicated in the graph above (Figure 4).

According to this study, 62% of the participants had high school/secondary school education, and 20% only attended a primary school as for the rest (14 percent) went ahead and attended tertiary institution or college. Therefore, for the study purposes one can conclude that most Khoisan members have formal education and a few of them are without formal education which could have a positive influence on understanding what hydraulic fracturing is and its impact.

During the apartheid years, education was reserved for the White minority and Non-White were provided with bantu education (Rakometsi, 2008). Gebremedhin and Joshi (2016) state that education was used as a tool for segregation policies. As Non-White communities had shortage or lack of teacher's inferior curriculum and shortage number of schools. Post-apartheid the Department of Education announced a new curriculum for transformation of educational system in South Africa (Gumede and Biyase, 2016). The curriculum was used to address issues such as the increasing the number of teachers, improving educational system and infrastructure backlog.

4.2.8. Occupation Status

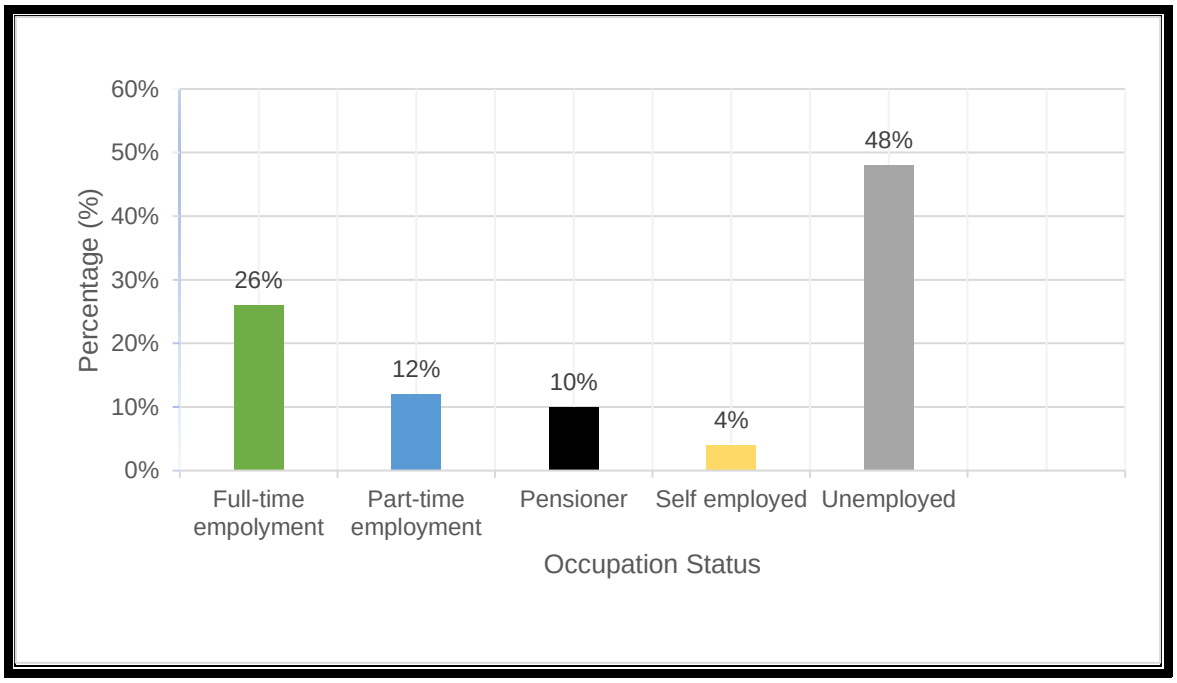

***Figure 0-6*: Occupation status of participants**

For the purpose of this study, participants were asked whether were employed or not, or have any form of extra income. Figure 4.6 above indicates that participants from Khoisan community are reported for both employment and unemployment. Forty eight percent of the participants were unemployed, while 4% were self-employed, only 10% were pensioners, 12 percent being part time employed and 26 percent by those working full time jobs. The study therefore

indicated that most of the participants are unemployed hence they depend on government for grants (Social, disability, old age, child support and COVID19 relief).

Where unemployment is concerned the youth (15 to 35 years) is the most vulnerable age category in the labour market, with the high unemployment rate for this category. South Africa unemployment rate is at its all-time high since 2008 at the rate of 34,9 percent in the 2021 third quarter. With the population of 7.2 million who are unemployed and mostly being youth (15 – 35 years). Even though unemployment in Khoisan community is not a prevalent issue it should be discussed (Van Wyk, 2016) states that more Khoisan people are unemployed and that is an issue raised in their socio-economic status.

4.2.9. Property Ownership

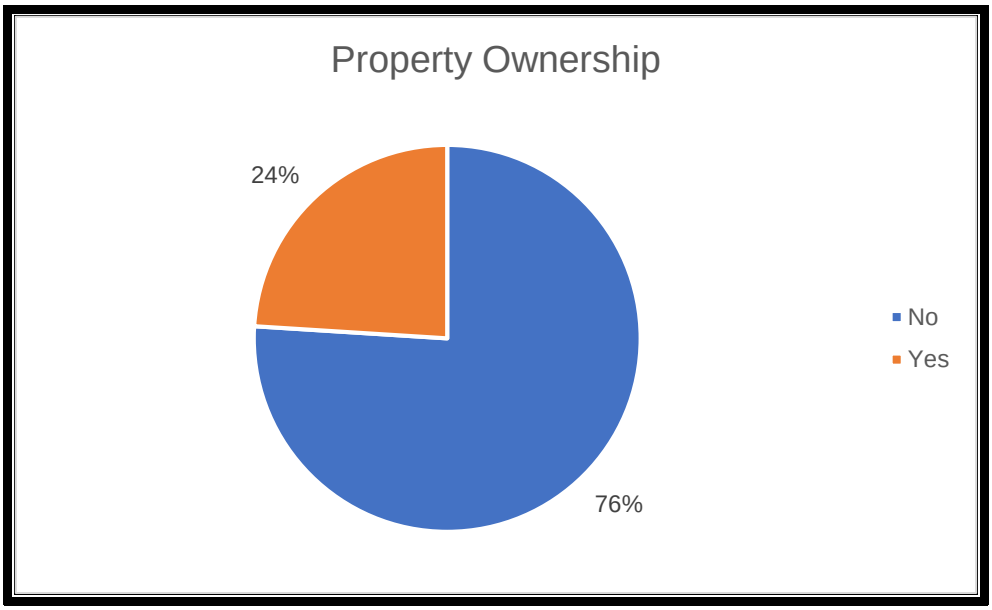

***Figure 0-7*: Property Ownership**

Participants were known to own some form of property whereas other do not have any property ownership. In Figure 4.7 above it shows that participants who own property and those who do not own any form of property. In the study, 24 percent of participants do not own any form of property therefore reside with their relatives and others their partners. Others mentioned that they have applied to receive Reconstruction and Development Programme

(RDP) houses and are waiting for the municipality to build them and allocate them to those houses.

Other participants mentioned that they do not have houses because they were moved from their previous homes to the new area with the promise that they'll be built houses only for them to be moved to smaller houses that do not even belong to them. This form of displacement was highly practiced in the post-apartheid by the African National Congress. Where people were moved from their comfortable home to be displaced elsewhere further away from the social amenities and work.

However, 76 percent of participants owned property were some of the participants inherited the property, purchased and received it through the RDP programme. According to Manomano and Kangethe (2015), people who live in low income houses also known as RDPs are succumb to unemployment and highly depend on social grant for survival.

4.2.10. Community Involvement

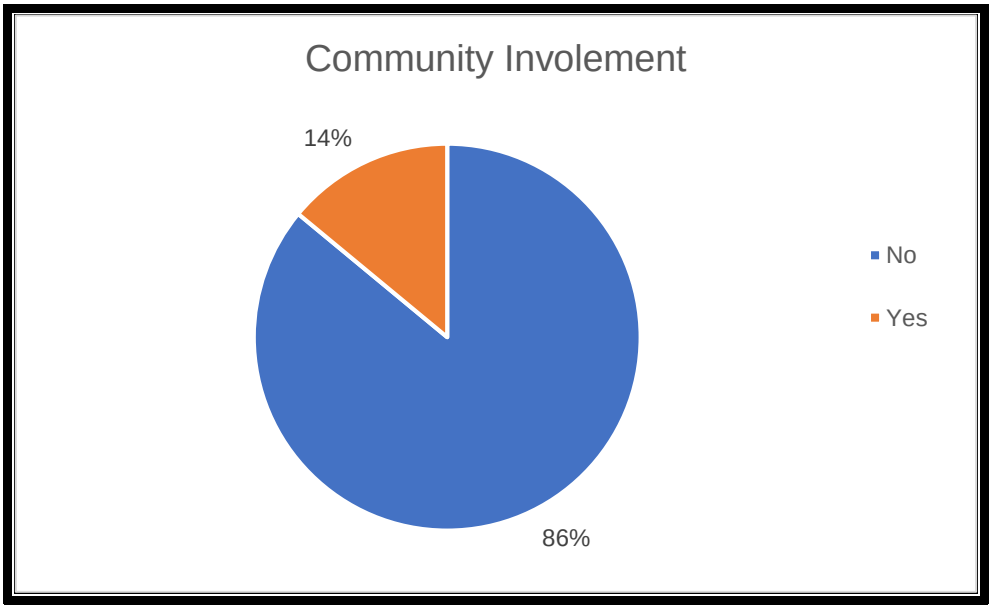

Figure 0-8: Community Involvement

From figure 4.8 above it is quite evident that the participants had a low community involvement. less participants from the study engaged in community work. With 14 percent of the participants who are involved in community organisations and 86 percent not engaging in

any. Community engagement is one of the influences of enhancing positive sense of place towards a particular setting (Stedman, 2002; Jorgensen and Stedman, 2006). The study shows that those who were involved in community engagement were likely to know what is happening in the area whether they are new development or workshops being conducted. These community engagements are Khoi and San group, soup kitchen and initiation forum. However, since there is a high number of participants who do not engage in these community engagements it evidence that some of them are not informed about what is happening in the area including the hydraulic fracturing development that the government wants to explore in the Karoo region.

4.2.11. Moved to other Areas

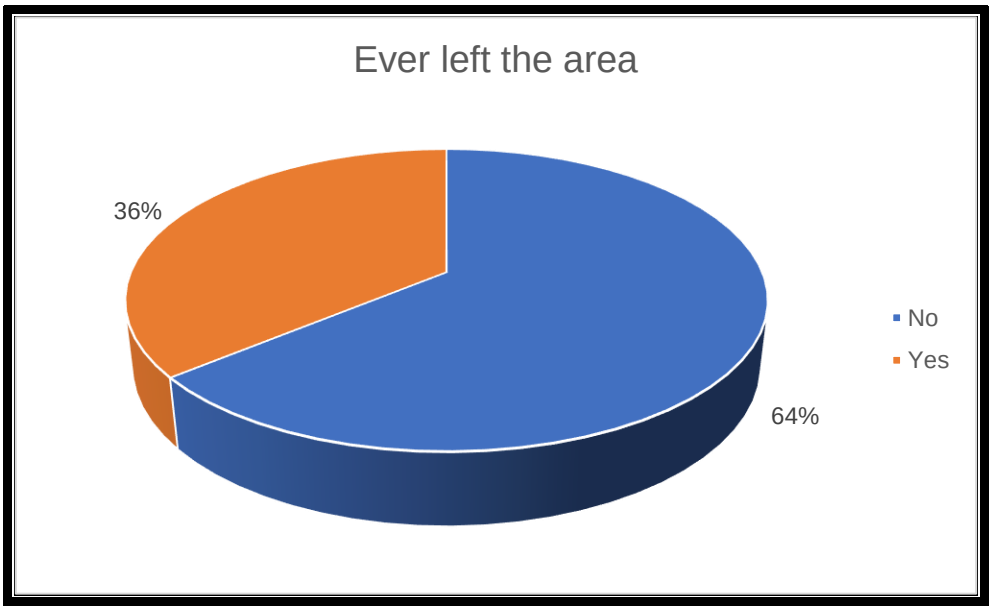

***Figure 0-9*: Participants you've left the area**

The above pie chart of Figure 4.9 shows that majority of the participants have never left the area which could influence their sense of place to a positive as their length of reside is long and no exposure to other areas which means what is front of them has more sentiment, in this case their area Cradock. Therefore, cannot be compared to any other. According to the study, 64 percent of the participants have never left the area while 36 percent have left the area or better job opportunities, marriage and school (tertiary). The number of years that the

participants have left the area ranges from 2 to 19 years. Others came back because of retrenchment, COVID19 and never left, others were failed marriage and completion of tertiary studies. Concluding on this is that participants prefer being in Cradock as there are closer to their loved ones and the pandemic showed them the important of being home or closer to family.

This section is represented the socio-demographic of participants. The study can conclude that the socio demographic of the research show that the majority of the participants are from the low-income group. Therefore, highly depend on the government for survival.

4.3. Sense of Place

This section of data analysis focuses on sense of place, how emotionally connected are the participants towards the Karoo region (Cradock). Their correlations to each subscale and how the variables influence their sense of place.

Sense of place reliability coefficient is =0.922, therefore indicating that the subscale of sense of place are reliable and consistence for the purpose of this study.

Factor (Scale α)	Item label	Item description
Place Attachment **(α= 0.96)**	**ATTACH1**	I am very attached to the Karoo
	ATTACH2	I would feel less attached to the Karoo, if the native plant and animals that live here would disappear
	ATTACH3	I am much attached to the natural environment of the Karoo
	ATTACH4	I learn a lot about myself when spending time in the Karoo
	ATTACH5	I feel a deep connection or feeling of oneness when I spend time in the natural environment in the Karoo
Place Identity **(α= 0.91)**	**IDENTIT1**	I fell the Karoo is a part of me
	IDENTIT2	I have a very special connection to the Karoo
	IDENTIT3	I identify strongly with the Karoo
	IDENTIT4	The Karoo means a lot to me
	IDENTIT5	I feel like I belong to the Karoo
	IDENTIT6	The Karoo says a lot about who I am
Place Dependence **(α= 0.89)**	**DEPEND1**	The Karoo is the best place for what I like to do
	DEPEND2	No other place can compare to the Karoo
	DEPEND3	I get more satisfaction from residing in the Karoo than from residing at a similar site
	DEPEND4	Doing what I do at the Karoo is more important to me than doing it in any other place
	DEPEND5	I wouldn't substitute any other area for doing the type of experience I have at the Karoo
	DEPEND6	The things I do at the Karoo I would enjoy doing just as much at a similar site

***Table 0-3*: Scale items for Sense of Place**

The Table 4.3 above shows the three sense of place components (Place Attachment, Place Identity and Place Dependence) were measured using Cronbach Alpha, with seventeen items while using a 5-likert scale which ranges from "strongly agree to strongly disagree". These specific items were adopted from previous research studies from (Stedman, 1997; Williams

and Roggenbuck, 1989). This table shows the standardised reliability coefficients (**α**) that was calculated on all the three subscales of sense of place. The reliability coefficient for Place Attachment 0.96, Place Identity 0.91 and Place Dependence 0.89 these shows that each scale of sense of place reflected on satisfactory degree of systematic variance from the study. With this high score of sense of place, it is quite evident that with this high score on subscales are consistent and reliable.

4.3.1. Place Attachment

Place Attachment							
Item Label	**No. of participants**	**Strongly Agree (%)**	**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Strongly Disagree (%)**	**Total (%)**
ATTACH1	**50**	92%	4%	4%	0%	0%	**100%**
ATTACH2	**50**	90%	6%	4%	0%	%	**100%**
ATTACH3	**50**	96%	4%	0%	0%	0%	**100%**
ATTACH4	**50**	96%	4%	0%	0%	0%	**100%**
ATTACH5	**50**	98%	2%	0%	0%	0%	**100%**

Table 0-4: **Place Attachment**

The Table 4.4 above shows that there was a high strongly agree selection as far as place attachment scale is concerned. There is a high place meaning towards Karoo (Cradock amongst the participants. This shows that majority of the participants strongly agree that they are attached to the Karoo. A participant said, *"I am strongly connected to the area through ancestry, rootedness and the feeling of belonging".* Taun (1977); Jorgensen and Stedman (2006) state that having a strong positive emotional bond towards an area make one want to protect it at all cost. Therefore, this connectedness and rootedness can be compromised (loss of place attachment) if exploration of hydraulic fracturing is given the green light by the South African government.

4.3.2. Place Identity

Place Identity							
Item Label	**No. of participants**	**Strongly Agree (%)**	**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Strongly Disagree (%)**	**Total (%)**
IDENTIT1	**50**	96%	4%	0%	0%	0%	**100%**
IDENTIT2	**50**	96%	4%	0%	0%	0%	**100%**
IDENTIT3	**50**	98%	2%	0%	0%	0%	**100%**
IDENTIT4	**50**	98%	2%	0%	0%	0%	**100%**
IDENTIT5	**50**	96%	2%	2%	0%	0%	**100%**
IDENTIT6	**50**	96%	4%	0%	0%	0%	**100%**

***Table 0-5*: Place Identity**

Place identity, as represented in Table 4.5 above shows that there is a strong place identity amongst the participants. Therefore, with a strong place identity that was scored on the study indicates that the participants are identity themselves through the Karoo region (Cradock) from their families' graveyards including the Cradock four gravesite, rock arts that are located in the reserve and also the spa was one of the mentioned things that they identify with. The spa which is a natural spring resort which has natural surplus water. Some believe it has gas from underneath the earth. Participants from Cradock area showed a strong place identity which indicate their symbolic importance and meaning of the area. Proshansky (1983), states that place identity is more like self-identity, if an individual has symbolic ties to a something within themselves, they can also have the same meaning or ties with an area (in this can Cradock). Furthermore, this strong positive place identity indicated that there is symbolic importance and meaning of Cradock area to the participants

4.3.3. Place Dependence

Place Dependence							
Item Label	**No. of participants**	**Strongly Agree (%)**	**Agree (%)**	**Neutral (%)**	**Disagree (%)**	**Strongly Disagree (%)**	**Total (%)**
DEPEND1	**50**	96%	0%	2%	2%	0%	**100%**
DEPEND2	**50**	92%	6%	2%	0%	0%	**100%**
DEPEND3	**50**	86%	14%	0%	0%	0%	**100%**
DEPEND4	**50**	90%	10%	0%	0%	0%	**100%**
DEPEND5	**50**	86%	6%	6%	2%	0%	**100%**
DEPEND6	**50**	86%	2%	6%	6%	0%	**100%**

***Table 0-6*: Place Dependence**

As place dependence is concerned, which is represented on Table 9 above shows that there is a strong positive place dependence. This could be because majority of the people residing in Cradock depend on the area for leisure purposes, job, families, schools, social amenities and familiarity. Table 9 above shows there is a strong place satisfaction towards Cradock area. There is a strong place dependence amongst Khoisan participants and Cradock, this shows in the table above. The participants highly depend on Cradock for jobs, family, schools, and being in familiar surroundings. Stedman (2002) indicated that a person can have a strong place dependence if their goal achievements are met in the area when compared to other alternatives. Therefore, with a strong positive place dependence it shows how participants depend on Karoo region (Cradock) as it meets their goal achievements through job or family ties. As they depend on Cradock compared to other alternatives with a similar setting for recreational purposes or goals that can be achieved or are already achieved.

4.3.4. Correlation (*N=50)*

	Place Attachment	*Place Identity*	*Place Dependence*	*Place of Birth*	*Occupation*	*Length of Residence*	*Property Ownership*	*Community Involvement*	*Ancestral Connection*
Place Attachment	1								
Place Identity	0.864358279	1							
Place Dependence	0.813791025	0.905889616	1						
Place of Birth	0.514832783	0.833777527	0.173033068	1					
Occupation	0.319981843	0.073048087	0.640520243	0.060719007	1				
Length of Residence	0.53193849	0.703219437	0.043564666	0.596485536	0.044011758	1			
Property Ownership	0.406420002	0.128355073	0.696949358	0.128780549	0.045494848	0.383990279	1		
Community Involvement	0.254816227	0.092157143	0.541923222	0.062442295	0.150657427	0.400819838	0.178146899	1	
Ancestral Connection	0.301111009	0.704546035	0.407571991	0.128472222	0.348893339	0.158559446	0.261463539	0.624422953	1
N = 50									

Table 0-7: Correlation (N=50)

The research analysed the data using correlation in relations to other variables. The Table 7.7 above shows the Pearson's correlation coefficients amongst the independent and dependent variables, these correlations were moderate to high. The correlation between variables of sense of place that existed at a high rate was between length of residence and sense of place, which shows that with the number of years one resides at a particular area can develop sense of place over time. Interestingly, were place attachment is concerned, there was a high correlation with length of residence (.53). Jorgensen and Stedman (2006) in the study they conducted in lakeshore, which states that length of residence has a significant correlation with place attachment, community involvement (Devine-wright and Howes, 2010) conducted a study in Wales (United Kingdom) on perception of residents on proposed wind farm development. They found that participants who view their community space with mentally restorative meaning opposed the development. As for place identity there was a high correlation with place of birth (.83), length of residence (.70) and ancestral connection (.70). Proshansky (1983) alludes that place identity is influenced by rootedness, connection and meaning to a particular

setting. Place dependence also had a high correlation with occupation status (.64), people who benefit from the Karoo, family history and owners of property (.69). It is evident that sense of place variables had high correlation amongst its subscales. These correlations were as followed: Place dependence and Place Identity (.90), Place Attachment and Place Identity (.86), lastly Place Attachment and Dependence (.81). In conclusion regarding correlation with variables was moderate to high, however it was very high with the independent variables and the main subscales of sense of place. Research on sense of place indicate that variables such as length of stay, community involvement and job opportunities may temporarily influence sense of place (Williams and Kitchen, 2012).

This section indicated that there is a positive correlation that exists between the Khoisan participants and Cradock area. This positive significant correlation is associated with ancestral connection with Cradock area. Therefore, if the proposed hydraulic fracturing development is approved, this could negatively impact sense of place which could lead to loss of solace (solastalgia). Solastalgia is distress caused by environmental degradation and deterioration which in this case will be caused by proposed hydraulic fracturing development, by clearing of fauna and flora for construction of wells and ancillary activities associated with development. This could potentially take years to recover or not recover at all. The loss of solace can be experienced through negative impacts associated with hydraulic fracturing such as displacement, change of Karoo scenery, high traffic due to construction and oil and gas transportation, environmental degradation.

4.4. Perceptions, Attitudes, Opinion and Knowledge towards Hydraulic Fracturing

This section will focus on participants perception, attitudes, opinion, concerns and knowledge on hydraulic fracturing. The purpose of this section is to find out if the participants know about the development of hydraulic fracturing.

4.4.1. Knowledge on Hydraulic Fracturing

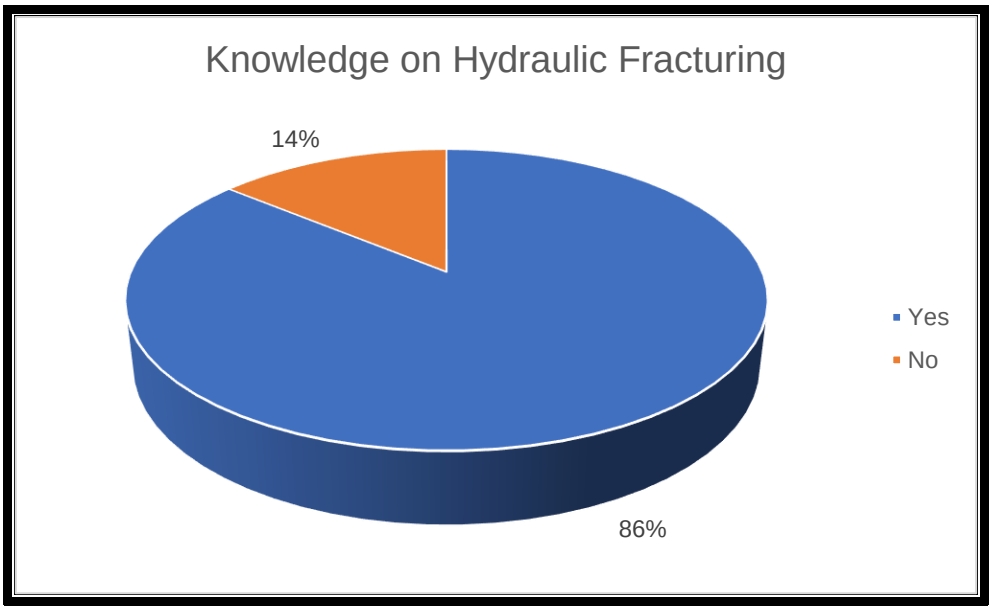

***Figure 0-10*: Participants Knowledge on Hydraulic Fracturing**

The above Figure 4.10 shows the participants knowledge on hydraulic fracturing. According to the study more participants had not idea or knowledge of what hydraulic fracturing is. For those who knew what hydraulic fracturing was explained it as [“*drilling of gas underneath the earth’s surface*” *“it is extraction of gas from beneath the earth by cracking the rock using sand and water” “Drilling gas vertically then horizontally into the ground of shale rock and crack it” “The horizontal drilling of shale gas from the bed rock beneath the surface to extract gas and pump it up the well”].* Only 14 percent of participants knew about hydraulic fracturing whereas the 86 percent had no idea. Therefore, for the study purpose the research had to skip all the question that followed for those who knew nothing about the proposed development of hydraulic fracturing and continued with those question related to hydraulic fracturing with those

who knew what hydraulic fracturing is. After finding out that some of the participants had no idea as to what hydraulic fracturing is, I could not further elaborate for them as it could have cause biasness for the study. This also shows how much government and local municipalities does not share such proposed development with community members in general. Therefore, public participation is then excluded or even manipulated (Boudet *et al.,* 2014). The lack of knowledge on what hydraulic fracturing is could also be influenced by the education level, which is low meaning some people will have no ideas as what it is and that when the municipality, hydraulic fracturing company shareholders, research institutions working on such development should provide workshop for local community members about hydraulic fracturing and its impacts.

4.4.2. Where did participants find out about Hydraulic Fracturing

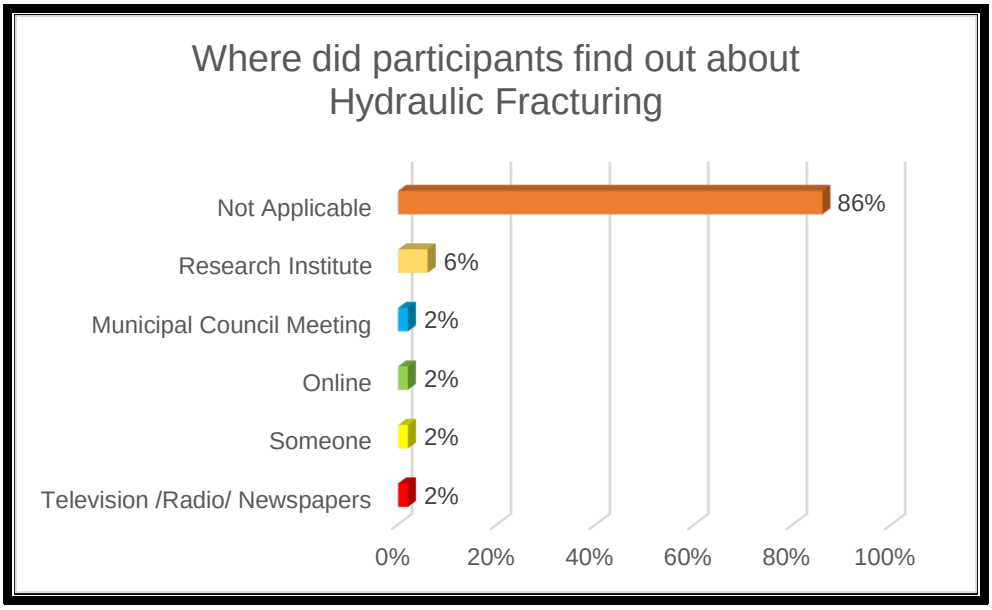

Figure 0-11: Where Did Participants Find Out About Hydraulic Fracturing

The above Figure 4.11 shows where participants heard or found out about hydraulic fracturing. It is quite concerning that an area that could be impacted by the boom of hydraulic fracturing as it is a neighbouring town, has a high number of participants (not applicable = 86 percent) who do not know what hydraulic fracturing is and have not found out about it until the research was conducted and only when participants were asked about these questions. This is alarming

especially because there is social media where such information can be shared with community member and through word of mouth by municipal leaders and ward councillors. This shows that there a gap in communication between the government, local government and community members (Graham, 2014). This study shows that 6 percent of the participants heard about hydraulic fracturing for the first time when African Earth Observatory Network (AEON) Earth Stewardship Science Research Institute came to the area in 2016 to do a baseline study on hydraulic fracturing. This Research Unit is situated in Port Elizabeth (Nelson Mandela University). As for the 2 percent that heard from the municipality council meeting, was because they were privilege enough to be allowed to attend on that particular day that it was mentioned. The other 2 percent was online, as the world is becoming more technology savvy people are sharing such knowledge, however it cannot be ignored that in our days the things being shared on social media is mostly content that about fun, beauty, and so on, and it is hardly on informative information such as hydraulic fracturing. Even if this form of knowledge was posted online the manner in which is communicated is hardly addressed in an inviting manner but rather in a long paragraph and not directly to the point (Boudet *et al.,* 2014). Boudet *et al.,* (2014) states that social media has can either influence people to support or oppose such hydraulic fracturing developments by the type of content being shred. He further on states that those media post that oppose hydraulic fracturing will show environmental degradation and deterioration content to draw participants to oppose the development, whereas the content on economic development will be shown to influence people to support development. However, with the issue of data prices in South Africa plays a huge role in people not being informed about such developments through social media. South Africa is one of the countries that sell data at an expensive price that most people cannot afford it (Chinembri, 2020) and with the high unemployment rate this form of communication about proposed hydraulic fracturing information, is hard to access. As for the 2 percent of the participants that said they heard it from someone and 2 percent was from newspaper, radio or television.

The 14 percent participants who heard or read about hydraulic fracturing also raised their opinions on the development as well as concerns. Some of the participants raise far enough opinions about hydraulic fracturing, the participants said *"It is dangerous for our human life" "Damage of land and bad for farming" "This can cause great damage to the earth", "It is dangerous for our environment and community, its sound like it is good for the economy but not sustainable enough for a small town like Cradock", "Dangerous for our community mostly young generation, and outsourcing of jobs", "It can effect food security"*. They went on and mentioned some of their concerns regarding this development *"Pollution and our health", Mining rights and outsourcing of jobs", "Due to toxic chemicals used in hydraulic fracturing are great concerns. The need for waste water disposal and shrinking water supplies are also pressing issues directly to the procedure…. Other environmental concern is water pollution, fracking can have long term effects on the soil and surrounding vegetation, waste water spills can reduce the soil ability to support plant life", "Did they research it properly from a South African perspective. Did they inform the community and explain this development"? "Water pollution and displacement of people living in those areas close to the fracking sites".* Even though, the participants who know what hydraulic fracturing is and have mentioned their concerns, they still aware that hydraulic fracturing is good for the economy through job creation however they felt that some of the jobs will be part-time and not on a full-time basis and most people will be outsourced from out of town, province and/or country. Therefore, participants who know about hydraulic fracturing strongly oppose it due to the various concerned that are mentioned above. They were also asked what is the immediate thought that comes to mind when they hear or read about hydraulic fracturing (Boudet *et al.,* 2014) calls it the "affective imagery" and their responses were *"damaging the environment and atmosphere", "danger", "destroying the earth", "displacement, development and high standard of living" and "explosions"*. Therefore, the 14% that is aware of what hydraulic fracturing is are actually aware of what impacts hydraulic fracturing comes with, but this was only possible through attendance of workshop with AEON research institute reading and keeping informed.

4.4.3. Development Satisfactory of Cradock

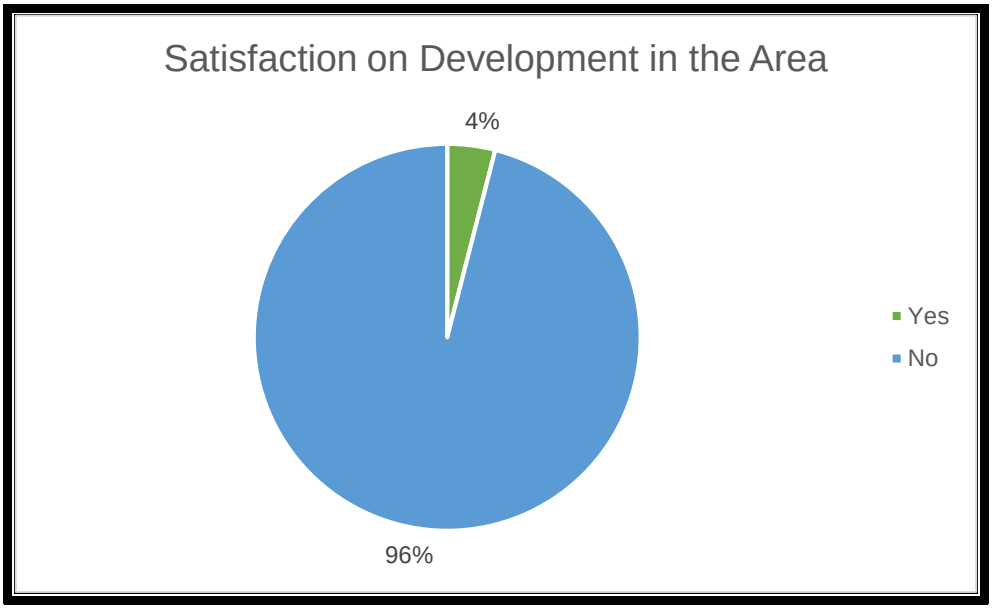

Figure 0-12: Satisfaction on Development in the Area

The satisfaction of development in Cradock, and participants of the study are not happy about the development in the area, this is shows in Figure 4.12 above. The 96 percent of the participants said no they are not satisfied with the development and 4 percent said yes, they are. This was influenced by service delivery in Cradock. One of the participants mentioned that they need water and houses as promised by the running local government (African National Congress). Other mentioned that the development in Cradock is one sided, people from town are always delivered services as promised however, the people residing in the townships are not.

Figure 0-13: Some of the Participants Living Condition

The living condition of a few participants who stay in shacks (plastic structure) alongside a gravel road mentioned that when COVID19 2020 lockdown took place, the municipality delivered one JoJo tank (As seen in Figure 4.13) and never refilled after. These participants have part-time jobs at a nearby farm and sometimes do not get paid by the farmers. However, they were provided the opportunity to relocate to the townships where they were going to be provided tin houses and they refused because the area is too far from their job. Not only was that their reason, they also complained about their children having to attend school with non-native children. They said they were afraid that the non-native children will illtreat their children by bulling and teasing because of their physical structure and because they are Khoisan.

The municipality does try to deliver some services however some are never met. Therefore, the participants are not happy or satisfied with the development and service delivery by the local municipality (Inxuba YeThemba Municipality).

This section of data analysis focused on the perception, attitudes, opinions and knowledge on hydraulic fracturing. This section showed that majority of the participants are not aware what hydraulic fracturing is and only a few participants were aware of what is hydraulic fracturing.

4.5. Impacts of Hydraulic Fracturing on Khoisan People

This section analyses data that is related to the social impacts of hydraulic fracturing, it focuses on how Hydraulic fracturing could possible local communities of Cradock societal impacts from ancestral connections, water scarcity and electricity bill, and main water source.

4.5.1. Ancestral Connection

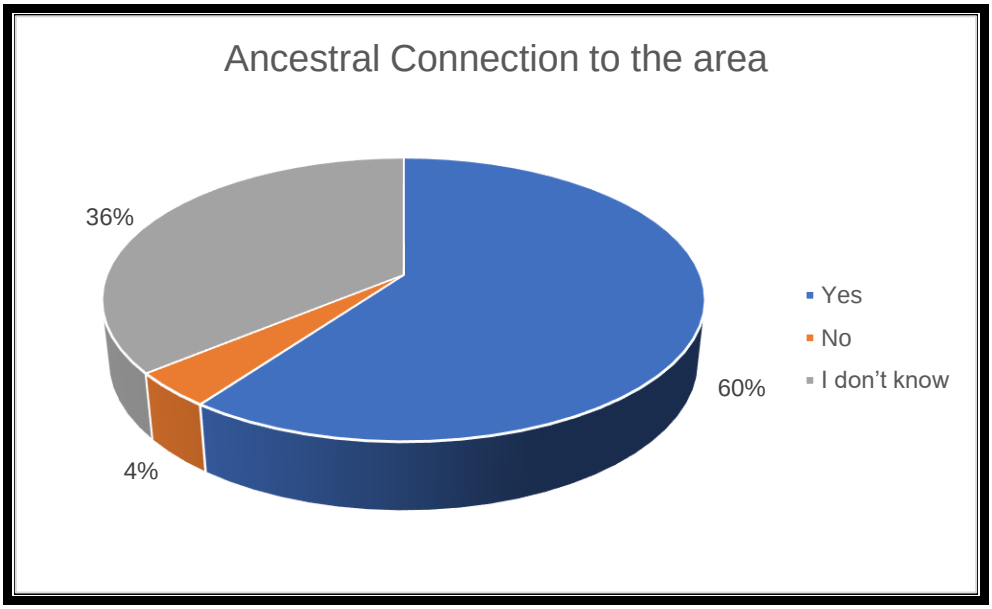

Figure 0-14: Ancestral Connection to Area

The above Figure 4.14 represents the ancestral connection to the area. 60 percent of participants stated that they have an ancestral connection to the area, 4 percent said no, and 36 percent said they do not know or they not sure. The 60 percent mentioned the rock art in the reserve, medicine plants and grave site of their late families. Others mentioned culture and their heritage some mentioned their family roots being in the area.

After being asked about their ancestral connection, the researcher wanted to find out about their families' background. Most of the participants mentioned that their great grandparents were born and bred in Cradock, other mentioned that it is hard to recall as their family were nomad (they always relocated for green pastures).

4.5.2. Benefits from the Karoo

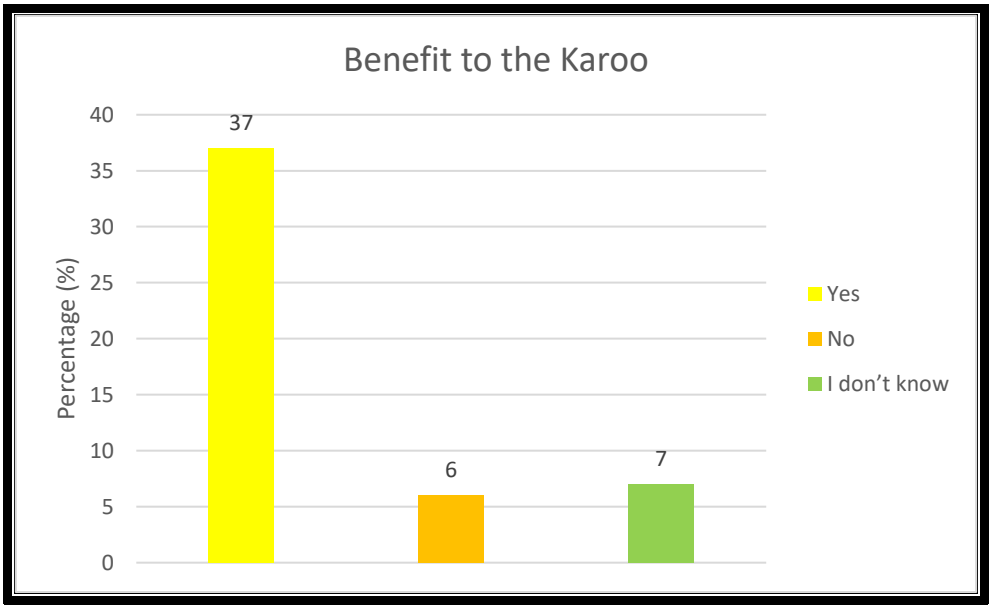

Figure 0-15: Benefits from Karoo

The Khoisan participants where asked on their benefit from the Karoo. And in Figure 4.15 above, it indicates that 37 percent of the participants do benefit from the Karoo region. Their benefits were mentioned to be through safety of their and their family, their mentions was that the Cradock area is still a small town therefore they do not experience high crime rate as compared to other developed towns and cities. Some of the participants mentioned that they benefit because of the areas rich heritage and culture which is still being practiced. Other participants mentioned traditional medicine as being beneficial to them, they mentioned that Cradock still have traditional medicinal plants that they use for asthma, diarrhoea, headache and period pains. Some participants went as far as mentioning "*fresh air that I breathe, the closeness of our people and the easy movement from point A to B*", the participant showed concerns of these benefits being hindered if the proposed hydraulic fracturing development does take place because this development could possibly cause environmental degradation. Other participants mentioned leisure places such as the Zebra Park, Cradock Spa as being beneficial to them. What most participants mentioned to be beneficial to them was job or work. As they able to look after their families and still have a shelter over their head. Six percent of

the participants do not have any benefits associated with the Cradock area and 7% said they do not know how and what they benefit from the area.

4.5.3. Household Water Source

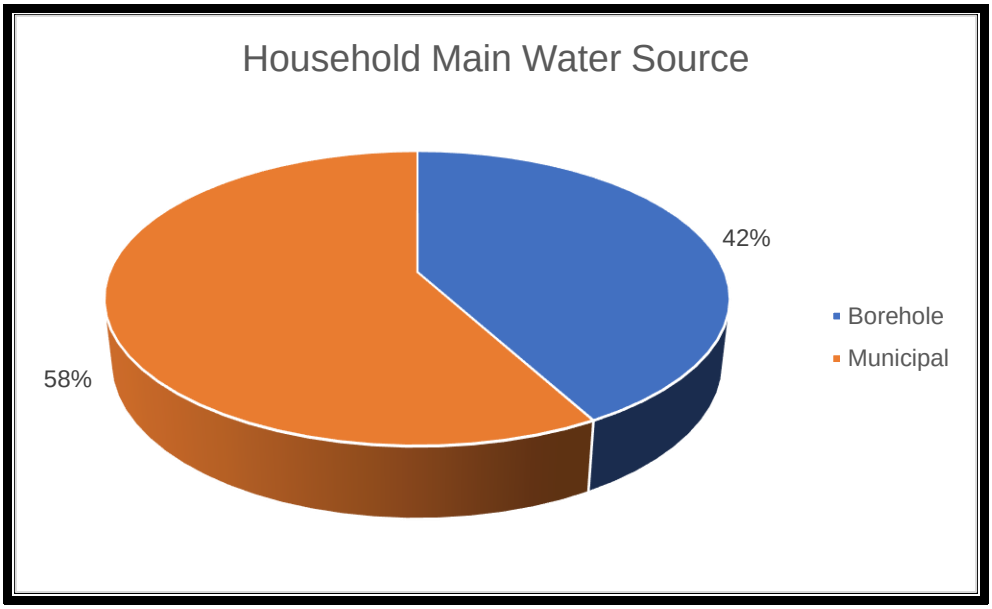

Figure 0-16: Household Main Water Source

The household main water source is represented above in Figure 4.15. This pie chart represents the 42 percent of the participants use borehole while the 58 percent uses municipal water. Participants who reside next to the farm use borehole from the local farmers stand where they work. The other use municipal water but have been complaining about the increase in rate. Participants also mentioned that there is water scarcity in the area considering that Cradock falls under the Karoo region which is known as dry land. The municipality will go for 2-3 days without water and when the water is restored there is usually red/orange water coming out of the tap, this indicates that the water filter has issues, or the water particles were not filter in advance to people accessing the taps. Some participants mentioned that the water will have small particles of clay residues and they are expected to drink that water. Knowing that the Karoo region is a water scarce region, in Cradock the municipality water is supplied

by Gariep dam. This transfer scheme from Gariep dam to Cradock is managed by Department of Water Affairs (IDP, 2020).

Even though, the Great Fish River runs cross the town, it is still having issues with water. As for hydraulic fracturing is concerned, this development need fresh water and other particles to crack the shale bedrock. Therefore, if the local people cannot afford to have proper access to clean, freshwater then approving this proposed development will hinder water availability for consumption. The proposed hydraulic fracturing development can contaminate the very least water that the region has if the proposed hydraulic fracturing development is approved.

4.5.4. Energy Source Used

Energy Source			
	Lighting	**Cooking**	**Heating**
Candle	24%	-	-
Electricity	76%	38%	66%
Wood	-	24%	34%
Gas	-	12%	-
Total (%)	**100**	**100**	**100**

Table 0-8: Household Energy Source Usage

The above Table 4.8 shows the household energy source for cooking, lighting and heating. For lighting, 24 percent use candles these participants are not in the developed area as they reside in plastic shack alongside the gravel road. 76 percent of participants use electricity for lights. As for cooking, 38 percent use electricity which are participants from the township and town, 24 percent use wood these are the participants alongside gravel road and 12 percent gas. The participants who selected gas for cooking are the one who use both electricity and gas, due to load shedding in the country having a gas stove and light helps when load shedding takes place. For heating purposes 66 percent use electricity and 34 percent use wood. With load shedding being a norm in South Africa, as has been around for 13 years

people have adjusted their lives around the load shedding schedule for all levels ranging from level 1 to level 5 Goldberg (2015). An increase in electricity tariff, has provided people other alternative to minimise cost of electricity and when load shedding is scheduled to take place you utilise it. With the increase in electricity, this means that if South Africa go ahead with hydraulic fracturing electricity tariff price could possibly decrease.

4.5.5. Monthly Electricity Bill

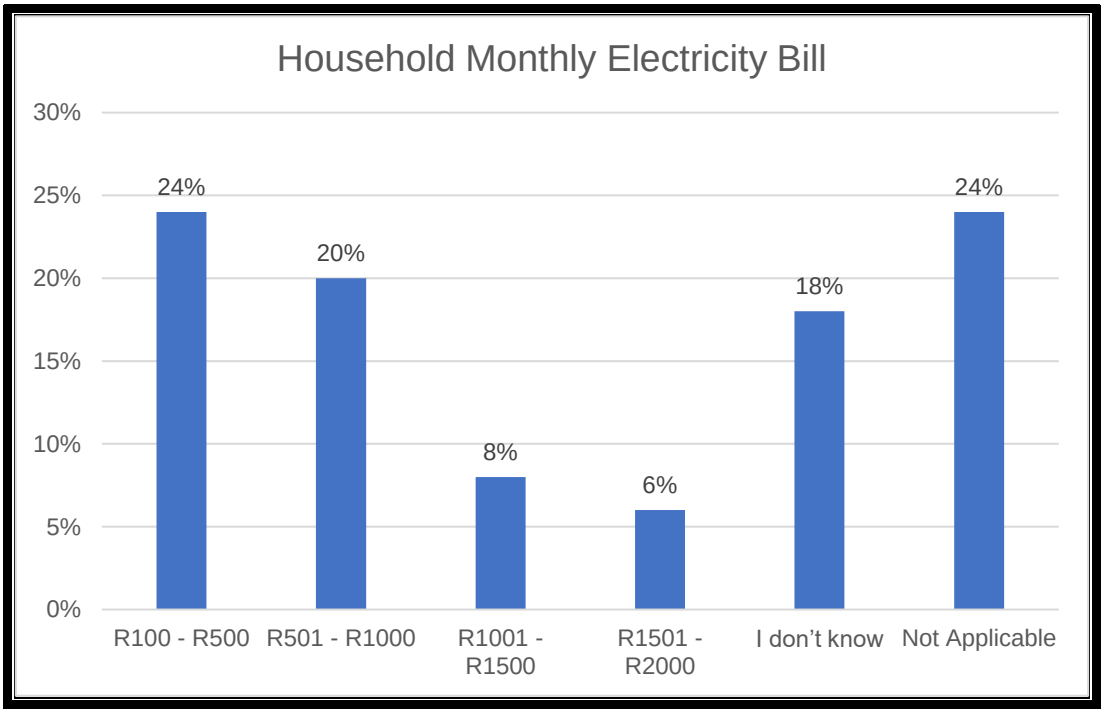

Figure 0-17 **Household Monthly Electricity Bill**

The research findings on household monthly electricity bill reveal that 24 percent pay R100 to R500 on electricity per household every month. 20 percent pays R501 to R1000 a month, 8 percent R1001 to R1500, 6 percent R1501 to R2000. 18 percent said they do not know. These are the members that are unemployed and do not contribute or even are not hands on, on household expenses. 24 percent are the participants who live alongside the grave road who do not have access to electricity at all. Participants mentioned that with all the fess they pay for electricity they still get small amount of electricity unit that do not even last longer. Some

participants are blaming the pandemic on an increase in standard of living as the pandemic had massive negative impacts on the South Africa economy. Samuels (2021) states that with the high electricity demand during lockdown because of the pandemic, the electricity tariff has increased compared to the other years pre COVID19. One of the participants complained so much about the electricity tariff increase that she suggested that she will bridge electricity (izinyoka nyoka) which is illegal in the country. Her issue was that the child support grant is small amount and the electricity tariff is a lot for her to pay every month. The negatively impacted economy and increase in standard of living has provided people with crime related solution to the countries problem.

The research examined whether the proposed hydraulic fracturing development will impact the Khoisan peoples' sense of place in the Karoo region. In doing so, this research contributes to the increasing research of quantitative research which is examining the relationship between energy development and sense of place. The research found that place attachment, place identity and place dependence are associated with one another as well as the Karoo region. Overall, findings indicated that Khoisan people have a strong sense of place with the Karoo region therefore they were not unfavourable with the proposed hydraulic fracturing development. This finding supports the already existing research on the disruption of energy development on sense of place which results to psychological stress (Boyd, 2015; Jacquet and Stedman, 2013).

4.6. Conclusion

This chapter has presented finding from the Khoisan participants, the results were analysed using Microsoft excel and SPSS v26. The results show that Khoisan participants have a strong positive sense of place towards the Karoo region (Cradock) that is deeply rooted and connected to the area. However, this strong positive emotional bond participants have towards Cradock are can be impacted if hydraulic fracturing does receive a go ahead from the government. Even though most of the participants had no ideas as to what hydraulic fracturing is but their emotional bond to the areas exists and could possibly be destroyed which could

lead to them having a weak negative sense of place, or loss of sense of place which could further lead to solastalgia.

Chapter 5: Summary, Recommendations and Conclusion

5.1. Introduction

The previous chapter focused on analysis that presented research findings originated from the study titled the potential impacts of hydraulic fracturing on Khoisan peoples' sense of place, in the case of the Karoo region. While the aim of this chapter is to deliver a summary of the findings of the study, recommendation for future refences and conclusion to the whole research.

5.2. Summary of Key Research Findings

The overall objectives of the research were to ascertain the potential impacts of hydraulic fracturing on Khoisan people's sense of place in the Karoo region, to establish their perceptions, attitudes and knowledge on hydraulic fracturing, to facilitate and improve understanding. Hydraulic fracturing need to be explained further to people residing in the Karoo region who will be impacted directly by this development and mostly the Khoisan community, as Karoo region is their home after they were displaced from the coast areas of (Eastern and Western Cape) when the settlers first colonised South Africa. The understand of this development can improve local members (Khoisan) to make better decisions when public participation is concerned. Even with a low level of education that exists amongst most South African, including the Khoisan community it is important to help explain and physically demonstrate the process.

The research adopted a survey technique to acquire data and analysis utilizing a questionnaire as guideline in the interviews. The research employed purposive sampling and snowball sampling to collect data from the target population (Khoisan). Qualitative, quantitative and descriptive methods were utilized to analyse data and present the findings of the study.

The research took place in the Karoo region (Cradock) in the Eastern Cape Province a very small town with most participants residing in the township. Where majority of the Khoisan individuals reside, some of the participants were from town. The Cradock area has household with very low income, low level of education, with minimal opportunities and employment available for local members. The people who reside in the township and mentioned that they have property are people who mostly have RDP houses that they inherited, purchased and received from the government.

5.2.1. Objective: Examine the relationship between the Karoo region and Khoisan peoples' sense of place

The Khoisan community has a strong Sense of Place towards the Karoo region (Cradock). This was found when the independent variables were calculated to come up with reliability coefficient of the internal consistency. The findings showed that the three place dimension subscales of Sense of Place (Place Attachment, Place Identity, Place Dependence) scored very high meaning the variables were reliable. The subscale showed high correlations amongst each other. However, correlation with other variables were slightly higher were length of residence and community involvement was correlated with Place Attachment. This means that Place Attachment is positively influenced by community involvement and length of residence. Place Identity also scored a high correlation with place of birth and ancestral connection; however, it had a moderate correlation with length of residence. This also means that Place Identity is positively influenced by place of birth and ancestral connection. Place Dependence also scored a high correlation when there is availability of jobs, family, property ownership. This means that place dependence has a positive influence on jobs, family and property.

5.2.2. Objective: Explore Khoisan peoples' perception, attitudes, opinions and knowledge on hydraulic fracturing

The main focus on this objective was to get an understanding of participants (Khoisan) knowledge, attitude and perception towards hydraulic fracturing. It showed that participants

were not aware of the development however those who heard about it was through a friend, and AEON a research Institute from Port Elizabeth. Other than that, it means the Khoisan community would not have known or heard anything about the development. This is concerning as this area could have direct impacts on hydraulic fracturing. Those who were aware of the development strongly oppose it as they are more concerned with preserving their culture, heritage and environment for future generation.

5.2.3. Objective: Identify socio-economic impacts of hydraulic fracturing

The aim of this objective was to identify impacts that might rise from the proposed hydraulic fracturing development. Participants are aware of their ancestral connection and their historical background, but this is mostly the old participants. This objective also investigated water and electricity supply, most of participants use municipal water and electricity and how the rates have increased over the years and with the issues of water scarcity and contaminated water in the area.

5.3. Limitations

There are two forms of hydraulic fracturing techniques that exist, mainly being unconventional and conventional oil and gas production. However, the study is limited to problem of unconventional oil and gas technique which is proposed to take place in the Karoo region.

In South Africa, there are different mining techniques that already exist. But, for the sake of the study, the focus was on the proposed hydraulic fracturing mining technique. The main goal of the research was to explore the potential impacts of hydraulic fracturing on the Khoisan people's sense of place. Therefore, this study was limited to South Africa, the case of the Karoo region (Eastern Cape, Cradock), where hydraulic fracturing technique is proposed to take place, however, excludes some parts of the Northern Cape, Western Cape and Free State province that fall under the Karoo region. The demographics and responds may differ in

other areas when compared to the study area on the proposed hydraulic fracturing development.

Since, Hydraulic fracturing is a new mining processes that has not yet taken place in the country, limited literature is available. Therefore, the literature review that was used was limited to countries that have been practising this mining technique for ages and have adequate experience in the technique, countries such as Canada and the United States of America (USA) which are developed countries and South Africa being a developing nation.

The participants of the study were limited to Khoisan ethnic group (Aborigines, First Nations, Indigenous people of South Africa) who reside in the Karoo region. The exact population of Khoisan population is highly limited as the South African government does not recognise the Khoisan ethnic group but rather identify them as Coloured people.

The sense of place theory was limited to the environmental psychology perspective using (psychometric approach), as the definition of the theory is defined as an emotional bond traditionalised by individuals who reside, perform their daily activities and benefit from a particular surrounding environment. In addition, the study views sense of place as an umbrella term of different multi-facets that fall under it, namely being place attachment, place identity and place dependence.

There is a need to conduct more studies on the relationship between hydraulic fracturing and sense of place. Even better, conducting studies, before the hydraulic fracturing development, during hydraulic fracturing development and after the development.

5.4. Recommendations

Recommendations on how to improve understanding on developments such as hydraulic fracturing on local and surrounding communities that will be directly impacted by the development are discussed below.

It is crucial that local government have a strong communication with local communities, whether it is through ward councillors, social media or word of mouth. The reason for this

recommendation is the lack of communication amongst the two which is why people are never informed about such proposed development in their surrounding areas. The local municipalities not only should they invest in communication but also investing in addressing such issue in an approachable manner with proper explanation and in all languages to accommodate everyone.

The finding of this study can be extended to other provinces and areas/towns. Sense of place can assist planners, architectures, developer, environmental practitioners, government and stakeholders in in predicting how the project will be perceived by local people, and gain insight on how they engage with stakeholders to develop more socially acceptable projects. This will allow locals to have a democratic decision making in which local people are encouraged to participate and share what their places mean to them, their emotional connection and their satisfaction and also what they would like to see on the development project.

It is important to consider that hydraulic fracturing is a game changer when related to climate change, as it releases less carbon dioxide into the atmosphere when compared to fossil fuels such as coal, which we still use in South Africa to date. It is also crucial to consider loadshedding, as it have been affecting productivity of South Africa for 15 years. Considering the shift to hydraulic fracturing might minimise the costs and keep the country lights on again. Also, with the increase in gas prices, producing our own gas will help low down the gas prices. And add employment which is at its all-time peak, if the hydraulic fracturing development is approved.

It is also important for local communities to host workshop and Imbizo to demonstrate and explain these techniques (hydraulic fracturing). Educating the public and allowing communities to engage in hydraulic fracturing industry so they are aware of the pros and cons that exist. It is the local government and provincial government duty to educate the public but also hydraulic fracturing stakeholders, Department of Mineral Resources, Department of

Environmental Affair and other department who are involved, as well as research institutes such as AEON.

The South African government must work on the inclusion of the Khoisan community in the demography, to also allow their voices to be heard in be included in decision making. They have a right to be included and represented accordingly the same way is done with other ethnic groups.

Sense of place plays a crucial role in understanding the emotional bond a group or individual have with an area. The inclusion of sense of place in Strategic Environmental Assessment, Environmental Impact Assessment and Heritage Impact Assessment. The reason is because the inclusion of sense of place will improve understanding of local peoples' connectedness, rootedness and emotional bond with the area. This could assist with decision making of any development.

The South African government must play a role in making sure that the international companies that take advantage of South African environment are stopped by implementing strict laws and regulations to protect the interest of South African, their environment including sense of place. Third world countries are always victims of white monopoly capitalist firms from the first world, who prey on small communities for their own benefits.

Corruption in this country should be dealt with, as it gives room for exploitation of people and resources. Especially by international firm who pay out officials to do shortcut to get rights to mine. Therefore, if corruption can be tackled then it could easier to protect our environment from hydraulic fracturing development and our communities from the impacts that come with these developments.

Research institute that are provided with baseline studies on hydraulic fracturing or similar development should consider sharing the data with communities that will be impacted directly by such developments (hydraulic fracturing).

If the hydraulic fracturing development is given a greenlight, it is essential that the oil and gas companies provide the government with the best expects who are qualified for the job in mitigating these potential impacts in the Karoo from occurring.

5.5. Conclusion

The proposed hydraulic fracturing development can play a significant role in improving local economy through job creation, corporate social responsibility, bursaries and local development however, the country and Karoo is not equipped to accommodate such development as it lacks infrastructure, resources and proper experience therefore it still has a long way ahead to meet these standards.

Even though the introduction of hydraulic fracturing is so important for the South African economy and energy sector, as the country faces more energy supply pressures due to population increase and production. Its negative impacts are greater when compared to positive which means the Karoo is more likely to lose more than it could gain from archaeology, environment, culture and heritage, tourism, agriculture and sense of place.

From a socio-environmental perspective, hydraulic fracturing should not be considered as an option as it will deteriorate the environment by clearing the area, oil spill which will end up in aquifers and affect human health, plants and animals to accommodate oil and gas development. As far as social issues are concerned, more crime will be in the area as it develops and accommodate more people. Moreover, the psychological impacts caused by hydraulic fracturing will be greater even though it cannot be seen physically but it will cause great impact on society but mostly on disadvantage groups such as the Khoisan community who are still not fully recognised by the same government who could possibly issue green lights for hydraulic fracturing development.

Therefore, it is crucial that South African government considers carefully the inclusion of all stakeholders from multiple disciplines in understanding the impacts of hydraulic fracturing and its benefits before going ahead with the development. This inclusion should also touch on

sense of place which is less studied but is very helpful in decision making of any development that local communities who are involved.

It is evident that the Khoisan people have a strong positive sense of place with the Karoo region (Cradock), this positivity is influenced by their attachment, belongingness, rootedness, connectedness, identity, satisfaction and meaning towards the Karoo. Therefore, going ahead with the proposed hydraulic fracturing development would disrupt their sense of place and lead to the loss of sense of place and solastalgia. The consideration of addressing sense of place when conducting development in the area is crucial as it can create a relationship that is cooperative and trusting between locals (Khoisan), stakeholders of the development and government to pursue equitable and sustainable future development.

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Appendices

7.1. Appendix A: Questionnaire

Topic: The Potential Impacts of Hydraulic Fracturing on Khoisan Peoples' Sense of Place: The Case of the Karoo Region, South Africa.

Questionnaire:

Participant No: _____

Section A: Socio-demographics

1. **Gender?**

Male		**Female**	

2. **Age?**

3. **Place of birth?**

4. **Length of residence?**

5. **No. of household members?**

6. **Average monthly household income?**

No income		**Less than R2000**		**Between R2000 - R5000**		**Between R5001 - R10000**		**Between R10001 - R30000**		**Between R30001 - R50000**	

7. **Highest Level of Education obtained?**

No School		**Primary School**		**High/ Secondary School**		**Diploma/ Degree**		**Postgraduate Degree**	

8. **Occupation status?**

Full-time employment		**Part-time employment**		**Self employed**		**Unemployed**		**Retired**		**Pensioner**	

9. **Do you receive any form of grant or other source of income (Excluding salary/ wage)?**

Yes		No	

If yes, which one?

_____
_____

10. **Do you have Land/ property ownership?**

Yes		No	

If yes, please specify?

_____
_____

How did you gain ownership?

_____
_____

11. **Are you from a royal family?**

Yes		No	

12. **Are you part of any community involvement?**

Yes		No	

If yes, what type of involvement?

_____
_____
_____

13. **Have you ever left your area?**

Yes		No	

If yes, for how long?

_____

Section B: Sense of Place

Place Attachment:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I am very attached to the Karoo					
2. I would feel less attached to the Karoo, if the native plant and animals that live here would disappear					
3. I am much attached to the natural environment of the Karoo					
4. I learn a lot about myself when spending time in the Karoo					
5. I feel a deep connection of oneness when I spend time in the natural environment in the Karoo					

Place Identity:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. I feel the Karoo is a part of me					
2. I have a very special connection to the Karoo					
3. I identify strongly with the Karoo					
4. The Karoo means a lot to me					
5. I feel like I belong to the Karoo					
6. The Karoo says a lot about who I am					

Place Dependence:

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1. The Karoo is the best place for what I like to do					
2. No other place can compare to the Karoo					
3. I get more satisfaction from residing in the Karoo than from residing at a similar site					
4. Doing what I do at the Karoo is more important to me than doing it in any other place					
5. I wouldn't substitute any other area for doing the type of experience I have at the Karoo					
6. The things I do at the Karoo I would enjoy doing just as much at a similar site					

In your opinion do you think you have a connection to the area?

_____

_____

_____

Section C: Perceptions and Attitudes of Hydraulic Fracturing

1. **Do you know what Hydraulic fracturing (fracking) is?**

Yes		No	

If yes, what is it?

_____
_____
_____

2. **Where did you hear/read about hydraulic fracturing?**

Newspaper		Online		TV/Radio		Someone		Other	

3. **What is your opinion on hydraulic fracturing?**

_____
_____
_____
_____

4. **What are your concerns on hydraulic fracturing, if the development is approved?**

_____
_____
_____
_____

5. **Based on your understanding of fracking, do you:**

Strongly oppose it		Oppose it		Undecided		Support it		Strongly support it	

And why?

_____
_____
_____

6. **How much have you read/heard about fracking?**

Not at all		A little		A few times		A lot	

7. **When you think of fracking, what is the first thing that comes to mind?**

_____
_____
_____

8. **Has any of the municipality official informed you about this development (hydraulic fracturing)?**

_____
_____
_____

If yes, what form of education have you received from the municipal officials?

_____
_____
_____

9. **Are you satisfied with the development in your area?**

_____
_____
_____

10. **Has your community been delivered services as promised?**

_____
_____
_____

Section D: Impacts of Hydraulic Fracturing on Khoisan People

11. What are your ancestral connections to the Karoo?

_____
_____
_____
_____
_____

12. What is your families historical background?

_____
_____
_____

13. How do you benefit from the Karoo?

_____
_____
_____

14. How do you think this development will impact your daily life?

_____
_____
_____
_____
_____
_____

15. What is the main water source for your household?

_____

16. What energy source is used for:

Lighting? _____
Cooking? _____
Heating? _____

17. What type of electricity supply does your household have?

_____

18. How much does your household pay for electricity per month?

_____

19. What is your experience with water scarcity in your area?

_____
_____
_____
_____

Section E: Recommendation

1. **What kind of support do you need to ensure that you are informed and educated about such developments in your area?**

   _____
   _____
   _____
   _____

2. **Who do you think should provide such information to you?**

   _____
   _____
   _____
   _____

Thank you!!!