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The perception, understanding and communication of climate change and Carbon Capture and Storage (CCS) technology aimed at mitigating climate change in South Africa.

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ABSTRACT

Climate change has become one of the most important issues on the global political, social and economic agenda. Information about climate change, its effects and mitigation measures remains concentrated within the scientific community. Despite having a socioeconomic impact, climate change is still regarded as a scientific problem, which will be solved by scientists. The main research problem for this study is based on the fact that there is little or no information available to the general public. This study explored factors pertinent in the perception, understanding and communication of Climate Change and Carbon Capture and Storage technology in South Africa as a developing country. The focus of the study was on identifying how a group of selected South African stakeholders understood and perceived the communication of climate change and CCS technology.

A qualitative research approach was used which allowed for exploring how participants understood and perceived climate change and CCS technology and their communication based on their personal experiences. Data were collected through semi-structured in-depth interviews of members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). The data was analysed by employing qualitative content analysis and systematic coding based on a conceptual map or framework. In accordance with a multi-theoretical approach, the conceptual framework was developed based on various development communication theories including the Development Support Communication (DSC) model, the Participatory Model of Development, the diffusion of innovation theory, the Agenda Setting Theory and the Participatory Rural Appraisal Theory. The thematic analysis allowed the identification of themes and categories that were used to interpret data.

Through an in-depth analysis, it emerged that, while there are several communication initiatives, climate change is still mainly communicated in scientific and academic circles and rarely in the public domain. Additionally, most programmes or initiatives were perceived as only suitable for urban areas and the solutions or suggestions provided were not suitable for people in rural areas. It was found that climate change alleviation was not viewed as a priority and information provided on climate change mitigation should address how ordinary citizens could deliberately and consciously adjust their daily routines and behavioural patterns in support of the mitigation of climate. There were uncertainties and doubts regarding the unanticipated risks associated with CCS technology as a possible solution for the fight against climate change.

It is recommended that research be conducted on specific communication initiatives and their outcomes. Future research studies could focus on perceptions in rural communities that have

been identified for CCS technology deployment and those most affected by climate change effects.

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Declaration

This thesis contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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CHAPTER ONE

INTRODUCTION AND ORIENTATION

1.1 INTRODUCTION

Climate change is one of the most debated topics on the world's economic, political and social agendas. It was determined to be responsible for extreme and unpredictable weather events and patterns which result in the reduction of agricultural production. Consequently, it hinders the development and growth of African countries, mainly because most of the countries are dependent on resources with regards to, for example, agriculture, livestock farming and fisheries and these are increasingly threatened (Asante & Amuakwa-Mensah, 2015:79; Rojas-Downing, Nejadhashemi, Harrigan & Woznicki, 2017:158). In South Africa and other countries on the African continent, climate change has had a visible impact on the lives of their peoples, specifically with regards to food security (Masipa, 2017:1). Specifically, the effects of climate change have serious consequences for people who rely on land, lakes and seas for food and to earn a living, as well as threatening the traditional way of life and existence of historical homelands (Godfrey, Le Roux-Rutledge, Cooke & Burton, 2014:2; Norton-Smith, Lynn, Chief, Cozzetto, Donatuto, Redsteer, Kruger, Maldonado, Viles & Whyte, 2016:2). One of the definitive reasons for the increasing devastation caused by climate change is evident in the following statement by Godfrey, Le Roux-Rutledge, Cooke and Burton (2014:2).

African citizens' response to climate change is hampered by a fundamental shortage of relevant, useful information for African audiences. The intensive media coverage and public awareness campaigns prevalent in much of the industrialised world have been largely absent in Africa, particularly outside major urban centres. Too often, African voices are absent from international climate debates. Africa's response to climate change will be dictated by how well it is understood by its people.

What is construed from the above-mentioned statements is that one of the biggest problems facing the mitigation of the disastrous effects of climate change on the peoples of Africa is a lack of relevant information and understanding delivered through strategic communication efforts. This view is supported by Anaafo (2019:201) who states that sustainable global attempts to mitigate climate change need to be counterpoised by "innovative ways of engaging with the general public and ensuring that the climate change agenda is broadly understood."

Specifically, the content of the information needs to be evident, pertinent and accustomed to indigenous stakeholders (Anaifo, 2019:201; Chanza & De Wit, 2016:1; Spence, Poortinga & Pidgeon, 2011:95). Managing the perceptions and communication of climate change content is essential in understanding sustainable mitigation technology by stakeholders. These aspects will be addressed in more detail in the discussion of the research rationale and problem.

1.2 CONTEXT OF THE STUDY

It is evident that understanding climate change and CCS technology is essential. Despite the formalisation of CCS over two decades ago, relevant information about the technology is not sufficiently available to stakeholders (Ringrose, 2018:166). This section will provide background information and the rationale for the study to be conducted.

1.2.1 Background of the study

The onset of the industrial revolution marked a turning point in climate change and since then major changes in agriculture, manufacturing, production, mining, production and transportation transpired (Chandrappa, Gupta & Kulshretha, 2011:27). According to the 2016 Integrated Energy Planning (IEP) Report, published in 2016 by the Department of Energy (DoE), South Africa is by far one of the fastest emerging economies in the third world. Whilst the country needs to continue fuelling its economic growth to fulfil the provision of its social needs, it must at the same time protect and conserve its natural environment (DoE, 2016:5). The IEP highlighted that energy security, localisation and technology transfer and minimisation of greenhouse gases (GHG) emissions are part of a myriad of factors which need to be considered and addressed in an integrated energy planning process (DoE, 2013:6).

In order to establish a sustainable climate change response strategy and to build climate resilience in South Africa, the National Climate Change Response White Paper (NCCRWP) was developed in 2011. The NCCRWP aims to effectively identify and manage investable interventions that can build and sustain the South African socio-economic and environmental aspects as well as its capacity in terms of emergency response to climate change (NCCRWP White Paper, Department of Environmental Affairs, 2011:5). Carbon Capture and Sequestration/Storage (CCS) technology has been named as one of the Near-Term Flagship Programmes in the 2011 National Climate Change Response White Paper (Department of Environmental Affairs, 2011:32). Despite CCS being globally recognised for its potential to reduce CO₂ emissions “communication and engagement experts working in this area are

increasingly being faced with what's fast becoming known as the CCS image crisis" (Prangnell, 2013:1). One of the challenges facing CCS is a notion that the technology is not environmentally friendly as it prolongs the use of fossil fuels (Bui, et al., 2018:1067; Prangnell, 2013:2).

According to the report titled '*Impacts of Carbon Capture and Storage (CCS) on South African National Priorities*' published in 2013, even though the benefits of CCS could be well known to the general public, the technology's impact on other societal issues such as "sustainable development, improved local infrastructure, job creation, [safety], poverty alleviation and social upliftment need to be [identified] and understood" (Pietersen, Pearce & Vernon, 2013:xii-xiii). The impact that CCS will have on the aforementioned societal issues might determine how people perceive the technology. The opinions and perceptions held by the various stakeholders are vital to the acceptance of any mitigation technologies related to climate change. Concomitantly, it is a complex problem if it is without clear endorsed political and scientifically proven solutions (Global CCS Institute, 2015:21). Therefore, before making any decision about the deployment of CCS technology in South Africa, it is of utmost importance to ensure that information on CCS has been communicated to the relevant stakeholders. The Global Carbon Capture and Storage Institute (GCCSI), in its Project Summary Report entitled '*Aquistore: CO₂ Storage at the First Integrated Project*' states that communication is critical to the successful deployment of any CCS project, even in the countries where awareness of CCS is high (Global CCS Institute, 2015:21).

The majority of CCS project developers have confirmed that they have and are currently implementing public engagement strategies when developing or executing their projects (Global CCS Institute, 2014:15). This goes to show that even the most successful CCS projects have identified public engagement as a key to the project's life cycle. Terwel (2009:11) states that the public's trust of project developers will play a key role in determining the implementation of CCS technology, rather than on specific qualities of the technology due to the fact that the "publics are not able to accurately judge CCS on its merits because of the technology's complexity" (Terwel, 2009:11).

Diekers and von Grote (2005:76) emphasise that the public tends to have negative perceptions of new technology, especially if they are aware of the adverse effects that the application of the technology may entail. Capstick, Whitmarsh, Poortinga, Pidgeon and Upham

(2015:34) state that the imbalance in the availability of the information relating towards the public perceptions leaves much unknown about the progression of public understanding of climate change worldwide. In this regard, further research is required to identify factors that impact perception towards climate change. It can hence be argued that how stakeholders understand or perceive the technology plays a role in whether the technology is accepted or rejected.

1.2.2 The rationale of the study

During the past few decades the deployment of CCS technology, as one of climate change mitigation methods, has been faced with political hesitation and several uncertainties concerning its technical, scientific, economic and financial components as well as a regulatory framework and public acceptance (Markusson, Shackley & Evar, 2012:2). Research on the perceptions, understanding and communication methods of climate change and CCS technology is essential because of the technicality and the complex nature of the concepts which are sometimes confusing and misunderstood by stakeholders (Broecks, Van Egmond, Van Rijnsoever, Verlinde-van Berg & Hekkert, 2016:58; Parker, Cockerham & Foss, 2018:1; Reiner, Curry, De Figueiredo, Herzog, Ansolabehere, Itaoka, Akai, Johnsson & Odenberger, 2006:1)

Reiner et al (2006:1) state that:

Public acceptability is widely recognized as an important element in determining the eventual fate of new technologies and carbon capture and storage (CCS) should not be an exception. Understanding of public attitudes and preferences on global warming in general and their knowledge on technologies and systems to mitigate anthropogenic emissions of greenhouse gases is important as a basis for decision-makers when developing strategies for communicating with the public.

The statement above indicates that despite climate change being a global concern, there is still insufficient public knowledge of climate change issues and the various mitigation options, and their potential impact and practicality.

The report on the global status of CCS in 2014 published by the Global CCS Institute states that the “majority of CCS social research carried out to date has focused on the developed world, shedding very little light on the role of CCS within developing countries” (Global CCS Institute, 2014:143). This indicates that there is an urgent need to improve access to CCS educational information and communication of work done by academics and other

researchers. Such studies will facilitate an understanding of the differences in needs between the developed and developing regions which will allow researchers to learn from one another.

In the view of the above-mentioned statements, it is important to conduct a study that will investigate the factors in the perception, understanding and communication of climate change and CCS as a climate change mitigation technologies in the South African context as a developing country.

1.2.3 Purpose of the study

The purpose of this study is to explore factors in the perception, understanding and communication of Climate Change and Carbon Capture and Storage technology in South Africa. Specifically, the study aims to gain a deeper understanding of the perception, understanding and communication of climate change and Carbon Capture and Storage (CCS) technology. The focus will be on identifying aspects that could influence how a group of South African stakeholders understand and perceive climate change and CCS technology. Hence, the study will explore how communication could play a role in the perception and understanding of climate change and CCS technology as a method of climate change mitigation.

1.2.4 Relevance of the topic

Research has indicated that, for climate change information to be fully understood by the public, it must be communicated regularly using language, metaphor, and analogy relevant to the recipients of the message (Roosen, Klöckner & Swing, 2017:1; Shome & Marx, 2009:2). In addition, a combination of personalised messages, creative art, narrative storytelling, visuals and hands-on experiential scenarios balanced with factual scientific information can be used to develop an understanding of climate change, its effects and potential mitigation techniques (Jacobson, Seavey & Mueller, 2016:1; Shome & Marx, 2009:2).

Based on these statements indicating the importance of communication, the topic is relevant because the general public and specific stakeholders are ill-informed about various climate change adaptation and mitigation measures such as CCS technology. This study will focus on investigating the potential factors in the perception, understanding and communication of climate change. For people to understand climate change and various mitigation methods such as carbon capture and storage technology, they must be able to interpret and respond

to often bewildering scientific, technological, and economic information about the technology (National Academy of Sciences, 2017:5; Shome & Marx, 2009:1).

1.3 RELATIONSHIP OF THE TOPIC TO THE DISCIPLINE OF COMMUNICATION

The 2012 World Bank Report Titled: *Carbon Capture and Storage: Initiating Stakeholder Engagement National and Local Stakeholder Engagement Plans (NatLoc Plans)* has identified the media as one of the main influencers of perceptions of CCS technology (Rothmann-Guest, Killian & Maharaj, 2012: xiii).

According to the Rothmann-Guest, Killian and Maharaj (2012:21), language differences and the inequalities brought about by apartheid still have a notable impact in the country's communication environment, access to information and communication technology (ICTs). Communication of CCS needs to be tailor-made to reflect the country's language diversity and in providing guidelines on how CCS information is to be transmitted to various stakeholders (Fritz, 2014:7). The media, in particular, has a key role to play in creating awareness and educating the public and other industry stakeholders about the technology. The media remains one of the key distributors of information in South Africa (Thompson, 2014:7).

Based on the information stated above, it cannot be denied that communication has an important role to play in the country's perception and understanding of climate change and CCS technology. The topic is hence relevant to the communication discipline since it seeks to investigate various factors in the perception, understanding and communication of climate change and carbon capture and storage technology.

1.4 CONCEPTUALISATION OF KEY CONCEPTS

Conceptualisation refers to the refinement and specification of abstract concepts to create specific meanings for a specific research project (Davis, 2014:107). Conceptualisation is one of the key fundamental processes in a research study. In this section, the main key concepts of the study will be outlined.

1.4.1 Carbon dioxide

Carbon Dioxide (CO₂) is a non-toxic, colourless, odourless and non-flammable gas, which is a naturally occurring substance in our environment. Humans and animals breathe out CO₂ and plants need it to grow (SACCCS, 2015). CO₂ only becomes harmful to humans when it is present in very high concentrations.

1.4.2 Carbon capture and storage technology

Carbon capture and storage, or CCS, is a technology that reduces carbon dioxide (CO₂) emissions to mitigate climate change (SACCCS, 2015). CCS involves the capture of CO₂ emissions from large scale point sources of CO₂ such as industry and power generation, the transport of the CO₂ using trucks or pipelines and the safe and permanent storage of the CO₂ in deep underground geological rock formations (Tucker, 2018:3; SACCCS, 2015).

1.4.3 Climate change

Climate change refers to the gradual change in the earth's climate and physical geography that accompany an increase in the earth's temperature that persists for an extended period, typically decades or longer (Chan, 2018:21; United, 2011:1). According to Capstick (2013:1), climate change is often referred to as one of the most complicated challenges facing humanity, characterised in various pieces of literature as a social dilemma.

1.4.4 Communication

Communication is the process of transmitting information and creating a common understanding (Lunenburg, 2010:1). According to Shahzad and Bokhari (2014:1), communication is an ever-present activity that has been used by human beings over time to disseminate or exchange information about ideas, things, places, other persons and policies. It is a natural interaction through which humans understand each other.

1.4.5 Climate change communication

Chirisa, Matamanda and Matumbwa (2018:1) indicate that climate change communication has the objective of bridging the differences between scientific and technical climate change information and indigenous understanding of the concepts. The overarching purpose is to apply communication theories and practices to improve the effectiveness of the adoption of climate change mitigation methods (Chirisa, et al., 2018:2).

1.4.6 Perception

Weintraub, Thomas-Maddox and Brynes (2016:30) define perception as the process by which people select, organise and interpret stimuli to make sense. Perception is the process through which humans judge the world around them and its impact on their self-being (McGee-Chiusan, 2015:14).

Perception involves four stages depicted in Figure 1.4.6. below



Figure 1.1. Stages of Perception (Sourced from McGee-Chiusan, 2015:14)

1.4.7 Public perception

Public perception is the way in which public groups perceive a specific element, subject or any type of information (Oltra & Sala, 2014:3; Vos & Schoemaker, 2006:10). Furthermore, Johansson, Patwardhan, Nakicenovic and Gomez-Echeverri (2012:10), highlight that public perception is formed and influenced narrowly at project (local, national and global) levels. The public includes various segments of the society such as policymakers, regulators, academia, environmental NGOs and the media which help the general public or communities to form an opinion (Johansson et al, 2012:10).

1.4.8 Understanding

According to Klüver and Klüver (2011:153), understanding is a process which involves learning societal rules, norms, cultural context and beliefs. In this study, understanding refers to how various members of society understand climate change and CCS technology.

1.5 TYPE OF STUDY

This study is can be classified as an exploratory and basic study. Exploratory research is used when a topic is relatively new, or when a researcher needs to familiarise him or herself with a particular topic to gain a better understanding (Babbie, 2014:94). Exploratory research is used to ask questions about a phenomenon, usually through the identification of themes, when little is currently known about a subject (Gray, 2014:36, 57). Exploratory studies often yield new insights into the topics explored (Babbie, 2014:95).

Basic research, which is sometimes referred to as fundamental or pure research, can be defined as a systematic study conducted to attain greater knowledge or understanding of the fundamental aspects of a phenomenon without specific applications or products in mind (Graziano, 2017:32). A basic research approach will be utilised mainly because it provides a systematic and deep insight into a problem and facilitates the extraction of scientific and logical explanation and conclusions (Rajasekar, Philominathan & Chinnathambi, 2013:7).

1.5.1 Research paradigm: Interpretivism

Researchers are often influenced by their own beliefs, experiences and views when conducting research. A researcher's actions and beliefs are guided or influenced by certain standards, rules or principles can be referred to as paradigms (Guba & Lincoln, 1994:105; Rehman & Alharthi, 2016:5). Researchers have a unique way of conducting their investigations, which is mainly constituted by the abstract beliefs and principles that shape how they view the world, and how they interpret and act within that world (Kijunva & Kuyini, 2017:26; Michel, 2008:40),

This study falls within the interpretivist paradigm which rejects the positivist idea that the same research methods used in the natural sciences can be used to study human behaviour (du Plooy-Cilliers 2014:27). Interpretivism is based on the notion that a single phenomenon may have multiple interpretations rather than a truth that can be determined by a process of measurement and also emphasises that humans are different from physical phenomena because they create meanings (Pham, 2018:3; Thanh & Thanh, 2015:25; Willis, Jost, & Nilakanta, 2007:6).

One of the main advantages of the interpretivist research paradigm is that it is characterised by a need to understand the world from a subjective point of view and seeks an understanding within the frame of reference of the participant (s) rather than that of the researcher who might have an objective view (Ponelis, 2015:538). The disadvantages of the interpretivist paradigm include its subjective nature, that it allows for bias and that the data gathered using this approach cannot be generalised (Noriey, 2017:59).

For this study, the application of the interpretive approach will ensure that the participants' views are noted. This approach is relevant in this study as it makes provision for the

understanding of climate change and CCS technology-related issues. It will also allow gaining an in-depth understanding and clearer insight (Thanh & Thanh, 2015:25).

1.5.1.1 Philosophical assumptions relevant to the study

All paradigms are founded upon certain philosophical assumptions which in terms of interpretivism relates to the notion that reality is socially and uniquely constructed through the experiences of the individual (Creswell, 2014:37). The ontological, epistemological and axiological assumptions inherent in interpretivism are discussed below.

1.5.1.1.1 Axiology

The term axiology originates from the Greek word *axios*, meaning value and axiology deals with questions regarding the role of values in research (du Plooy-Cilliers, 2014:31; Killam, 2013:9). The axiological position of interpretivism is that it values the subjective and value-sensitive distinctiveness of the findings of a study (du Plooy-Cilliers 2014:31). The gathering of different and subjective views of participants to determine how climate change and CCS technology are perceived and understood refer to the value-sensitive nature of a qualitative approach. The researcher will ensure that all participants are provided with an opportunity to provide their understanding and perception of climate change and CCS technology. Consequently, a unique and thick subjective, and contextual description will be provided.

1.5.1.1.2 Epistemology

Epistemology can be referred to as a study of knowledge through the establishment of various forms of knowledge and how knowledge is acquired (du Plooy-Cilliers, 2014:23; Kivunja & Kuyini, 2017:27). The epistemological position of interpretivism indicates that knowledge about the world can be gathered through various methods to provide subjective interpretations and thick descriptions of lived experiences (Al-Saadi, 2014:3; Ormston, Spencer, Barnard & Snape, 2014:3). People interpret what their senses tell them and as such, their knowledge of the world is based on understanding which arises from their reflection on events rather than only on lived experiences (Al-Saadi, 2014:3).

According to du Plooy-Cilliers (2014:28), positivists see scientific knowledge as the only valid form of knowledge whereas interpretivists believe that common sense guides people's behaviour. Interpretivists believe that truth is based on individual interpretation of facts or information, and hence, generalising findings is not the aim of the researcher in the field of social sciences research (du Plooy-Cilliers, 2014:28-29). In this study, the researcher aims to

garner different views from participants on their own perception, understanding and communication of climate change and CCS technology in South Africa.

1.5.1.1.3 Ontology

Just like the aforementioned two philosophical research positions, the word ontology has Greek origins. It is a combination of the word *ontos*, which means 'being' and *logos* which means 'study of' (du Plooy-Cilliers, 2014:23; Kivunja & Kuyini, 2017:27). The main focus is about answering the question of what determines reality (Guba & Lincoln, 1994:108). In the interpretivist school of thought, the reality is unique and idiosyncratic since interpretivists do not believe that everyone can experience the same reality (du Plooy-Cilliers, 2014:29). Reality can change from time to time, especially when people's perceptions towards certain aspects of life change (du Plooy-Cilliers, 2014:29). Furthermore, interpretivists believe that, even though people may experience the same circumstances, subscribe to one culture and live in the same environment, they may or may not experience the same reality (du Plooy-Cilliers, 2014:29).

In terms of the ontological position of interpretivism, the reality is viewed as something that exists independently of those who observe it but is only accessible through the perceptions and interpretations of individuals (Ormston, et al. 2013:21). This ontological position recognises the critical importance of participants' interpretations of the issues researched and believe that their varying vantage points will yield different types of understanding (Ormston, et al. 2013:21). Therefore, in this study, the researcher will explore the unique understanding of participants relating to factors of climate change and CCS technology.

1.5.2 Research approach: Qualitative research

Deciding on a research approach is one of the key prerequisites for any study and at this stage, the researcher should at least have an idea of what needs to be investigated or achieved through the study (Davis, 2014:14). Once a researcher has decided on the type of study to be conducted, it is important to decide on the approach will be undertaken or used to conduct the research. The research approach, according to Davis (2014:93), helps the researcher to answer the research questions or address the problem accurately, without being biased and in an economically viable manner.

Since the study will focus on exploring the perception, understanding and communication of climate change and Carbon Capture and Storage (CCS) technology in South Africa, qualitative

research methods will be used. The qualitative research approach can be referred to as a strategy that focuses mainly on words instead of numerical information when collecting and analysing the data (Davis, 2014: 30). Davis (2014:30-31) further explains that the qualitative approach is mainly used by interpretivists, whose aim it is to investigate reality subjectively. Methods such as focus groups, in-depth interviews, and ethnographic and narrative inquiries are used in qualitative research studies to collect data as these methods can help in gaining an in-depth understanding of the research problem of the question under investigation (Davis, 2014:30-31; Yin, 2011:8).

The advantage of using qualitative research in this study is mainly because it is based on exploring participants' lived experiences of the research topic (Yin, 2011:8). This approach will allow the researcher to investigate how people feel, understand and perceive climate change and CCS technology based on their personal experiences. The main disadvantage of qualitative research is that it comprises of a smaller sample size raises even though the results might be intended for a bigger population (Rahman, 2016:103).

Despite the challenges stated, qualitative research methods will be relevant to the study as it mainly deals with social values, attitudes, people's feelings and perceptions that cause and influence their behaviours. The study is not investigating whether climate change and CCS technology are real or not; the researcher is interested in the perception and understanding of climate change and CCS technology by participants.

1.6 RESEARCH PROBLEM, QUESTIONS AND OBJECTIVES

One of the first steps in conducting any research study is to develop or construct the research question, aim and objectives within the context of the research problem identified (Doody & Bailey, 2016:19). The research question, aim and objective help to develop subsequent steps that guide and govern the researcher's choice of population, methods and period for the study (Doody & Bailey, 2016:19). The research question, aim and objective should be clear and succinctly posed for the research to be successful (Doody & Bailey, 2016:19).

1.6.1 The research problem

A research problem is an issue or concern that needs to be addressed (Creswell, 2014:20). In terms of the study, efforts to mitigate or address climate change in Africa, South Africa included, are mainly due to a fundamental shortage of relevant and useful information for

African audiences (Godfrey et al. 2014:2). In addition, limited access to information on CCS and climate change could have an impact on the deployment of the technology. In this regard, it is important to investigate and analyse those factors. For example, Glazewski, et al., (2012:39) state that CCS awareness in South Africa is currently limited, citing differences in language, religion, culture and preoccupation with meeting basic human needs as the main barriers that could impact public engagement.

The problem of limited access to information and knowledge on climate change to climate is as a result of various socioeconomic factors. Firstly, climate change and CCS technology are both still regarded as scientific problems, yet they have social impacts (Ashworth, 2010:10; Markowitz, Hodge & Gabriel Harp, 2014:i). Secondly, although there has been a consensus amongst scientists that climate change is happening, the fact that its effects are difficult to observe directly has made it difficult for people to perceive and understand climate change as a reality (Jylhä, 2016:20; Rudiak-Gould, 2012:120). Thirdly, the efforts to mitigate or address climate change has often faced climate change sceptics, who cast doubts on climate science (Dunlap & Jacques, 2013:699; Dunlap & McCright, 2015:300; Jylhä, 2016:15). Fourthly, the remoteness and lack of proper communication infrastructure in the targeted areas can have an impact on the communication processes of CCS technology in South Africa (Rothmann-Guest et.al, 2012:31).

The aforementioned problems are an indication that, despite climate change being a global concern, there is still insufficient public knowledge of climate change issues and the various mitigation options such as CCS technology. It is therefore important to investigate in detail various factors in the perception, understanding and communication of climate change and CCS technology to address the above-mentioned problem.

1.6.2 Research questions

The main objective of a research question should be to address the research problem by ensuring that the gap in the research is addressed adequately and are pragmatically and theoretically relevant, precise and anchored in the literature (Creswell, 2012:111). Creswell, (2012:111) further highlights that the research question plays a significant step role in narrowing down and directing the research aim and objective to specific areas relevant to the study.

The main research questions of this study are:

- i. How is climate change perceived and understood by members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng)?
- ii. How is the communication of climate change in South Africa perceived by members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng)?
- iii. How is Carbon Capture and Storage (CCS) perceived and understood by members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng)?
- iv. How is the communication of Carbon Capture and Storage (CCS) in South Africa perceived by members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng)?

Sub-questions include:

- i. How do members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng) perceive and understand their energy use and carbon footprints?
- ii. How do members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng) perceive and understand the mitigation of climate change?

1.6.3 Objectives of the study

One of the most important steps in conducting research is to formulate research objectives that are specific and relevant to the questions being asked (Ming, 2005:25; Thomas & Hodges, 2010:39; Yan, 2015:28). The objectives should be closely related to the research question, cover all aspects of the problem, be specific, ordered in a logical sequence, achievable, taking into consideration the available resources, including time, and be mutually exclusive of each other (Yan, 2015:27).

Below are the objectives of this study:

- i. To explore factors that affect the perceptions of climate change and CCS by the members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng);
- ii. To determine factors in the understanding of climate change and mitigation measures such as CCS technology; and,
- iii. To investigate how the communication of climate change and CCS technology is perceived.

1.7 RESEARCH METHODOLOGY AND DESIGN

The methodology consists of two key components of a research approach; namely design and methods (Durdella, 2019:9). Research methodology can be defined as a systematic technique or plan of action which guides how the research is to be conducted by providing a “description and analysis of methods, [which] throws more light on their limitations and resources, clarify their presuppositions and consequences, relating their potentialities to the twilight zone at the frontiers of knowledge” (Nkwake, 2015:27). A research design is a structural outline of a project which optimises the validity of data for the research problem under investigation (Chomba, 2013:26). Davis (2014:93) describes the research design as the research’s overall plan that guides the researcher in the process of completing the study. Furthermore, according to Creswell (2014:11-12), the researcher has a choice between qualitative and quantitative or mixed methods to conduct the study. These research methods provide procedural direction to the study (Creswell 2014:11-12). In this regard, the researcher will develop a proper methodology used as a guideline on how the relevant data will be collected, analysed and interpreted.

1.7.1 Unit of analysis

According to Chenail (2012:266), one of the main challenges in analysing qualitative data is deciding on what piece of the data constitutes a meaningful unit to analyse. The unit of analysis can refer to the person, collective, or object that is the target of the investigation (Bhattacharjee 2012:9). In this study, individuals are the units of analysis.

1.7.2 Population

For the researcher to commence with data collection, a targeted population must be first identified and selected. The researcher is required to gather data or information from participants belonging to a certain identified research population relevant to the study in their quest to contribute to academic debates and knowledge (Asiamah, Mensah & Oteng-Abayie 2017:1608; Bradshaw, Atkinson & Doody, 2017:3-4). Once the researcher has identified the population of interest to form part of the sample becomes the next stage.

Pascoe (2014:135) adds that to complete the study in a viable manner, the population must be accessible (Pascoe, 2014:135). For this study the selected sample will be drawn from the

Gauteng North and Johannesburg regions, specifically, members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). Since this is a qualitative study, the sample does not need to be representative of the bigger population. The focus in the selection of a population was the accessibility of participants and their expert opinions on the topic.

1.7.3 Sampling

Because of limitations such as budget, resource availability and the objectives of the study, a non-probability sampling method will be used in the study. According to Pascoe (2014:135), non-probability sampling methods can be used when the projected findings of the research being conducted are not aimed at representing the larger part of the population of the study. In this study, purposive sampling methods will be used.

The main objective of using purposive sampling relies mainly on targeting the participants that might be deemed by the research to be more relevant to the study under investigation (Bryman, 2016:408). Since climate change and CCS are still regarded as complex concepts, it is important to target or select the participants, who are more likely to be familiar with the technology and the concept of climate change (Etikan, Musa & Alkassim, 2016:10), purposive sampling will be the most judicious sampling method relevant for this study. In this regard, the method will be discussed in detail in Chapter Four.

1.7.4 Data collection method: In-depth interviews

According to Morgan (2015:266), data forms an integral part of a research study. It is in this regard that a researcher needs to select a data collection method that is adequate or suitable for the study. In this study, in-depth interviews will be used to collect data. A more detailed description of the in-depth interviews will be provided in Chapter Four.

1.7.5 Data analysis and interpretation methods

Data analysis and interpretation form the basis of the research findings, recommendations and reporting (Davis, 2014:16). According to Grbich (2013:1), the processes of data analysis in a qualitative research study are complex as it is not a matter of selecting and applying a universally accepted process such as statistics. In qualitative research, data analysis is guided by the researcher's views and choices (Grbich, 2013:1). Secondly, data analysis is also reliant on the research design and methods utilised, the quality of the data gathered and how the researcher managed the collected data (Grbich, 2013:1). This means that the researcher must not only focus on collecting the data but must collect quality data that is relevant to the study and be able to manage it. For this study, a thematic analysis will be used for the interpretation

of data. The analyzed and interpreted data will assist in identifying the factors in the perception, understanding and communication of climate change and CCS technology in South Africa. Chapter Four will provide detail on the data analysis and interpretation methods used in this study.

1.8 FEASIBILITY OF THE STUDY

For a research study to be successful it should be manageable or sustainable in terms of its relevance, time, sample size, methodology and costs involved (Bezuidenhout & Davis, 2014:66). Understanding key considerations before conducting any research project ensures that the study is doable within a reasonable time and that the required resources are realistic and justifiable (Bezuidenhout & Davis, 2014:291).

People must be able to trust and rely on the findings and recommendations generated from a research study (Koonin, 2014:253). Koonin (2014:254) identifies four dimensions of trustworthiness which include credibility, dependability, confirmability and transferability. These dimensions and their applicability in the study will be discussed in more detail in Chapter Four.

1.9. TRUSTWORTHINESS OF THE STUDY

For qualitative research to be accepted as trustworthy, researchers must demonstrate that the study has been conducted in a precise, consistent, and exhaustive manner. According to Lorelli, Nowell, Jill, Norris, Deborah, White and Moules (2017:2) and Korstjens and Moser (2018:121), trustworthiness is one of the ways in which researchers can provide confidence that their research findings are worthy of attention. The concept of trustworthiness in research was introduced by Lincoln and Guba to parallel the conventional quantitative assessment criteria of validity and reliability (Lorelli et al, 2017: 2). Their criteria included elements such as criteria of credibility, transferability, dependability, and confirmability which are discussed below.

1.9.1. Credibility

The confidence that can be placed in the truth of the research findings. Credibility establishes whether the research findings represent plausible information drawn from the participants' original data and is a correct interpretation of the participants' original views. The researcher will provide evidence of the participants' comments to enhance the credibility of the findings.

1.9.2. Transferability

The degree to which the results of qualitative research can be transferred to other contexts or settings with other respondents. The researcher will facilitate the transferability by providing thick descriptions of research process followed in the analysis, interpretation of the data.

1.9.3. Dependability

Dependability refers to the stability of findings over time. Dependability involves participants' evaluation of the findings, interpretation, and recommendations of the study such that all are supported by the data as received from participants of the study. The dependability will be enhanced by using a second coder.

1.9.4. Confirmability

The degree to which the findings of the research study could be confirmed by other researchers. Confirmability is concerned with establishing that data and interpretations of the findings are not figments of the inquirer's imagination but derived from the data. The research design will be described in detail to allow other researchers to possibly duplicate the study with different data sets.

1.10 ETHICAL CONSIDERATIONS

Research ethics play a significant role in research studies. Every researcher needs to adhere to a set of ethics throughout the study's lifecycle. For this study, the researcher will adhere to the Monash University ethics codes. The researcher received approval from the Monash University Human Research Ethics Committee (MUHREC) before commencing with the study. The researcher will further seek informed consent from participants and organisations that will participate in the study. It also involves an explanatory process through which the potential research participant is informed about his/her rights to participate or not participate in the study, the purpose of the study, the procedures to be undergone, and the potential risks and benefits of participation (Ssali, Poland, & Seeley, 2015:1). The researcher will only select the participants who willingly agree to participate in the study. The confidentiality of participants will be maintained through the use of pseudonyms or codes. They will be ensured that they will not be identified in the research report.

1.11 CONCLUSION

Chapter One focused mainly on providing background information about the aims and objectives of the study. This included an overview of various concepts related to the study were also defined. Numerous studies have been conducted with regard to the communication, awareness, perceptions and understanding of both climate change and carbon capture and storage technology. What makes this investigation unique is that it is mainly based on the South African context. Existing studies focused mainly on the technical aspects of the technology, with more emphasis on issues relating to the cost, risks and narrowly focusing on the communication aspect of the technology, especially its deployment.

The researcher anticipates that the findings of this study will assist in understanding various factors that influence the communication, understanding and perception of CCS technology within the South African context. Additionally, the data gathered will assist the CCS community in South Africa about stakeholder engagement processes and CCS awareness campaigns. One of the main outcomes envisaged might be the role of language, education and technology in the framing of CCS technology among other climate change mitigation methods in South Africa.

1.12 EXPOSITION OF THE STUDY

Chapters Two will focus on reviewing literature that relates to the study. It will explore the communication challenges of climate change and Carbon Capture and Storage technology and how they impact or affect people's understanding and perceptions.

Chapter Three will focus on a review and analysis of various communication, development and climate change theories to understand different schools of thoughts when it comes to climate change and CCS technology.

Chapter Four will mainly focus on providing a detailed description of the research methodology of the study. The emphasis is mainly on the research design, approach, and data collection methods that will be applied in this study.

Chapter Five will focus on the collection, analysis and interpretation of data and the presentation of the interpretations. This will include identifying various categories and sub-categories of codes and themes that will assist in grouping different sets of data.

Chapter Six will focus on the presentation of the research findings and recommendations for future research.

CHAPTER TWO

CLIMATE CHANGE AND CCS

2.1 INTRODUCTION

The previous chapter provided an overview of the study. This chapter will focus on reviewing literature that relates to the study from various sources. A literature review involves the process of reviewing existing knowledge and theoretical points of view that are relevant to a study being conducted (Hart 2018:3; Rowe 2014:242). In short, the literature review is a process that acts as a foundation and support for a new research study (Ramdhani, Ramdhani & Amin, 2014:48). Several studies have been conducted on the awareness and communication methods of climate change and CCS technology (Drake, Kontar & Rife, 2013:48). In this chapter, the focus is on identifying and analysing the existing literature relating to the study.

2.2 CLIMATE CHANGE FACTORS

The onset of the industrial revolution marked a turning point in climate change and since then major changes in agriculture, manufacturing, production, mining, production and transportation transpired (Chandrappa, Gupta & Kulshretha, 2011:27; Godfrey, Le Roux-Rutledge, Cooke & Burton, 2010:2). According to the Integrated Energy Planning Reports published in 2016 by the Department of Energy (DoE), South Africa is by far one of the fastest emerging economies in the third world (DOE, 2016:11). In this regard, whilst the country needs to continue fuelling its economic growth to fulfil the provision of its social needs, it must concurrently enhance its efforts to protect and conserve its natural environment (DoE, 2013:5, DOE, 2016:23; Miller, 2016:3).

South Africa, for example, has committed to reducing emissions by 34% levels by 2020 and by 42% by 2025 (Department of Environmental Affairs, 2018:9). One of the main challenges of addressing climate change in South Africa and the rest of the continent is that Africa's response to climate change has been hampered significantly by a lack of or limited information to enhance mitigation and adaptation measures relevant to the local recipients (Godfrey et al, & 2010:2; Intergovernmental Panel on Climate Change, 2012:17; Oduniyi, Mpandeli, & Maponya, 2013:4; Pereira, 2017:273).

One of the best ways to mitigate against and adapt to climate change is through effective provision of relevant and accurate information to the people at the right time as this enables informed responses by those likely to be affected (African Union, 2014:29; UNICEF, 2011: 16).

This section will focus on the history of climate change, its causes, effects and possible solutions. In addition, more emphasis will be placed on the role of communication in mitigating climate change.

2.2.1 The communication of climate change in South Africa

Since the topic of human-induced climate change first emerged on the public agenda in the mid-to-late 1980s, public communication of climate change and most recently, the question of how to communicate it effectively has increased in importance (Moser, 2019:31). According to Markowitz, Hodge and Harp (2014:i), in the last two centuries, climate change has mostly been discussed as a scientific phenomenon. This means only scientific language was used in most climate change communication messages, which made it difficult for the general public to understand the concept.

According to the Department of Environmental Affairs (2011:xv), the South African government has introduced several initiatives aimed at educating and raising awareness of climate change (Department of Environmental Affairs, 2011:xv).

2.2.2 Accessibility and availability of climate change information

Currently, more than ninety-seven percent of published scientific journals shows that there is an agreement between environmental, geological, climate and social scientists that climate change is a reality and the fact that human-induced activities are for the increase in GHG emissions into the atmosphere (Harris & Roach, 2016:1, National Academy of Sciences, 2014:2).

Jylhä (2016:20) states that since the progression and impact of climate change effects. The general public relies heavily on the media and opinions from scientists or expects to learn about climate change, however, the challenge is that at times, people may incorrectly diffuse or interpret the information they receive (Ho, Budescu, Mandeep, Dhami & Mandel, 2015, 2009:44). For instance, scientific uncertainties such as inconsistent predictions and varied

views from scientists can lead individuals questioning the level of confidence in the findings and predictions, and to question the validity of the contradicting information distributed by the scientists (Ho, et al., 2015, 2009:44).

2.2.3 Campaigns against climate change science

Over the years, there have been many dismissive discourses that focused mainly on casting doubt on climate science (Jylhä, 2016:15). According to Mckie (2018:48), even though there is evidence to support that humans contribute immensely to climate change, this global environmental problem still faces some contestation from the political arena and the society at large. Some companies make use of front groups to shield their anti-environmental business operations (Mckie, 2018:51). These groups receive money mainly from big oil companies to spearhead messages against climate change. For example, the Global Climate Coalition formed in the late 1980s in reaction to the established of the Intergovernmental Panel on Climate Change (IPCC) was one of the most vocal organisations that campaigned against the Kyoto Protocol (Mckie, 2018:51).

In addition, lack of first-hand experience of climate change effects is one of the main reasons why some people are not taking any action to mitigate climate change (Spence, Poortinga, Butler & Pidgeon, 2011:1). For example, if a person has not been exposed to or experienced climate change effects such as floods, drought, unpredictable temperatures, it becomes difficult for them to believe in the existence of climate change. Therefore, to ensure that climate change remains part of the global agenda, the United Nation has included the fight against climate change in the new Sustainable Development Goals developed in 2015 (United Nations, 2015:16).

2.2.4 Climate Change communication initiatives in South Africa

Over the past few years, efforts to raise climate change in South Africa has been raised through education, public communication, community programmes and through a host of other mediums. In addition, examples include public information campaigns such as *Climate Action Now* which was launched during COP17 in 2009 (Mnkeni & Mutengwa, 2014:14; Windell, 2016:32-46) and media integration in disseminating useful climate information to effectively guide public debate and understanding about the weather and climate change (Tagbo, 2010:6).

The complex nature of climate change tends to make it difficult to communicate mainly because the greenhouse gases cannot be seen with the naked eye and it can take many years for their accumulating effects to be felt (Anup, 2018:21; Rudiak-Gould, 2012:120). One of the main barriers in climate change and CCS technology in South Africa is the low level of science and technology awareness in the country (Department of Science & Technology, 2016:340). Heinrich Boll Stiftung's Southern Africa's report titled "*20 years of African CSO involvement in Climate Change Negotiations*" has indicated that, in addition to government initiatives, non-governmental institutions have launched their programmes aimed at creating climate change awareness in South Africa (Madziwa, Betzold & Harris, 2014:14). The expansion of the aforementioned initiatives could assist in creating more awareness of climate change in South Africa.

Through communication, the public can learn about the basics of climate change and CCS technology, as well as understand various climate change response techniques (Bradbury, Greenberg & Wade 2011:5). In order to understand the role of communication in raising awareness of climate change and CCS technology and an understanding of communication in general, it is important to note that communication is not just about sending and receiving messages. It is a complex phenomenon that involves sensitivity and emotional aspects that aim to ensure that the stakeholder has access to essential or useful information, to reduce anxiety in change situations, to provide negative or positive feedback, and to provide solutions to problems or issues raised by stakeholders (Bourne, 2015:1; Lunenburg, 2010:2).

2.3 CARBON CAPTURE AND STORAGE TECHNOLOGY

The International Energy Agency (IEA) and the Intergovernmental Panel on Climate Change defines Carbon dioxide (CO₂) Capture and Storage (CCS) as "a process consisting of the separation of CO₂ from industrial and energy-related sources, transport to a storage location and long-term isolation from the atmosphere" (Metz, Davidson, de Coninck, Loos & Meyer, 2005:3, Taniguchi & Itaoka, 2016:344). In November 2016, the IEA published a report entitled "*20 Years of Carbon Capture and Storage*" to review the progress made since the IEA published the Special Report on CCS in 2005. The report states that the successful deployment of CCS will have to involve improved efforts to ensure local communities and the general public understand and accept the technology (IEA, 2016:49).

2.3.1 The nature of CCS technology

According to the report titled “*Carbon Capture: A Technology Assessment*”, CCS technology is regarded as one of the portfolios of technologies to reduce the emission of large quantities of carbon dioxide (CO₂), the principal being greenhouse gas released into the atmosphere (Folger, 2013: i). Since the mid-twentieth century, CO₂ has been identified as one of the major contributors to the global climate change, especially the human-induced emissions from the electricity-generating power stations and other large industrial sources (Folger, 2013:i). CCS refers to several technologies which capture CO₂ at some stage from processes such as combustion (most generally for power generation) or gasification (Boot-Handford, et al., 2014:130). Understanding the nature of the technology is one of the methods that can be used to assist people in understanding how it works as the technology comprises different stages, from when the CO₂ is captured at power until it is safely stored in geological formations. Therefore, understanding where and how the technology originated is important for all role players, especially those likely to be affected by its deployment.

2.3.2 The history of carbon capture and storage technology

The basic idea of CCS was first realised in 1977 as a way of capturing CO₂ and preventing it from being released into the atmosphere (International Energy Agency: 2013:1). In 1977 Marchetti suggested that rising atmospheric CO₂ levels were as a result of burning of fossil fuels, and since this time, globally, this issue has become increasingly severe (Zheng & Xu, 2014:5222). However, public awareness is essential to highlight CCS advantages, such as the mitigation of CO₂ emissions and environmental degradation (Yoro, 2016:11). This might in turn stimulates the interests of various stakeholders, who might contribute towards its implementation in South Africa. South Africa, through the South African Centre for Carbon Capture and Storage (SACCCS), is creating public awareness of the need to curtail the indiscriminate emission of CO₂.

According to Ashworth’s report on Communications for CCS published in 2010, CCS technology is still perceived as a scientific concept and therefore identifying better communication content and engagement methods that are easily understood by the lay public could assist in creating more awareness of CCS technology (Ashworth, 2010:10).

2.3.3 Communication of CCS technology in South Africa

The remoteness and lack of proper communication infrastructure in the targeted areas can have an impact on the communication processes of CCS technology in South Africa (Rothmann-Guest et.al, 2012:31). In South Africa, communication varies in urban and rural areas, unlike in urban areas, where there is evidence of communication infrastructure, public engagement in rural areas is constrained by limited infrastructure, the remoteness of the population and high levels of poverty (Rothmann-Guest et.al, 2012:31).

Addressing climate change through CCS technology might not have immediate benefits to the communities that are likely to be affected by the project (De Coninck & Benson, 2014:262; Hardisty, Sivapalan & Brooks, 2011:1460,). Most stakeholders in South Africa are concerned about how a CCS project can benefit the communities in terms of job creation and project legacy (Modiko, Ngcobo, Tshivhase, Raselavhe, Surridge & Beck, 2014:7047). Steyn and Nunes (2001:1), state that most projects are planned in a top-down manner without involving the specific community in the needs analysis, decision-making and planning processes. One of the most successful CCS demonstration projects in the world is the Aquistore CCS Project based in Canada which involved the communities from the start (GCCSI, 2015:5). For these reasons, project developers need to involve the communities before any logistical and technical decisions. Dealing with a variety of stakeholders requires an action plan or strategy such as a communication or stakeholder engagement plan (Hammond & Shackley, 2010:28), therefore, before engaging with the communities, project developers need to have a detailed plan acting as a guideline on how to engage with the identified stakeholders.

2.3.4 Perceptions and awareness of CCS technology in South Africa.

Although CCS technology is still new to South Africa, perceptions are already held by certain stakeholders in the country. According to the NatLoc Plans report published in 2012, CCS developers in South Africa need to engage with communities as early as possible and adequately garner community acceptance of the technology (Rothmann-Guest et.al, 2012:24). The developers need to consult with key stakeholders on national, provincial and local municipality level (Rothmann-Guest et.al, 2012:24). Glazewski et al (2012:39) state that CCS awareness in South Africa is currently limited, citing differences in language, religion, culture and preoccupation with meeting basic human needs as the main barriers that could impact public engagement.

Ejembi and Alfa (2012:2) point out that the approach in creating awareness of the impact of climate change in terms of land use, energy, biodiversity, health and water resources is crucial. Stakeholders' perceptions of climate change are critical in establishing the level of understanding and the adoption of methods to mitigate its potentially devastating effects on the production and supply of food (Ejembi & Alfa 2012:2). Glazewski et al (2012) and Ejembi and Alfa (2012) agree that the level of climate change awareness in South Africa is still at a minimal level. Ejembi and Alfa (2012:2) emphasise that it is only when people understand what climate change is about that they will be able to implement its adaptation measures such as CCS technology. South Africa being one of the emerging economies globally has its unique challenges for communication CCS technology. Apart from perception, communication and awareness challenges, CCS still faces some deployment obstacles, especially with regards to its application value chain.

2.3.5 Challenges of understanding the CCS technology value chain

Although there is a reasonable level of general knowledge about CO₂ across the lay public, understanding of its specific properties is more limited (Gough, O'Keefe & Mander, 2014:100). CCS is a technology that comprises of different stages, from when the CO₂ is captured at a power station and when it is safely stored in a selected storage site (Gough, O'Keefe & Mander, 2014:100; Løvseth & Wahl, 2012:324). The main stages in the CCS value chain include but are not limited to; capturing, transportation, injection, storage and monitoring (Pietersen, Pearce & Vernon, 2013:11). A basic understanding or a breakdown of these stages can help in creating an understanding of CCS technology. It is therefore important to provide an overview of these components of CCS technology and how they affect people's perceptions towards the technology.

The deployment of CCS faces challenges of making people understand what the whole process of CCS technology entails. For example, the complexity of understanding the technicalities of how the capturing of CO₂ works is one of the main challenges for CCS technology (Ben-Mansour, Habib, Bamidele, Basha, Qasem, Peedikakkal, Laoui & Ali, 2016:227). CO₂ capture is almost entirely technology-dependent, and an expensive exercise (Brown, Gambhir, Florin & Fennell, 2012:2; Folger, 2013:1). If capturing is perceived to be too expensive, it might mean that decisionmakers, policy developers and the general public might opt for other methods. The next stage after CO₂ has been captured is to ensure that it is safely transported to its destination. The transportation of CO₂ based on the quantities and location should adhere to regulatory frameworks to ensure public safety (de Coninck, Loos & Meyer, 2005:181; Leung, Caramanna & Maroto-Valer, 2014:432; Metz, Davidson).

In most cases, the public is concerned that CO₂ injection into the subsurface might fracture underground and activate faults that could induce seismic activities such as earthquakes or create CO₂ leakage pathways (Mazzoldi, Rinaldi, Borgia & Rutqvist, 2012:434-435). The project developers need to ensure that the right amount in the right pressure is being injected because if the injection rate is too high, the rise in pressure may create fractures or activate faults within the rock formations (Szulczewska, MacMinnb, Herzogc & Juanesa, 2013:5186).

The engagement of stakeholders in CCS projects can be enhanced through a broader CCS guided communication strategy, which includes communicating the inherent risks of the technology and the mitigation measures should there be a leak (Corry & Reiner, 2016:12). Role players such as governments, non-government organisations (NGOs) and the scientific community can help in capacitating communities in the role of CCS as one of the portfolios of technologies identified as an effective global or national response to climate change (IEA, 2016:49).

2.3.6 The socio-economic dynamics and the cost of CCS technology

Despite CCS being one of the priority technologies to mitigate climate change, its economic validity has affected its deployment amid concerns from the general public, governments and prospective investors in the technology (Karayannis, Charalampides & Lakioti, 2014:295). For CCS to be truly an effective option in efforts to mitigate climate change, it must be sustainable. This means that CCS deployment costs should not exceed environmental and social benefits and must provide long-term security for environmental and human health protection (Hardisty, Sivapalan & Brooks, 2011:1460). Environmental NGOs like Greenpeace perceive CCS as a very expensive and uneconomic investment climate change mitigation method (Ash, 2015:11). If the technology is perceived to be too expensive the chances of it being deployed despite its benefits are low.

While there are notable technical challenges in integrating the various stages of CCS technology, the lack of coherent and comprehensive policy measures from governments has delayed full-scale demonstration and deployment of CCS projects (McCoy, 2014:8). The risk factors are important aspects that could affect how people perceive the technology.

2.3.7 Risks, opposition and criticism of CCS technology

According to Stephens (2015:7), the health and safety risks of storing CO₂ underground have generated concerns from the general public and that has led to delays and cancellation of several large-scale CCS demonstration projects in Germany and the Netherlands. These risks include possible CO₂ leakages from a geological storage site to contain the trapped carbon dioxide, the hazards of CO₂ [contaminating drinking water or disrupting ecosystems], and even increased likelihood of earthquakes (Zoback & Gorelick, 2012:10164). If CCS is not regulated, the public will not trust or believe in the technology, mainly because there will be no enforcement to protect the public and the environment.

Public opposition to CCS deployment has been experienced in some European countries and the United States of America. For example, opposition to a CCS demonstration project in Ohio State arose because of concerns about the project's negative impact on property values, leakage, and citizen objections to being the object of being used as laboratory rats (Feldpausch, Parker, Burnham, Melnik, Callaghan & Selfa, 2015:3059).

Given the above, the way in which risks are communicated to people can influence how they perceive the technology. Cologna, Bark and Paavola (2018:278) indicate that there is both a need for more dialogue between those at risk and improved risk communication delivered with a greater understanding of how at-risk communities perceive risk. The aforementioned shows that issues such as property rights and the unproven nature of the technology could result in mass rejection of CCS, especially in the areas that are likely to be affected. It is therefore important to focus on the global awareness of CCS technology.

The CCS in developing countries report released by the World Bank Group in 2014 has indicated that the lack of awareness of factors such as the risks, costs, prospective applications, legal aspects, property rights and technical aspects regarding the technology may have an impact on how people perceive CCS technology (Kulichenko & Ereira, 2011:54). This means CCS developers should go beyond just preaching CCS, and provide stakeholders and the public with information on the basics of the technology.

Since the last decade, institutions like the Global CCS Institute have become platforms through which information on CCS is distributed and shared. The Institute has indicated that supporting knowledge sharing initiatives is vital in improving public awareness (Kulichenko &

Ereira, 2011:68). According to the GCCSI global status CCS report published in 2011, sharing information about the achievements or milestones reached about CCS deployment is critical in creating awareness and building enthusiasm towards the technology (GCCSI, 2011:16).

2.3.8 Social frame of CCS technology

Buhr and Wibeck (2014:7) state that, regardless of whether or not the descriptions of CCS are based on scientifically verifiable facts, different social frames or representations about the technology exist. Framing refers to the process by which a communication source constructs and defines a social or political issue for its audience (Nelson, Oxley & Clawson, 1997:221). According to Stephens, Markusson and Ashii (2011:6250), the social framing of a CCS project may change over time, but the initial frame will have a big impact on how the project is designed and how and what types of learning occur. Buhr and Wibeck (2014:7) highlight that the social framing of CCS is not enacted only by members of the general public, but also by researchers, the international community of professional CCS experts, international organisations, and the media. For example, Environmental Non-Governmental Organisations (ENGOS) and CCS developers will have different frames for the technology based on their stance towards it.

2.3.9 Cancelled CCS projects

According to Thronicker and Lange (2014:2), during the past decade, a considerable number of CCS projects has been put on hold or cancelled. In Europe, some projects were cancelled because of public opposition. It has been proven over the years that public acceptance can make or break any project. The most visible example of a project that was cancelled because of public resistance is the Barendrecht project in the Netherlands (De Coninck & Benson, 2014:258-259). In the United States and Australia, the general attitude seems more favourably disposed toward CCS, perhaps because of a more positive view of the fossil-fuel industry (De Coninck & Benson, 2014:258-259). However, even in those countries, resistance has emerged around several CCS projects, focused on safety, public benefits, and environmental justice issues (De Coninck & Benson, 2014:258-259).

The deployment of CCS technology faces stiff competition from other technologies such as renewable energy and nuclear technology. For instance, there is a notion that CCS must not divert public investments or political attention away from renewable energy and energy efficiency (Bui et.al, 2018:1139). Amongst other concerns by the environmental NGOs concerns were that CCS wastes energy, is expensive and undermines funding in sustainable solutions and that the world already has the solutions to the climate crisis in the form of

renewables (Bui et al, 2018:1039). Linked to these concerns is a view that CCS simply perpetuates fossil fuels, which is compounded by many of the first projects being part-financed by using the captured CO₂ for enhanced oil recovery (Bui et al,2018:1039).

2.3.10 The future of CCS in South Africa

Over the past few years, there have been doubts on whether CCS has a future in climate change mitigation, however, the outcomes of the Paris Agreement may be seen as a turning point for the technology (Alloisio, D'Aprile, Davide, Calliari & Jonson, 2017:9). South Africa depends heavily on fossil fuels for energy generation (Rothmann-Guest, 2012: viii). For example, coal fuels contribute over 90% of the country's electricity production, making the country a significant emitter of CO₂. Because of its reliance on fossil fuels, since 2004 the South African government through the Department of Energy has done a significant amount of work to explore the potential for CCS (Rothmann-Guest, 2012: viii).

The fact that CCS can help South Africa to mitigate climate change without putting brakes on coal use can have an impact on how the people view or perceive the technology. For example, environmental NGOs, are of a notion that CCS prolongs the use of coal (Global CCS Institute, 2011:12), whilst those in the coal mining and use industries can view CCS as the industry's saviour, coal will have to reduce its environmental impact if it is to remain a significant energy source (Hammond & Jacobs, 2014:476). In this regard, it appears that the future of CCS in South Africa will rely on its continued coal use, support for the technology and future investments from the industry or international donors (Academy of Science of South Africa, 2014:15; Beck, Surridge, Liebenberg & Gilder, 2011:6158) Therefore, it is important for all role players to ensure that all relevant stakeholders are aware of the technology's existence, objectives, benefits and inherent risks

2.4 CONCLUSION

The purpose of this chapter was to review and analyse various aspects of communication of climate change and CCS technology globally, with more emphasis on South Africa. This chapter further provided an analysis of the communication role for climate change and CCS technology. The literature cited above illustrates that there are a number of factors that could directly or indirectly influence people's perceptions and understanding of climate change and CCS technology. The way in which CCS and climate change messages are being communicated could affect how people view and understand the technology. This means that for people to provide a fair judgement or opinions towards addressing climate change and

their perceptions on the deployment of CCS technology, they first need to be provided with relevant information. This information should help them to understand the concept of climate change in a manner that is easy to understand. For CCS technology the stakeholders will need to be provided with information that consists of various aspects of the technology such as benefits, risks, costs and reactionary measures in case of leakages.

In view of the above, it is also important to review and analyse various communication, development and climate change theories. The next chapter will analyse and put into perspective various theories based on their relevance to the study. Development communication theories such as the Development Support Model, Participatory Development, diffusion of innovation theory, Agenda Setting and the Participatory Rural Appraisal theories are addressed.

CHAPTER THREE

THEORETICAL FRAMEWORK

3.1 INTRODUCTION

Chapter Two provided the context of the study in terms of literature available on the topic and this chapter describes the theories deemed most applicable. It is important to consider theories relevant to the knowledge base of the phenomenon to be researched. Neumann (2014:56) describes the theory as a logically connected set of general propositions that establish a connection between two or more variables. According to Creswell (2014:51), determining what theories might be relevant to a research study is an important element of reviewing the literature. In this section, several theories relevant to the study will be discussed. According to Imenda (2014:186 -187), “a theory is a set of interrelated concepts, which structure a systematic view of phenomena to explain or predict a structure.”. This means the theoretical work needs to be well structured and relevant to the study being undertaken. According to Bezuidenhout (2014:43-44), theories have several functions in a research study including, among others, the identification of key notions, providing different perspectives and the explication of underlying relationships between constructs and concepts. Bezuidenhout (2014:55) defines a theoretical framework as a specific collection of various schools of thought and theories that relate to the phenomenon being researched.

Despite widespread beliefs by various authors that the world is currently in the era of the information age whereby it is perceived that there has been a universal expansion of mass media and online information, and ‘superhighways’ reaching to all corners of the globe, in South Africa, it is clear that there is still some difficulty to reach and communicate with rural communities (Barker, 2001:3). It is of utmost important to explore various development and communication theories as well as climate change-related theories. The following theories and models will be analysed and explored to determine their relatedness to communication, understanding and perceptions of climate change and CCS technology.

3.2 DEVELOPMENT COMMUNICATION THEORIES AND APPROACHES

This section will focus on exploring various development communication theories that will assist in creating an understanding of how the public adapt, accept or reject new developments. The main focus of development communication is to exchange information that can contribute to addressing developmental challenges faced by society (Carciotto & Dinbabo, 2013:69). The concept of development communication (DC) originated as a result of communication and the media's roles in developing countries and can be regarded as organised efforts to utilise communication processes and the media to bring about socio-economic improvements in the society (Shahzad & Bokhari, 2014:1). What makes development communication different from other forms of communication is that it is purposive, value-driven; and pragmatic (Shahzad & Bokhari, 2014:2).

3.2.1 Development support communication (DSC) models

The Development Support Communication model (DSC) can be described as any forms of communication strategies designed to provide support to a particular development initiative (Shahzad & Bokhari, 2014:3). Shahzad and Bokhari (2014:3) regard DSC as a "concept of communication activities that undertake the exchange of messages at a more participatory level to achieve specific goals of exchange and development." The concept of DSC serves as a means of linking all role-players involved in the projected development projects such as agencies, beneficiaries, media, policymakers and opinion leaders to enhance the distribution and consumption of information amongst all relevant stakeholders (Magongo, 2014:26).

According to Pannu and Tomar (2010:51), the development support communication (DSC) model promotes dialogue and information sharing to enhance participation from the targeted participants. Although this theory seems to support dialogue and information sharing, it is important to understand its origins, advantages, disadvantages and relevance to the study being conducted.

3.2.1.1 *The origins of development support communication model*

According to Pannu and Tomar (2010:51), the origins of the DSC model can be traced to the 20th century, especially in the field of agriculture. However, Shahzad and Bokhari (2014:2), indicate that it was actually in the early 1960s were the idea of development support communication (DSC) was conceived by the United Nation's Professional Information Officer, Erskine Childers, who proposed that project planners and developers should instead employ skilled communicators to enforce and motivate the people towards successful development and change. The DSC was as a result of the emergence of new emphases, trends, initiatives and theoretical approaches in the 1980s and 1990s aimed at modernising the development processes that promote participation and empowerment of those involved (Shah, 2011:7).

3.2.1.2 *The philosophy of DSC*

Shahzad and Bokhari (2014:2), highlight that the philosophy of DSC is based on the following:

- i. The latest efforts were undertaken to bring about a change in a limited area;
- ii. It emerged as a more specific and participatory communication effort to educate the people of rural settings;
- iii. It aims at targeting the audience to achieve a specific and defined goal of change and development;
- iv. It does not depend on technological based communication media;
- v. It works within a limited community to create awareness about innovations;
- vi. Its philosophy is to motivate the intended audience towards change using all available means of communication; and;
- vii. It is about interaction with those directly or indirectly affected.

3.2.1.3 *The advantages of the DSC model*

Unlike other models that apply a top-down or mass media approach, the development support communication model promotes the use of all relevant structures, methods or stakeholders to distribute or share the information (Pannu & Tomar (2010:52). The DSC approach can play a major role in creating, expanding and maintaining a community's participation, choices, capacity, capability and opportunities to contribute to project implantation (Ngwainmbi, 2014:24). In this regard, project developers should consider instigating community engagement initiatives that enable the general public to not only benefit from the project but also create an environment that allows the community to be capacitated to contribute meaningfully to the project (Ngwainmbi, 2014:24). Furthermore, Kumar (2011:7) states that

DSC encourages the use of communication methods that provides the general public with information in a language that they understand. This means development plans must be communicated in the local vernacular.

3.2.1.4 *Criticism towards the development support communication model*

Although the theory is based on a horizontal flow of information, the DSC in practice is not different from the actual development theory (Shah, 2011:7). Even though the model does not apply the top-down approach, the influence is often from the outside, meaning that Western experts can still be highly influential because of institutional biases and values upheld by those who hold power (Shah, 2011:7). Marzuki (2015:21) also emphasises that although developers often take local culture and context into consideration when planning or implementing projects, local community involvement is sometimes hampered by the lack of a systematic approach and poor planning by project developers, which contributes to the public's exclusion from the process. In addition, the exclusion is caused by the lack of knowledge about public participation and low levels of education of the public (Marzuki 2015:21)

In view of the above, this theory is suitable for communicating climate change and CCS as it involves direct communication with those who are likely to be affected by the deployment of CCS technology. Furthermore, the model seems to promote the reduction or elimination of technical jargon that might not be well understood by the stakeholders.

3.2.2 Participatory model of development

The participatory model of development communication regards the society (recipients) as key role players in their society's developmental process (Naidoo, 2010:18). Barker (2001:6) defines the participatory model of development as a "global process for which societies are responsible and the key concept is grassroots participation in the development process" (Barker, 2001:6). This model promotes two-way communication between the developers and the society and is based on the school of thought that supports a transactional two-way dialogue whereby the communities or those who are likely to be affected by the planned development project are involved in every stage of the project (Naidoo, 2010:7).

3.2.2.1 *The origins of participatory development communication*

The participatory development communication model has its roots in the participatory action research (PAR) that was developed by the Colombian sociologist Orlando Fals Borda in the

1960s and 1970s (Tufte & Mefalopulos, 2009:9). According to Borda's method, stakeholders should be involved in the identification of the core issues in the development process. In general, the participatory approaches have undergone several waves of interest within the research and development community since the 1970s (Van de Fliert, 2010:95). Furthermore, Van de Fliert (2010:95) states that participatory communication has over the years become one of the most widely used terms in project proposals as it recognises that the people should play an integral part in balancing the community's socio-economic development goals and environmental sustainability. In the 1980s, Robert Chambers, a research associate at the Institute of Development Studies in Sussex, UK, developed a successful method of community engagement known as Participatory Rural Appraisal (Tufte & Mefalopulos, 2009:90). The method allows people to express their knowledge and conduct their analysis, assessment and action planning.

3.2.2.2 *The nature of the participatory communication model*

According to Msibi and Penshorn (2010:2), participatory communication mainly focuses on people's involvement in all stages of a communication development project. This model requires that for "development projects to be sustainable, the communication must be participatory in nature" (Jooste & Van der Vyver, 2014:631). Based on this model dialogue should be the leading principle to conserve the community's independence and cultural identity during the processes of development. Kheerajit and Florblt (2013:1) state that the participatory development communication approach functions as a set of techniques consider that people change their knowledge, attitudes, and practices by allowing them to voluntarily engage in the all relevant activities affecting them.

3.2.2.3 *Stakeholders and participatory development*

In its Handbook on Poverty and Social Analysis published in 2012, the Asian Development Bank (ADB) regards the potential beneficiaries and other project-affected groups as important aspects that can enhance the quality of the project as a whole (Asian Development Bank, 2012:xi). Such stakeholders might include the government, civil society, and the private sector at national, intermediate and local levels (Asian Development Bank, 2012:xi)

The ADB (2012:xi-xii) has identified the following stakeholders as important role players in a development project:

- i. The general public that comprise of those who are directly or indirectly affected by the project;

- ii. The Government, which consist of policymakers and civil servants from various government structures;
- iii. Civil society organisations: networks, national and international NGOs, grassroots organisations, trade unions, policy development and research institutes, media, community-based organisations;
- iv. Private sector: umbrella groups representing groups within the private sector, professional associations, chambers of commerce, and;
- v. Donor and international financial institutions: resource providers and development partners.

3.2.2.4 *The challenges of applying the participatory communication model*

All projects are initiated to achieve certain objectives or goals, however, over the years it has been noted that many development projects have failed mainly because not all the stakeholders, especially the beneficiaries were properly presented with an opportunity to participate in the identification, assessment and addressing of community needs before the commencement of the project (Msibi & Penzhorn, 2010:53). Furthermore, the main challenge that could hinder the deployment of this approach is that not all members of the community are likely to agree or participate in the project and that in turn may cause delays for project completion (Servaes & Malikhao, 2005:95).

Kilewo and Frumence (2015:3-9), identify numerous factors that could hinder community participation during project development were identified. The factors include, but are not limited to the following (Kilewo & Frumence 2015:7-9)

- i) Limited communication and information sharing;
- ii) Lack of awareness on community participation;
- iii) Lack of resources;
- iv) Lack of knowledge of roles and responsibilities; and
- v) Community participation in a project.

According to Tufte and Mefalopulos (2009:10), when applying a participatory approach to communication in development projects, there are key questions and a framework of guiding principles to lead practitioners and stakeholders. The following are some of the key questions to consider (Tufte & Mefalopulos 2009:10):

- i. What is the development problem to address: information, lack of skills, or social inequality?
- ii. What notion of culture is inherent in the proposed approach?
- iii. Is the catalyst or change agent understood?
- iv. What principles guide the understanding of education?
- v. Are there active stakeholders or audiences to address?
- vi. What are their respective roles in the communication process?
- vii. What messages will be communicated: examples, life experiences or social issues?
- viii. What is the aim of the change: individual behaviour, social norms and power relations, social or economic structures?
- ix. How will outcomes be monitored and evaluated?
- x. What is the time perspective to achieve the desired changes?

3.2.3 The diffusion of innovation theory

The diffusion of innovation approach can be summed up in two words; namely, diffusion and innovation and according to Rogers (2003:5), diffusion is the “process by which an innovation is communicated through certain channels over time among the members of a social system”. In short, it is a special type of communication process whereby the intended message is concerned with communicating new ideas to the targeted audience (Rogers, 2003:5). He further defines innovation as an idea, practice, or project that is perceived as new by an individual or other unit of adoption” (Rogers, 2003:12).

3.2.3.1 *The history of the diffusion of innovations*

The diffusion of innovation theory has its roots in the 1940s when the American researchers initiated studies to investigate the way in which innovative ideas and practices were shared or distributed within the agricultural communities (Tola & Contini, 2014:495). Various attempts to explain whether an innovation will be shared and adopted by the society have been based on Rogers’ diffusion of innovation theory as the model that examines innovations using different perspectives (Aizstrauta, Gintersa & Eroles, 2015:72). Since many scholars have adopted Roger’s theory of diffusion of innovation, it is important to look at key elements of the theory identified by Rogers.

3.2.3.2 *Elements of innovation*

Many authors and researchers seem to agree with Rogers’ 2003 view of key elements of the diffusion of innovations theory. Sahin (2006:14) identifies innovation, communication

channels, time, and the social system as key components of the diffusion of innovations theory. Below is Rogers' description of diffusion of innovation key elements.

According to Sahin (2006:14), innovation is not always a new concept or invention and may have been in existence for invented a long time in other areas. For example, Europe and the Americas have had CCS technology since the mid 1990s (European Academies Science Advisory Council, 2015), but in South Africa the work for CCS technology only began in 2004 (The World Bank, 2016:3), meaning that the technology is still a new invention for most South Africans. Therefore, this study needs to investigate how the lack of knowledge on CCS could affect people perceptions towards the technology.

3.2.3.3 *Communication channels*

Communication channels are key elements identified by Sahin (2006:14). Furthermore, Greenhalgh, Robert, Macfarlane, Bate and Kyriakidou (2004:581) state that communication is the process of transmitting information about new ideas or inventions either through the use of mass media platforms or interpersonal communication channels.

3.2.3.4 *Time*

The diffusion of innovations in society might take some time mainly because individuals are likely to adopt a certain concept or invention at different times (Sáenz-Royo, Gracia-Lázaro & Moreno, 2015:1). According to Sahin (2006:14), "the innovation-diffusion process, adopter categorization, and rate of adoptions all include a time dimension."

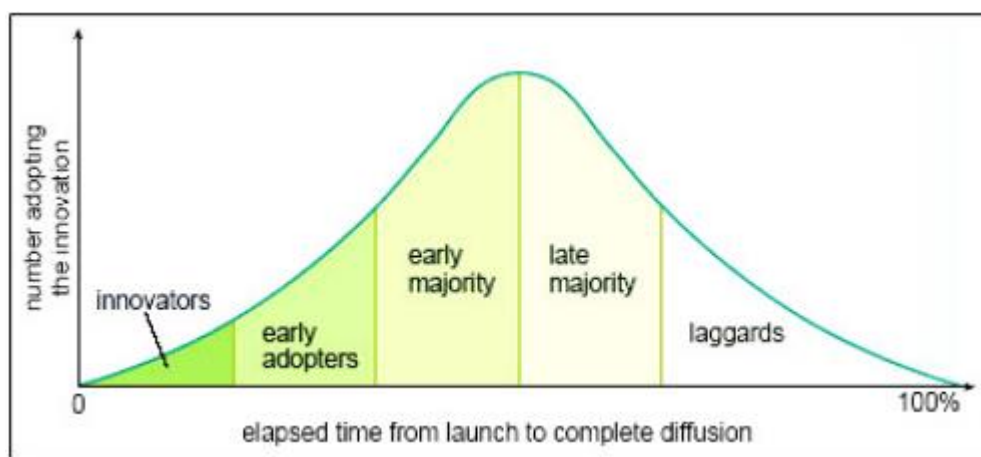


Figure 3.1 Rogers' Curve theory of diffusion. (Sourced from Tola and Contini, 2014:494).

3.2.3.5 Social systems

According to Sahin (2006:15), the diffusion of innovations is mainly influenced by the social system since the innovation of new concepts or ideas takes place within a social environment. The social system is defined by Sahin (2006:15) as “a set of interrelated units engaged in joint problem solving to accomplish a common goal.” The social system structure can have an impact on the diffusion of innovations in a variety of ways such through opinion leaders (Karakaya, Hidalgo & Nuur, 2014:393).

3.2.3.6 Challenges of diffusion of innovation approach

Getting a new idea adopted or accepted by people is one of the most difficult tasks facing innovators regardless of the advantages of such innovation (Rogers, 2003:1). The participants' diverse natures are some of the main challenges associated with the diffusion of innovations (Rogers, 2003:19). According to Tutore, Ferretti and Simoni (2013:116), diffusion is a complex phenomenon that involves economic and non-economic social factors. Complexity has been identified as one of the main challenges associated with the diffusion of innovations. Complexity can be described as a measure of the degree to which an innovation is perceived as difficult to understand and use (Tutore, Ferretti & Simoni, 2013:116).

In view of the above, it is important for this study to investigate ways in which CCS technology are communicated to stakeholders in a way that they can understand and adopt the technology as one of the climate change mitigation technologies. This theory will be relevant to the study as CCS is a new technology that is still being introduced to the world at large.

3.2.4 Agenda Setting Theory

According to Shaw (1979:96), the agenda-setting theory indicates that people's decision making is influenced by how the media reports the information to them. One of the ways to distribute information in South Africa is through mass communication channels such as radio and television. In this regard, the Agenda Setting theory is relevant to the study because people tend to rely on the media to consume information. Agenda setting is associated with the media or powerful political actors' ability to influence issue salience among the mass publics (Stuckey, 2009:28). If something is not covered in the media, people are likely not to take cognisance of it. Typically, the agenda setting theory proposes that awareness of current events is created through media attention and exposure. Climate change and climate change communication are not featured sufficiently to maintain awareness of climate change and the

methodology of carbon capture. The theory will thus assist in explaining the possible reasons why there is no awareness of the aspects discussed with participants.

3.2.4.1 *The history and evolution of the Agenda-setting Theory*

According to McCombs, Shaw and Weaver (2014:781), the origin of the agenda-setting theory dates back to five decades ago. McCombs and Valenzuela (2007:44) state that the Agenda-setting theory has been replicated or cited in more than 400 studies since the first study of agenda-setting was conducted in Chapel Hill, North Carolina in the mid-twentieth century. McCombs and Valenzuela (2007:44) add that the agenda theory has now become one of the central components of scientific research on the media's role in influencing or shaping public opinion. The Agenda-setting theory of mass media has over the years played a significant role in analysing and determining how the media affects people's decision-making process since the theory's inception (Berger & Freeman, 2011:2). It is therefore important to understand the building blocks of this theory.

3.2.4.2 *Assumptions of Agenda Setting Theory*

According to Freeland (2012:3), the agenda-setting theory rests on four basic assumptions:

- i. Agenda setting is viewed as the creation of public awareness and concern of salient issues by the news media;
- ii. The media establish an agenda and in so doing are not simply reflecting, but are shaping and filtering reality for the public;
- iii. The media's foci on the issues that comprise their agenda influence the public's agenda, and these together influence the policymakers' agenda; and,
- iv. The public and policymakers can influence the media's agenda as well.

The relevance of the Agenda Setting Theory is now being challenged since the emergence of social/online media in the 21st century. However, Freeman (2011:20) states that agenda-setting is still prevalent and applicable to vertical media forms. In this regard, before CCS can be considered to be one of key of portfolios of technologies to address climate change, CCS developers in the country must be mindful of how the media portrays climate change and CCS technology.

3.2.4.3 *The nature of Agenda Setting Theory*

The agenda-setting theory postulates that the media's agenda is to disseminate those items they deem important to the general public (Berger & Freeman, 2011:2). Additionally, this theory conceptualises and explains the different forces that dictate how important issues in the media are perceived by people in society (Adams, Harf & Ford, 2014:2). Furthermore, the "Agenda-setting theory contrasted with the prevailing selective exposure hypothesis, reaffirming the power of the press while maintaining individual freedom" (Adams, Harf & Ford, 2014:2). One of the media's strongpoints in its agenda-setting endeavours is through the continuous repetition of certain news headlines (McCombs & Valenzuela, 2007:44).

3.2.4.4 *Media coverage of carbon capture and storage*

According to Rothmann-Guest (2014:xiii), information can be disseminated via established media infrastructures such as local newspapers and radio. The media has a role to play in the development of CCS technology, therefore, it is important to understand that the media can influence people's opinions or perceptions on CCS technology, depending on how such information is reported (Rothmann-Guest, 2014:10, 47). The media does not only regulate the flow of information or decide on its newsworthiness but also influence political agendas, public perceptions and policymaking through how the information is presented to the audience (Feldpausch-Parker, 2010:50).

Of the few news articles published about CCS technology in South Africa, CCS was mainly portrayed neutrally, however, some articles portrayed the technology negatively. Some of the CCS related media articles published in South Africa are listed in Table 3.1 below:

Table 3.1 Portrayal of CCS (Sourced from various print and online news platforms)

Publisher	Title	Portrayal	Year
1. Leadership Post	SaskPower hosts grad students for carbon capture research camp	Positive	2016
2. South Africa Information	South Africa approves CO ₂ capture plan	Neutral	2012

3. Independent Newspapers	KZN earmarked for CO ₂ dump	Negative	2013
4. Business Day	Norway renews carbon capture, storage pact with SA	Neutral	2015
5. Pretoria News	Carbon Storage mooted in World Heritage Site	Negative	2014
6. Independent Newspapers	SA World Heritage site under threat	Negative	2014
7. GCX Africa	Environmental Management – Wetlands	Negative	2014

By just reading the headlines in the table above, it is clear that the media can play a role in influencing the general public about CCS technology. It is in this regard that the agenda-setting theory is one of the critical theories to be considered in this study.

3.2.4.5 Criticism towards Agenda Setting Theory

Berger and Freeman, (2011:2) state that the emergence of online and social media has made the Agenda-setting theory irrelevant in recent times as the media has become more personalised than it was in the past. Pearce, Brown, Nerlich, and Koteck ((2015:3;4) highlight that whilst climate issues still feature in the mainstream media, the online environment has provided a new and expanding arena for such discussions, which has led to an increase in the of climate scientists participating in social media conversations. This is further supported by Williams, McMurray, Kurz and Lambert (2015:126) who observe that social media can reach many people due to the way the message is spread across various networks especially when it's viral or has some particularly interesting findings. This means that the agenda that the media might be trying to disseminate may be diluted before it reaches the targeted audience or individual. The new media has made it difficult for the mass media to develop uniform messages for their unique/personalised audiences and thus makes it difficult to transfer the message (Berger & Freeman, 2011:2).

Takeshita (2006:278-279) has identified critical problems have that could impact the agenda-setting theory negatively. These problems are discussed below:

3.2.4.5.1 The challenge of the nature of agenda setting

Takeshita (2006:279) states that agenda-setting does not automatically influence people's opinion on its own and is part of the overall process of opinion formation. Miller and Krosnick (cited Takeshita, 2006:365) demonstrate that participants who both trust the media and know a lot about politics had the strongest effect on agenda-setting. Among this type of participant, the variable of perceived importance was found to mediate the subsequent priming effect (Takeshita, 2006:365). These findings suggest that agenda-setting is not an unthinking and automatic process, but is mediated by inference. People actively learn from news journalists' views what are important problems facing the country (Takeshita, 2006:365).

3.2.4.5.2 The emergence of framing theory challenge

The 1980s saw the emergence of the framing perspective in the field of mass communication research (Takeshita, 2006:279). Unlike agenda-setting research which chooses to cover or disseminate information only on certain aspects of the societal issues, researchers in the field of framing theory explore how the media cover an issue or event (Takeshita, 2006:279-280). One feature of framing research is that it addresses the problems that traditional agenda setting has often neglected. Framing research examines the substance of a specific issue, while traditional agenda-setting research usually handles an array of issues, not looking into how an individual issue is constructed (Takeshita, 2006:280).

3.2.4.6 The development of communications technologies

The emergence of online media platforms seems to have had an impact on the agenda-setting model application in recent times (Berger & Freeman, 2011:2). The sudden rise of online media is challenging the idea that the theory of Agenda setting is still relevant to new horizontal media forms (Berger & Freeman, (2011:20). The advent of the Internet, more especially the social media, has provided the general public with a platform to not only become the consumers of information but also to distribute their information in a way that they want the message to be distributed to their targeted audience (Luo, 2014:1291).

3.2.5 Participatory Rural Appraisal Theory

The Participatory Rural Appraisal (PRA) can be described as methods or approaches that emphasise the importance of local communities' involvement in the appraisal, analysis and planning as well as the need assessment and evaluation of the projects by those who are likely to be affected by the deployment of such projects. (Alam & Ihsan, 2012:27; Uddin &

Anjuman, 2014:72). According to Chhetri (2017:3), community participation in a project includes the affected people's involvement during decision-making processes, programmes implementation, benefiting from the project and their involvement in evaluating the effectiveness and impact of such projects (Chhetri, 2017:3). PRA and its variants also continue to be used by government agencies, non-governmental, and community-based organisations in local-level assessment, planning, monitoring, and evaluation, as well as in national-level poverty assessments (Cornwall & Pratt, 2009:263). It is therefore important for the study to discuss the nature, origins, principles, application and challenges of the Participatory Rural Appraisal approach with more emphasis on the relevance of the approach in enhancing climate change and CCS technology communication in rural areas. Furthermore, the focus will be placed on how the approach could be used in determining people's understanding and perceptions towards CCS technology.

3.2.5.1 The origin of Participatory Rural Appraisal

The origin of the participatory methods came as a result of researchers, field practices and development experts trying to better more effective methods for the involvement of local communities in decision making for projects that affect the community (Alam & Ihsan, 2012: 26). According to Alam and Ihsa (2012:27), the Participatory Rural Appraisal (PRA) comprises of research techniques developed mainly in the 1970s and 1980s to find alternative ways of community involvement other than the top-down approach. However, in the early 1990s on the Participatory Rural Appraisal approach developed significantly in the international community (Cornwall & Guijt, 2004:165; Cornwall & Pratt, 2009:263).

Participatory Rural Appraisal (PRA) is regarded as one of the most effective ways to garner information from rural communities (Cavestro, 2003:3), because of its bottom-up approach which allows communities to be involved in determining the nature of development projects happening in their areas. The approach derives its basic principles from activist participatory research, agroecosystem analysis, applied anthropology and field research on farming systems (Uddin & Anjuman, 2014:72). The principles of the participatory rural approach will be discussed in detail below.

3.2.5.2 The principles of Participatory Rural Appraisal

The application of the Participatory Rural Appraisal (PRA) emphasises the importance of local communities' involvement in the appraisal, analysis and planning of the projects that affect them directly or indirectly. According to Cavestro (2003:3-4), any PRA activity comprises of the five key principles below:

3.2.5.5.1 Participation

PRA relies heavily on participation by communities (Cavestro, 2003:3). For example, local people should be involved in developing and analysing information that relates to climate change for them to understand the need to address its effects. In addition, for CCS projects, local people should be involved as early possible, especially once the potential issue has been identified.

3.2.5.5.2 Flexibility

The combination of techniques that is appropriate in a particular development context will be determined by such variables as the size and skill mix of the PRA team, the time and resources available, and the topic and location of the work (Cavestro, 2003:4). This means the project developers need to first understand the area they are working to enhance community participation in the project. It is also important to take note of the various segments of the community and be able to develop messages suitable for each sector of the community.

3.2.5.5.3 Teamwork

Generally, a PRA is best conducted by a local team (speaking the local languages) with a few outsiders present, a significant representation of women, and a mix of sector specialists and social scientists, based on the project (Cavestro, 2003:3). For CCS project developers, as well as climate change communicators need to rope in community members when developing their communication strategies to ensure that the local context forms part of the plan.

3.2.5.5.4 Optimal Ignorance

To be efficient in terms of both time and money, PRA work intends to gather just enough information to make the necessary recommendations and decisions (Cavestro, 2003:3). However, for complex projects like CCS, developers need to practice the principle of optimal ignorance by developing proper stakeholder matrix to ensure that relevant information is shared with the right stakeholders.

3.2.5.5.5 Systematic

The PRA- data is based on statistical analysis whereby small samples are utilised for data collection (Cavestro, 2003:3). However, for projects like CCS deployment, large segments of the community need to be represented. For example, in the context of South Africa, community gatherings such as imbizos, council meetings, makgotla and committee meetings need to form part of the communication or stakeholder engagement plans.

Although the PRA method is community orientated, that are certain challenges that could lead to its implementation, as well as challenges that may occur as a result of its application.

3.2.5.6 *Challenges of Participatory Rural Appraisal*

According to Thomas and Hodges (2013:7), community involvement efforts in project developments are perceived to be just a way of securing the community's approval for the project or decision that has already been decided upon. One of the main challenges for applying PRA for CCS projects is the fact the technology is still new and complex, therefore lack of knowledge on the technology can minimize hinder people's participation in the project (Yoro & Sekoai,2016:2). However, awareness-raising and capacity-building programmes can be used to train people about the basic concepts of the technology. It is time that remains one of the main challenges for the application of the PRA is the issue of time required with different segments of the community. For example, amongst factors hindering community participation in community development initiatives included constraints on time, labour and resources (Chifamba, E. (2013:16).

According to Modiko et al, (2014:7051) communication of CCS and the Pilot CO₂ Storage Project in local vernacular and jargon-free language of one of the main barriers to CCS communication. The communication barrier can be regarded as one of the obstacles for rural participatory communication. For example, high illiteracy levels in the areas such as UMhlabuyalingana Local Municipality whereby 54% of the adult population is functionally illiterate (UMhlabuyalingana Local Municipality, 2017:49) can hinder public participation.

Despite the obstacles cited above, Chambers (1995:1) and Duraiappah, Roddy and Parry (2005:3) regard Participatory Rural Appraisal as an evolving approach. The PRA method remains relevant because projects are likely to be more effective since the local people were involved in drawing up the plans (Heaver, 2001:2). Heaver (2001:2) further explains that PRA can increase local people's understanding of their developmental challenges opportunities, as well as to have a say in the development plans proposed to their communities. The approach allows the concerned communities to participate effectively in the project throughout the life-cycle of the project.

3.3 CONCLUSION

This chapter focused mainly on analysing theories that are relevant to the various development communication and participatory approaches were analysed. The development support communication model placed more emphasis on direct communication or involvement of those who are likely to be affected by the deployment on CCS technology. The participatory approach model focused on how the model's two-way participation approach can have an impact on how CCS technology and climate change are viewed and perceived by various sets of stakeholders. With CCS still being regarded as a new technology, the Diffusion of innovation approach focused on how it can be communicated to all relevant stakeholders, as well as various stages through which a technology can be communicated to the stakeholders. Due to perceived media coverage, the Agenda Setting theory's focus is on how media coverage could impact people's perceptions and understanding of the technology.

The next chapter will focus on the methodology of the study, focusing mainly on sampling techniques, data collection methods, interpretation and analysis techniques, as well as various research, approaches applied in the study.

CHAPTER FOUR

RESEARCH METHODOLOGY AND DESIGN

4.1 INTRODUCTION

Chapter three focused on providing the theoretical framework of the study, with more emphasis on the development of communication-related theories. This chapter will focus on providing a detailed overview of the research approach and methodology that was used in this study. An appropriate research approach can be regarded as part of the most important requirements on a research study and it is expected that when the researcher reaches this stage, they should at least have a picture of what needs to be achieved by conducting the study (Davis, 2014:14). The research approach, according to Davis (2014:93), helps the researcher to conduct a study that is free from biases, [time efficient] and is economically feasible. In the following sections, the approach and methodologies that were used in this study are described.

4.2 RESEARCH DESIGN

A research methodology can be defined as a researcher's plan of action which outlines how a study is to be conducted through a description of various components to address the research questions and problem (Chomba, 2013:26). A research design is the research's overall plan or structural outline that guides the process of conducting the study (Chomba, 2013:26; Davis 2014:93). Furthermore, according to Creswell (2014:11-12), researchers can be either use qualitative, quantitative or mixed methods. Research approaches act as procedural guidelines for a researcher when conducting their studies (Chomba, 2013:26; Creswell 2014:11-12).

4.2.1 Units of analysis

The unit of analysis is one of the critical components in analysing qualitative data that helps the researcher to decide on the data that can make a meaningful contribution to a study (Babbie, 2016:98; Chenail, 2012: 266). The unit of analysis can be in various forms, such as objects or people, depending on the type of the study (Babbie, 2016:98; Bhattacharjee, 2012:9). In this study individuals were the units of analysis.

4.2.2 Population and sampling

According to Davis (2014:97), the research population is the collation of people or things in the universe that the researcher has identified to be the main sources of information for the study being conducted. According to Pascoe (2014:135), a sample that is representative of the population is required to conduct a study in a manner that is viable, and hence researcher needs to ensure that the selected sample represents the targeted population (Pascoe, 2014:135). However, since this is a qualitative study, a representative sample is not required since a deeper understanding is sought by using a smaller sample size.

4.2.2.1 Study population: Gauteng North and Johannesburg Regions

The study population for this study is based in Gauteng province's North and Johannesburg regions. Gauteng province has a highly developed economy that is based on fossil fuel energy sources, making the province one of the significant emitters. For this study, the selected sample will be drawn from the Gauteng North and Johannesburg regions, specifically, members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). Since this is a qualitative study, the sample does not need to be representative of the bigger population. The focus in the selection of a population was the accessibility of participants and their expert opinions of the topic.

4.2.2.2 Sampling

According to Pascoe (2014:143-144), factors such as time, resource availability, research purpose, error allowance and budget should be taken into consideration when deciding on the sampling method (Pascoe, 2014:143-144). Because of limitations such as budget, resource availability and the objectives of the study a non-probability sampling method will be used in the study. According to Pascoe (2014:135, 145), the non-probability sampling methods such as snowball and purposive sampling are relevant for qualitative studies as long as the purpose of the research is not to be generalised to the larger population. In this study, the purposive sampling, supplemented by the snowball methods will be used. The main objective of using purposive sampling is to sample cases or individuals in a way that those selected are relevant to the study under investigation (Bryman, 2015:408). With this method, the researcher selects samples that are or will be relevant to the research questions posed to the participants without generalisation of results or findings (Bryman, 2015:408). Consequently, purposive sampling involves the process of targeting individuals with specific characteristics to participate in a research study (Gideon, 2012:67).

One of the disadvantages of purposive sampling is that it is driven by a certain purpose that the researcher has in mind. Hence, the sample is selected to include people who might have some interest and exclude those who do not suit the purpose of the study. However, since the goal of the study is to generate a deeper understanding and a rich in-depth exploration, it makes sense to sample people who have some insight or knowledge about the technology (Etikan, Musa & Alkassim, 2015:10). Despite the possible biases of the sampling method, it should be borne in mind that this study is a qualitative study and the intent is not to generalise findings beyond the context of the population or population parameters.

In order to strengthen the sample selection using the purposive sampling method, snowball sampling technique was also used when selecting the sample. Snowball sampling involves requesting a small number of interested individuals to provide referrals to increase the sample size (Pascoe, 2014:135; Paul et. al, 2014:116). Pascoe (2014:135) further elaborates that participants in the study could suggest the names of people who could fit or want to form part of the research (Pascoe, 2014:135). According to Etikan, Musa and Alkassim (2016:1), a disadvantage is that the recommended participants often share the similar characteristics or opinions with the initial participants, thus making it difficult to have sufficient variance of the selected sample. The advantage of using snowball sampling in qualitative research is that “the researcher is deeply involved in developing and managing the origination and progress of the sample, and always ensures that the chain of referrals remains within limitations that are relevant to the study” (Etikan et.al, 2016:1).

One of the most critical aspects, once the sample has been determined, is to establish when the data saturation point has been reached (Fusch & Ness, 2015:1048). In addition, Pascoe (2014:137) refers to data saturation point as the state in which the researcher is unable to get new information or data from the participants.

The research was conducted in a manner that minimises costs, whilst also ensuring that the sample size and method used are not time-consuming (Pascoe, 2014:145). Furthermore, the availability of resources was considered when selecting the sample for the research study to be successful. Consequently, the sample size was seven participants including three from Eskom Expo for Young Scientists Gauteng and four from the Gallery of Academic Leaders.

4.3 RESEARCH METHODS

The research methods used in a study ensure that the researcher collects, analyse and interpret data as unbiased and free from presumption as possible (Creswell 2014:295). Strydom and Bezuidenhout (2014:175) indicate that to ensure the trustworthiness of a qualitative study, the data collection, analysis and the interpretation methods need to align with the research goal and questions. Accordingly, since the study aims to describe the subjective experiences and meanings of participants associated with climate change communication, perception and understanding, qualitative data collection, analysis and interpretation methods were most suitable. The following sections describe the research methods chosen for data collection, analysis and interpretation.

4.3.1 Data collection methods

Murgan (2015:266), regards data as an integral part of any research study and therefore, it is important to select a data collection method that will be suitable for the study as it enables accurate data collection. Qualitative data collection methods allow a richness and in-depth understanding of data gathered in a specific context of complex and multi-faceted phenomena (Strydom & Bezuidenhout, 2014:173). Consequently, in-depth interviews were selected as a data collection method to allow detailed descriptions and convey an intimate and subjective portrayal of participants' experiences.

4.3.1.1 *In-depth semi structured Interviews*

A semi-structured in-depth interview is one of the key instruments for collecting data in qualitative research and can be described as a form of conversation to collect data based on open-ended questions. (Babbie 2014:263) Strydom and Bezuidenhout (2014:189) describe in-depth interviews as one of the qualitative data collection methods that allow gathering participants' views, beliefs and opinions on a specific topic. The advantage of using this method to collect data is its flexibility and open-endedness and the potential to focus mainly on people's actual experiences more than the general beliefs and opinions (King & Horrocks, 2010:13).

However, completely structured interviews have disadvantages, as they are likely to provide the interviewer and the participants with little freedom, as well as the possibility of omitting concepts not included in the initial interview questions (Alshenqeeti, 2014:40). For this study, semi-structured questions will be asked to the participant's in the form of face-to-face

interactions as it allows the interviewer the opportunity to expand on or probe the responses from the participants (Alshenqeeti, 2014:40).

4.3.2 Data analysis and interpretation methods

Data analysis and interpretation form the basis of the findings, recommendations and reporting of a research study (Davis, 2014:16). Flick (2013:5) and Nieuwenhuis (2007:99-10) described qualitative data analysis tends to be an ongoing and iterative process that is used for the classification and interpretation of through various data collection, processing, analysis and reporting methods that are intertwined. In the following sections, the data analysis and interpretation methods selected will be described.

4.3.2.1 Data Analysis

According to Grbich (2013:1), the processes of data analysis in a qualitative research study are complex, as it is not only a matter of the researcher selecting and applying a universally accepted process such as statistics (Grbich, 2013:1). In qualitative research, data analysis is guided first by the researcher's views and choices, his or her impact on the data that is collected and analysed through the duration of the study (Grbich, 2013:1). Secondly, data analysis is also reliant on the research design and methods utilised, the quality of the gathered and the way in which the researcher managed the collected data (Grbich, 2013:1). This means the researcher must not only focus on collecting the data but must collect quality data that is relevant to the study and be able to manage it.

Babbie (2014:382) describes qualitative data analysis as the “nonnumerical examination and interpretation of observations to discover underlying meanings”. It is a complex, arduous and time-consuming process of making sense of an often bewildering mass of data (Bezuidenhout & Cronje 2014:233). Qualitative data analysis involves the process of reducing the mass of data collected, sifting for importance, identifying patterns and thus, giving data collected structure and meaning (Schurink, Fouché & de Vos, 2011:397).

Data analysis thus involves organising data, breaking it down into parts and recombining these parts, seeking patterns and identifying key parts of the data. (Bezuidenhout & Cronje, 2014). For this study, qualitative content analysis will be conducted. In conducting qualitative content analysis, a researcher uses systematic coding to identify themes and patterns in textual data (Strydom & Bezuidenhout, 2014:191). The researcher needs to identify themes and patterns

in the transcribed data to provide a dense description of the text (Strydom & Bezuidenhout 2014:191).

Qualitative content analysis was used in this study. Hsieh and Shannon (2005:1278) define content analysis as “a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns”. Qualitative content analysis and coding are interrelated processes and embody iteration between data analysis, interpretation and context (Bezuidenhout & Cronje, 2014:232; Neale, 2016:1098).

Qualitative content analysis is used for descriptions of participants reflecting on how they perceive the social world (Hashemnezhad 2015:60). “Qualitative content analysis pays attention to unique themes that illustrate the range of the meanings of the phenomenon rather than the statistical significance of the occurrence of particular texts or concepts” (Hashemnezhad 2015:60). Although qualitative content analysis is generally inductive and based on inferences made from data, it may involve both inductive and inductive processes (Hashemnezhad 2015:60; Strydom & Bezuidenhout 2014:234). Hsieh and Shannon (2005) identify three approaches to content analysis, namely: conventional, directed and summative content analysis. Directed content analysis aims to validate or extend a theoretical framework or theory conceptually by utilising existing theory or prior research through identifying key concepts as initial guiding coding categories (Hsieh & Shannon, 2005:1281).

Raw data gained from the interviews were transcribed into written text. Data was organised into more manageable units by defining the basic ideas or codes with either words or phrases, ensuring that each relevant theme is assigned a code. Coding units were developed both deductively, based on the literature review drawing on existing research as well as relevant theories, and inductively based on the data. Hence, existing research and theories described in the theoretical framework were used to code the text. The coding process will be discussed in more detail in Chapter Five.

4.3.2.2 Data Interpretation

Thematic analysis will be used for the interpretation of data. Thematic coding, also known as conceptual coding and used interchangeably with qualitative content analysis, involves reducing the data by identifying themes (Strydom & Bezuidenhout, 2014:232). “Thematic

analysis is a method for identifying, analysing, and reporting patterns (themes) within data“ (Braun & Clarke, 2006:78).

Certain aspects of thematic analysis are simultaneously potential pitfalls and advantages. An important strength of the thematic analysis is that it is flexible and can be used to answer most research questions (Nowell, Norris, White, & Moules, 2017:2). However, the flexibility of the method presents the danger of identified themes being arbitrary if the researcher is unclear what these themes represent, especially if they are not located within a defined theoretical and epistemological framework (Willig, 2013:58). Furthermore, researchers may be committed to creating codes based on existing literature and may ignore or dismiss new insights which emerge from the data (Willig, 2013:65).

These possible disadvantages may be avoided, however, by grounding the study in a defined theoretical framework, using the previous literature to guide the research rather than to manipulate it (Willig, 2013:65). With a solid framework and a clear idea of the questions which are the focus of the study, thematic analysis is considered well-suited to questions regarding social phenomena, media representations and social issues (Willig, 2013:59).

4.4 TRUSTWORTHINESS OF THE STUDY

In qualitative research, which includes elements of subjectivity and interpretation which cannot be measured objectively, trustworthiness is the overarching term used for determining the validity and reliability and the level of credibility of a study (Gray, 2014:185; Koonin, 2014:258). Trustworthiness consists of four categories including, credibility, dependability, confirmability and transferability (Lincoln & Guba, 1985 cited in Koonin, 2014:258). In order to confirm the trustworthiness of this study, the researcher has safeguarded the overall process of data collection, interpretation and analysis to ensure that the study was credible, dependable, confirmable and transferable.

4.4.1 Credibility

According to Koonin (2014:258), the credibility of a study refers to how accurately the researcher interpreted the data gathered from the study participants. In order to maximise the accuracy of interpreting the collected data, the researcher spent a reasonable time with the participants to understand and gain insight into their perceptions and subjective experiences.

4.4.2 Dependability

Koonin (2014:259) states that dependability refers to the quality of the integration that takes place during the processes of data collection, data analysis and the theoretical position developed from the data gathered. In order to ensure the dependability of this research, the researcher developed and described a methodology that guided the overall research process., The definition of concepts, literature review, theoretical analysis, the use of traceable sources, and ensuring that recordings and transcripts of the primary data collected were safely stored and all information used in the study were properly documented, enhanced the dependability of the study. Each stage of data collection, analysis and interpretation have been detailed in as rigorous and clear a manner as possible, so that the systematic processes of the research are easily identifiable and understandable.

4.4.3 Confirmability

The data collected during the duration of the study should be able to feed into and support the researcher's findings and interpretation thereof (Koonin, 2014:259). Anney (2014:279) states that the confirmability of a research study refers to the degree to which the results of an inquiry could be confirmed or corroborated by other researchers. Confirmability is concerned with ensuring that data analysis and interpretation are not the fabrications of the researcher's imaginings, but are derived from the data (Anney, 2014:279). To ensure that the collected data is confirmable, a second expert coder was used.

4.4.4 Transferability

Transferability refers to the process in which the qualitative research findings can be contextually transferrable to, or used by other researchers (Anney, 2014:277). In order to ensure that the study is transferrable, the researcher is often required to facilitate the process for a potential user through thick description and purposeful sampling (Anney 2014: 278). The basis here is to ensure that the research findings can be applied to a similar situation and produce similar results (Koonin, 2014:258). Consequently, descriptions of data and interpretations have been made as detailed as possible, to ensure that the knowledge produced through the study could potentially aid in the understanding of similar topics.

Over and above ensuring that the study is trustworthiness, the researcher also adhered to several aspects of ethical conduct throughout the study's lifecycle as guided by Monash University South Africa Research Ethics. The researcher received approval from the Monash

University Human Research Ethics Committee (MUHREC) before commencing with the study. The researcher also received consent from individuals and organisations that formed part of the study. The researcher acknowledged the authors of all the information sources that were used in the study.

4.5 CONCLUSION

This chapter focused on providing the methodology, approach and methods that were being used for data collection, analysis and interpretation. In-depth interviews were selected as the data collection method for this study. Purposive sampling method was utilised as the Gallery of Academic Leaders and Eskom Expo for Young Scientists were identified as a suitable population. The next chapter will focus on the description of the processes data collection, analysis and interpretation used in this study.

CHAPTER FIVE

DATA COLLECTION, ANALYSIS AND INTERPRETATION

5.1 INTRODUCTION

Chapter Four focused mainly on describing the research design and methodology applied in the investigation into the factors in the perceptions, understanding and communication of climate change and CCS technology in South Africa. This chapter is dedicated to describing and presenting how data collection, analysis and interpretation were conducted. A conceptual framework is presented and the coding process used is described.

5.2 DATA COLLECTION

Data was collected by interviewing participants from the *Gallery of Academic Leaders* and *Eskom Expo for Young Scientists*. Both organisations are non-profit organisations based in the Gauteng province of South Africa. The *Gallery of Academic Leaders* aims to empower learners and students from previously disadvantaged communities through the provision of information that will enable them to make informed decisions about their future (Do It for Charity, 2018). *Eskom Expo for Young Scientists* is a science fair, where students can exhibit their scientific investigations (Eskom Expo, 2018). Both organisations granted permission to interview some of their members as part of the study. In total seven (7) participants were interviewed including three from *Eskom Expo for Young Scientists* Gauteng and four from the *Gallery of Academic Leaders*.

5.3 PARTICIPANTS PROFILE

The participants are both working professionals and students. Both participant groups were over the legal age limit for adulthood in South Africa. All participants were provided with explanatory statements and were requested to sign consent forms before the interviews took place.

Below is the profile of the participants:

- Participant #1

Participant #1 is a male working professional in the Library and Information Services

- Participant #2

Participant #2 is a male working professional in the Chemical Engineering

- Participant #3

Participant #3 is a female graduate in the Media Sector

- Participant #4

Participant #4 is a male working professional in the Public Relations sector

- Participant #5

Participant #5 is a female working professional in the Environmental Sciences

- Participant #6

Participant #6 is a female working professional in the Renewable Energy Sector

- Participant #7

Participant #7 is a male working professional in the Customer Services

The participants were purposively selected by the researcher from the two organisations. The interviews were conducted between August and September 2018. In order to analyse the data, audio recordings were then transcribed into text. Once the data was collected and transcribed, a conceptual framework was developed to facilitate the coding process.

5.4 CONCEPTUAL FRAMEWORK

A conceptual framework is described as “a system of concepts, assumptions, expectations, beliefs and theories that supports and informs research” (Yamauchi, Ponte, Ratliffe & Traynor, 2017:11). Either in narrative or graphical form, it is used to provide guidance and coherence to the inquiry of a phenomenon by emphasising key factors and concepts (Imenda, 2014:189; Yamauchi, et al, 2017:11). The conceptual framework and multi-dimensional coding scheme developed and represented in Fig. 5.1 and Fig. 5.2 are based on concepts and constructs derived from the literature and theories presented in Chapters Two and Three. The broad dimensions focus on climate change and CCS factors. Consequently, the conceptual framework includes categories and dimensions representing aspects of climate change, and carbon capture and storage. Each dimension was sub-divided into three categories including perception, understanding and communication.

The perception categories in both graphic representations refer to how both climate change and CCS technology are perceived. McGee-Chiusan (2015:14) defines perception as a process through which humans, through their frames of reference, judge the world around them and its impact on their well-being. Capstick (2013:1) states that climate change is often referred to as one of the most complicated challenges facing humanity and, due to its complexity, the public may not be able to judge CCS properly, especially based on its ability to address climate change (Terwel, 2009:11). Therefore, these categories in Fig. 5.1 and Fig. 5.2 detail factors relating to the understanding of climate change and CCS technology.

The third category is based on the communication factors of climate change and CCS technology. Scholars like Rudiak-Gould (2012:120) and Ashworth (2010:10) have indicated that their complex natures tend to make it difficult to communicate. Ashworth (2010:10) indicates that it is mainly because the causes of climate change are often not discernible to laypersons. Additionally, there is a need to identify both communication content that is easily understood and preferred engagement methods (Ashworth 2010:10). In this regard, this category details factors in both the communication of climate change and CCS technology dimensions.

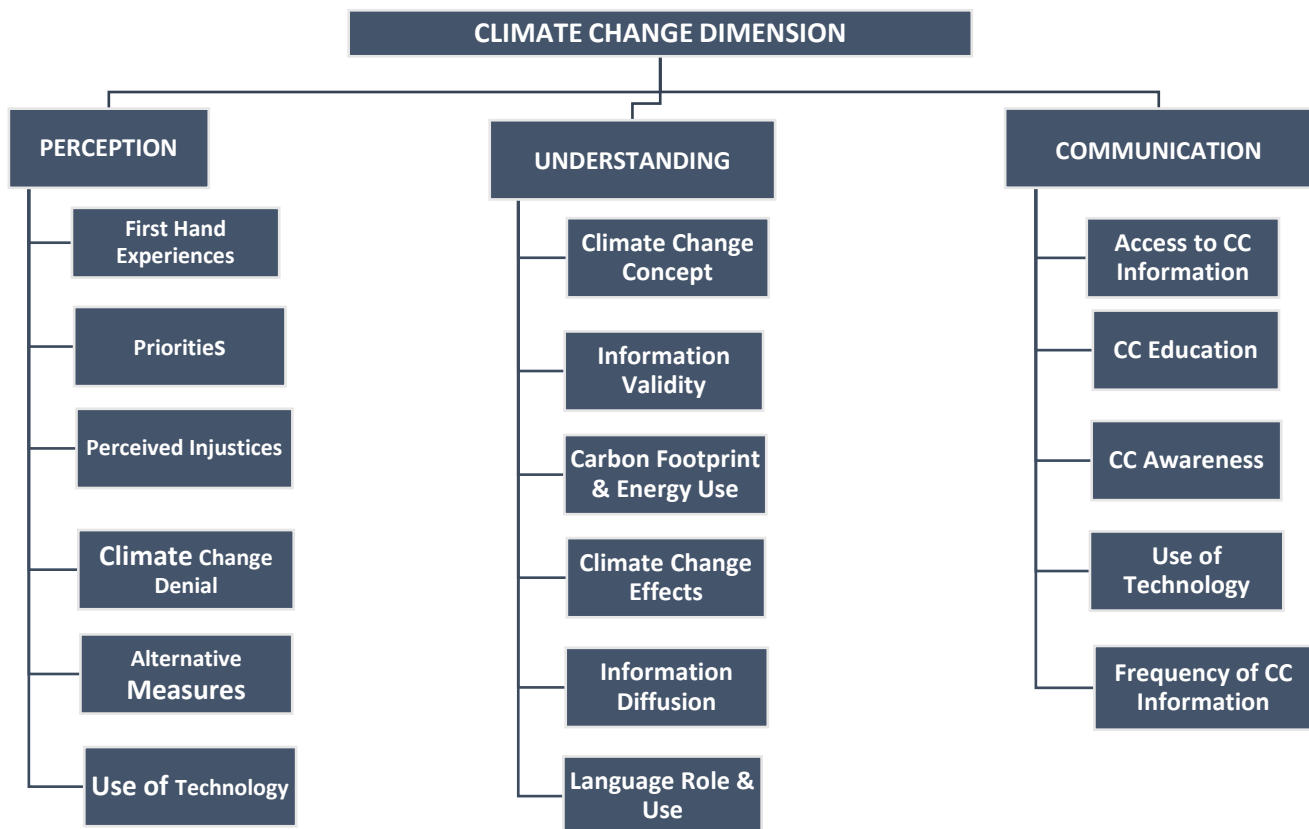


Fig. 5.1 Conceptual framework: Climate Change

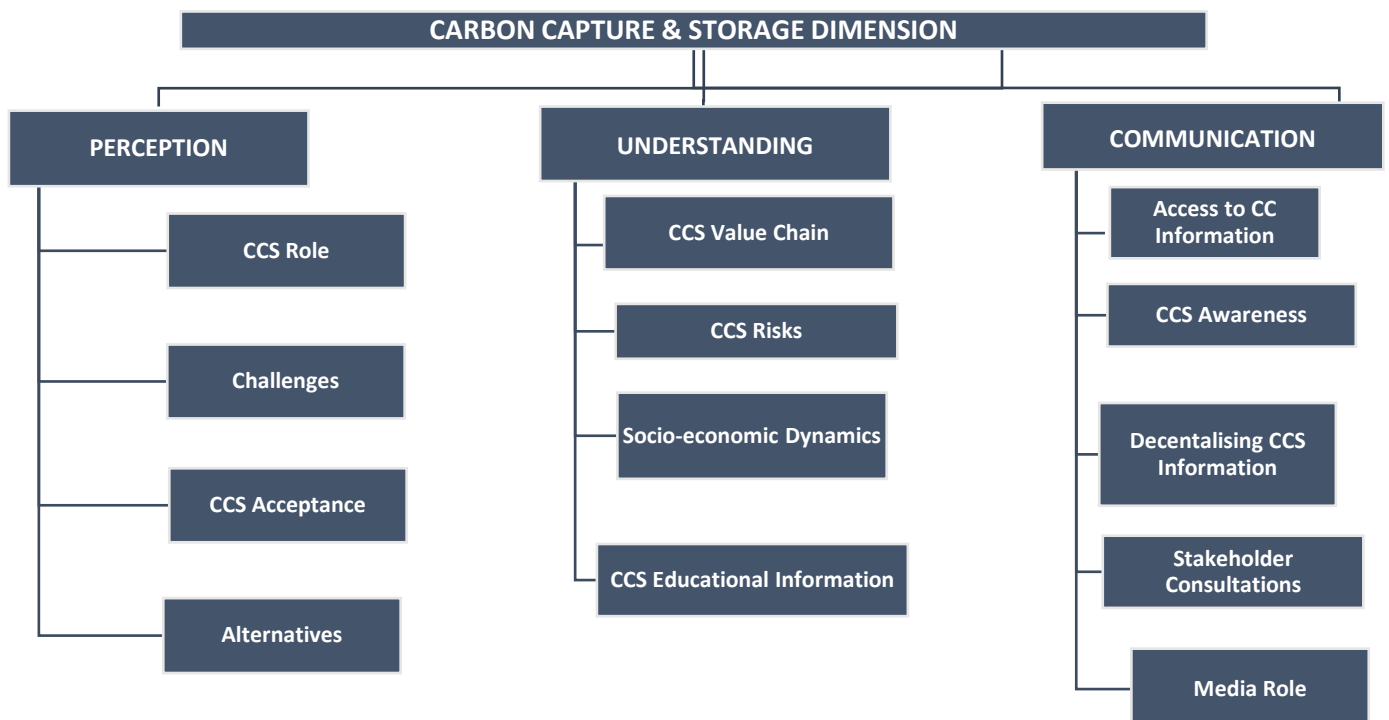


Fig. 5.1 Conceptual framework: Carbon Capture and Storage Dimension

5.5 CODING

Coding refers to a method used to organise the data so that underlying messages portrayed by the data may become clearer to the researcher (Theron, 2015:4). A combination of keywords and phrases was used as the coding units and a multi-dimensional coding scheme was developed based on information gathered from the literature and theories presented in Chapters 2 and 3.

Various coding processes were used as part of data analysis. Open coding, which is sometimes referred to as initial coding and involves the process of breaking the qualitative data down into distinct parts and using *in vivo* coding, as this helps the researcher to examine the identified data closely and compare them for similarities and differences (Theron, 2015:5). The second method of coding applied was axial coding which serves to refine and differentiate concepts that were already identified through the open coding process. In axial coding, one main category may be located at the centre and a connection or network of relationships is developed around it (Bezuidenhout & Cronje, 2014:241; Böhm, 2004:271).

Following these coding processes, selective coding was used as a way of selecting core and essential data. Selective coding is the process of selecting core or essential data that corresponds or relates to all categories and subcategories (Bezuidenhout & Cronje, 2014:241; Theron, 2015:6). This method allowed the researcher to align and link the categories with subcategories. Lastly, thematic coding, a method in which the identified categories were developed into themes was used. Bezuidenhout and Cronje (2014:241) describe thematic coding as a process of data reduction by means of identifying themes. Table 5.1 below represents the main themes identified from the dimensions in the conceptual frameworks alongside the main and sub-themes and the codes utilised for coding and analysis.

Table 5.1 Codes and themes

Climate Change and Carbon Capture and Storage Coding Dimensions		
Main Theme	Communication = CCC	Codes
Sub-Theme Information Access= IA		Limited access to information = LAI (C-C); Information Availability = IA ; Information Sharing = IS ; Scientific information = SI ; Public Domain = DP ; General Public = GP .
Sub-Theme Awareness = A		Lack of Climate Change Awareness = LCCA ; Constraints = LCCA-C ; Limited Media Coverage, Awareness Programmes, Awareness Initiatives, urban-rural divide with regards to access and communication infrastructure.
Education = E		Climate Change Education = CCE , improving education, Level of Education, Number of Options, Discussions On Climate change, Exposure, Educate Kids, Educate and Empower the people of rural settings.
Technology Use = Tu		Technologies in Information Dissemination = TID ; Communication Channels, Mass Media Platforms, Broadcast Information.
Communication Frequency = CF		Limited Effectiveness = LE , lack of information and knowledge, not yet versed, social media, the emergence of online and social media, reach, new media, ordinary publics.
Information Decentralisation = InfD		Communication is still Concentrated Within the scientific community = CSC , scientific concept, technology perception, creating more awareness, consultation

Stakeholders = Sth		Consult The People = CP , decision-making processes, people’s involvement, dialogue and information sharing, affected
Media = M		Mainstream and Social Media = MSM , promotions, outreach, information distribution, influence,
Main Theme	Understanding = CCU	Codes
Sub-Themes Information Validity = IV		The validity of climate change information or data = V , published, non-scientific, peer-reviewed, accessibility, opinions, discrediting, varying views.
Carbon Footprint = CFp		Knowledge of Carbon Footprints, cut off emissions, Reducing the CO ₂ Human Behaviour, Causes, Industrial Revolution, fossil fuels, the individual’s contribution
Energy Use = Eu		
Knowledge = K		
Effects = E		Climate Change Effects = CChE , hard to identify, observed directly, droughts, flooding, extreme weather changes, the supply of food, water shortage
Information Diffusion = ID		Scientific Opinions and Explanations = SOE , Reliance on Media, Reliance on Experts, information diffusion, information interpretation, opposition, campaigns, anti-climate change
Language = L		Local Language = LL , jargon, scientific language, scientific phenomenon, simple language, Use of English, vernacular language, learning material
Mitigating = M		CCS technology role, safe storage, mitigating against climate change, impressions of CCS technology.

Value Chain = VC		The risks of CCS technology, understanding of CCS technology, stages of CCS technology, safety,
Main Theme	Perceptions = P	Codes
Sub-Themes First-hand Experience = FhE		Agreement on climate change existence = ACCE , reality, scepticism, flooding, rainfall patterns, denial,
Priority = P		National Priorities, poverty, behaviour patterns, daily livelihoods, habits, new ways of life
Injustice = Ij		Beneficiaries, victims, fault, ecosystem, future generations, rural, urban, poor, agriculture, regulations
Uncertainties = Uc		Political will, evidence, discourses, agriculture, doubt on climate change, changing seasons,
Measures = M		Electricity production, solar energy, renewable electricity,
Risks = R		Concerns, leakage, disaster, underground water, contamination, effects, reject
Alternatives = A		Coal use, renewable energy, environment.

5.6 DATA ANALYSIS AND INTERPRETATION

Qualitative data analysis involves a combination of approaches that utilises the analysis of raw data such as overviews and summaries and includes the elaboration of categories, hermeneutic interpretations or identified structures (Flick, 2013:5). The following section presents the analysis data in terms of each theme and its respective sub-themes and the interpretation of the data. In a qualitative study, the analysis and interpretation of data are processes involving often boundless and seamless cycles of analysis and interpretation

(Bezuidenhout & Cronje 2014:230). Meaning emerges from recombining the analysis and interpretation processes (Bezuidenhout & Cronje 2014:230).

5.6.1 Climate Change

The climate change dimension is divided into three sub-categories namely: (i) climate change perception; (ii) climate change understanding; and (iii) climate change communication. Identified sub-categories were then divided into codes and themes. The codes, themes and sub-categories are discussed below.

5.6.1.1 *Communication of climate change*

This section focuses on climate change communication factors such as access to information, climate change education, climate change awareness, use of technology to communicate climate change and the frequency of communicating climate change information.

5.6.1.1.1 Access to information about climate change

The overall opinion of participants was that climate change information available in the public domain is limited in its availability in terms of periods and its publication in specific columns or sections that the general public hardly reads.

There is still a gap like in terms of communicating or sending a message to the people because the message now is still confined within certain groupings. - Participant 2.

Information is limited which makes it difficult for people to be aware of climate change and its effects and this is not in line with the principles of the Development Support Communication (DSC) model which promotes the use of all relevant structures, methods or stakeholders to distribute or share the information (Pannu & Tomar, 2010:52). In the DSC model, it is highlighted that different means of communication must be utilised and the messages must be tailor-made for each intended audience (Shahzad & Bokhari, 2014:2). The model further encourages interaction with those directly or indirectly affected by climate change (Shahzad & Bokhari, 2014:2).

Participants also mentioned that although climate change impacts negatively on people's lives, most current and crucial information is mostly available in the niche and scientific circles instead of being disseminated to the general public.

Our people are not really educated so new concepts don't affect them much and don't really impact them that much and they are not considerate so now they are used to

what they are used to do back then and with climate change for them to adapt and to start to live with what is happening and adjust they are not able to do so. – Participant 5.

The participants also noted that one of the few times that they get to know about climate change is when there are international summits in countries like Switzerland and the information is widely shared on both social and traditional media.

I don't hear about it often enough in any form social media, current news unless there is a summit in Switzerland or something. That's the only time I hear about it or when countries are arguing about policies but on everyday news it is not there. – Participant 4.

Markowitz, Hodge and Harp (2014) support these opinions that climate change has been understood primarily as a scientific concept existing outside the day-to-day context of the public. The problem of access to information on climate change is compounded by the fact that even on the platforms where the scientific information is available, there is disagreement on the existence of climate change. For example, the efforts to mitigate or address climate change are often invalidated by climate change sceptics, who cast doubt on climate science (Jylhä, 2016:15; Mckie, 2018:64).

Some of the participants admitted that they have access to climate change information in the public domain, but the challenge is that the general public hardly sees climate change as a priority. Some of the participants recalled campaigns like *Basa nje nge Gogo* from years ago.

It is education and I believe some departments have started for instance there is that initiative that was called Basa nje ngo Gogo. That was to teach people that are dependent on coal and open fire for heat how to start a fire that will have less smoke less emissions of CO₂. So those kind of initiatives have started. Do I think they are enough? They could be enough but because we live in a country where there are other things to worry about like food, security, the climate change topic is not as big because we are worried about health care we are worried about education, climate change is at the back. – Participant 3.

Based on the statement above, seemingly people are more likely to be interested in basic issues that affect them directly like education, food and security, while climate change information appeals to a specific audience and has limited significance for those who are not directly affected by it. Furthermore, in cases where climate change is mentioned, the focus is usually on the disastrous effects of climate change like tsunamis instead of clearly articulating

what climate change is. When it comes to accessing climate change information, the general consensus was that it is usually left to the individual to do his or her reading to be better informed. The participants who indicated that they have information on climate change admitted that they did their reading of academic sources.

5.6.1.1.2 Climate change awareness

The participants mentioned that there is a noticeable lack of climate change awareness in South Africa while there is significant awareness on a global level. Glazewski et al (2012:39) observe that some of the variables that contribute to constraints in climate change awareness include multiple languages and religions as well as prioritising the need to meet daily basic human requirements. The participants who had this viewpoint mentioned three key issues which are discussed below. Firstly, the participants noted that there are hardly any articles on climate change awareness available on mainstream media.

We do not have enough airtime on the media. - Participant 3.

Secondly, participants hardly knew of any climate change awareness program by the Department of Environmental Affairs which is supposedly in charge of climate change information dissemination.

I am not aware about it but I just know that the United Nations are trying to talk about it but is funny how they are going about it. - Participant 5.

Lastly, besides the Department of Environmental Affairs, none of the participants recalled an initiative by a government agency which visited a school or a village to educate communities about climate change.

Yes, so the Department of Environmental Affairs they have got a number of initiatives that are driving. One was to prioritise some of the programs that look at how to mitigate against climate change and looking at the long term scenarios if we don't do something what will be the effects of climate change. Over and above that you find some environmental NGOs that are really pushing away from the using of coal and the usage of renewable energy which is sort of one of the strategies which be able to fight against climate change. – Participant 4.

As seen from the quote, the information provided does not specifically mention a programme or awareness initiative but rather speaks of awareness campaigns in general terms. One of the common narratives running through most of the responses is the fact that the sooner people are made aware of climate change; the sooner they can change their energy consumption so that they can reduce their carbon footprint. The main concern is that the public

is not even aware that they are seriously contributing towards environmental degradation at a time when they should be adopting measures to mitigate the impact of climate change.

It also emerged that there is an urban-rural divide as far as information access is concerned. For example, one of the participants noted that, because of the very fact that they stay in urban areas, they are aware of some of the initiatives like solar street lights. Additionally, because most of the climate change information is distributed through the Internet, rural dwellers are at a disadvantage since penetration is less than in urban areas due to weak network signals and limited access. For example, Shahzad and Bokhari (2014:2), in their description of the DSC model's philosophy, highlighted the importance of communicating and educating people in rural areas on any development taking place in their area. One of the challenges raised in the DSC model is that communication is not technological or media-based. Rothmann-Guest et.al (2012:31) state that communication in rural areas is faced with infrastructure-related challenges mainly because of the remoteness of their areas and affordability challenges.

5.6.1.1.3 Climate change education

Participants noted that little education on climate change occurs. The importance of improving education in climate change mitigation, adaptation, impact reduction, and early warning was identified by Osborn, Cutter and Ullah (2015:18) as one of the ways of mitigating climate change. The participants specifically cited the government as not doing enough and indicated climate change education should be promoted on various platforms.

I think climate change should be a subject at your primary level of education and your middle or senior level of education your high schools. I for one believe that is where we should start, educate our kids and our kids will take the message home because if we don't educate our kids our kids are key role players of campaigns and education in our society. - Participant 1.

This statement indicates that there is a need to ensure that climate change information and civic education are made available. The DSC model highlights that there is a need to educate and empower people in rural settings about any change or development through participation (Shahzad & Bokhari, 2014:2). Once the community is empowered with climate change information and are allowed to participate in related discussions, they are more likely to be educated on the concepts. Participants acknowledged the importance of climate change education and proposed that once the public is exposed to the various discussions on climate change, they will be more aware of the number of options they have to adopt a 'cleaner' lifestyle to mitigate climate change.

5.6.1.1.4 Use of technology to communicate climate change

The participants mentioned radio, televisions, smartphones, the Internet and social media in particular as technologies that may enable the dissemination of information on climate change.

All the media information is transferred through technology. So technology has a role to play like your radio, more commercials, more shows on that, I think in terms of media it is easy to transfer the information. – Participant 2.

This statement is affirmed by Sahin (2006:14), who indicates that communication channels are key elements when it comes to the dissemination of new information. Communication allows the transmission of information about new ideas or inventions either through the use of mass media platforms or interpersonal communication channels (Greenhalgh, Robert, Macfarlane, Bate & Kyriakidou, 2004:8). Specifically, social media can also be used to disseminate information which can be spread quickly when users share it within their respective social circles.

Technology can play a major and an integral part on this issue because now everyone is on social media. Either on Facebook, Instagram or Twitter, if we talk more about it people will then be captured by it and they will learn a lot by it. - Participant 5.

While radio and television can be used to air and broadcast information and facilitate discussions on climate change, smartphones can also be used to push information to the individual user.

5.6.1.1.5 Frequency of communication of climate change information

When it comes to the limited effectiveness of the climate change information, the common opinion was that most people saw it online usually coming up in Internet searches and hardly from mainstream media. Most importantly, those media platforms that are closer to the general public like community newspapers, community radio stations and community television channels seldom cover issues of climate change. This leaves the coverage to large national and international media outlets that are disengaged from the general public. Some of the participants hypothesised that the reason why there is limited communication on the media platforms that are closer to the general public is because of their relative lack of information and knowledge on the subject.

I believe that there is lack of knowledge from the media. - Participant 3.

Even if innovation or a concept might have good intentions, to get it adopted or accepted by society remains one of the most difficult tasks (Rogers, 2003:1). This is relevant to the South African mainstream media as well as the local and community media. Most of them are not

knowledgeable when it comes to climate change. This is compounded by the fact that there are misconceptions about climate change which creates a challenge for people who are not well versed in the subject. This is relevant to this concept as climate change awareness or education is still limited to most of the public. Additionally, social media has been identified as one of the vital tools in distributing climate change information, unlike the traditional media which focuses mainly on headline news.

We have got social media platforms that we can use even to campaign on that because if we are not even doing big campaigns about this we will end up having a community that is full of lack of knowledge - Participant 5.

Berger and Freeman (2011:2) state that the emergence of online and social media has made the Agenda-setting theory very irrelevant in recent times as the media has become more personalised than it was in the past. Looking at climate change communication, Pearce, Brown, Nerlich, and Koteyk (2015: 3) highlight that, the online media platforms have expanded platform used for climate change communication as compared to the traditional mainstream media. This is supported by Williams, McMurray, Kurz and Lambert (2015: 126) who state that the viral nature of online platforms such as social media has expanded the reach to a greater audience. Berger and Freeman (2011: 2) argues that the new media has made it difficult for the mass media to developed structured messages aimed at setting up a certain agenda.

Participants nonetheless acknowledged that there were probably several programs and initiatives on climate change, but their effectiveness is limited since most of the participants were not aware of them.

I know one that I was once involved in. Otherwise the only other time I know about it is if I go and research it specifically but it's not like it is out there for me to see. I would only find out about these things if I go out and research and look. There are a few I just can't really think of any at the top of my head but there are the department runs a few campaigns especially during the environmental calendar days. They do things in the environmental calendar days. - Participant 6.

Participants indicated that they are only aware of the programmes they were involved in. This, therefore, necessitates the need to have the information disseminated in channels that reach the general public and in a language that a layperson can understand. Some of the communication channels that the participants suggested included social media and mainstream media like radio and television. Additionally, the use of government institutions like schools and clinics which people frequent were suggested as important sites for delivering

campaign messages. Additionally, traditional leaders can also be used as part of the campaign since they are still effective in disseminating information. The information has to be tailored in such a way that the audience can relate to the information and the examples. For example, the urban audience can learn about the carbon footprint of using vehicles and electricity as everyday examples.

5.6.1.2 *Understanding climate change*

Reiner et al (2009:1) emphasise the importance of understanding attitudes on climate change and people's preferences and knowledge of technologies and systems to mitigate anthropogenic emissions of greenhouse gases. It is important as a basis for decision-makers developing strategies for communication with the public. In this sub-section, the researcher provides a detailed analysis of various climate change understanding contributing factors such as the carbon footprint, climate change knowledge, understanding of climate change effects, the role played by information diffusion methods, as well as the role of language in the understanding of climate change.

5.6.1.2.1 The validity of climate change information

Two narratives emerged regarding the validity of climate change data. Firstly, it emerged that because of the different and sometimes competing sources of information on climate change, it is difficult for the public to discern the trustworthiness and credibility of the sources. This is made more difficult by the fact that most of the information that is against the existence of climate change is often published in non-scientific or community publications which are readily available to the public. People often value opinions raised by individuals who are more educated, regardless of their area of expertise.

I have met one person at a social gathering and he was an IT specialist that said that climate change is a manufactured problem. - Participant 2.

The statement from the participant is an indication that there are varying views about the existence of climate change and it also becomes difficult for ordinary public members to differentiate between expert options and general comments. Secondly, participants indicated that there have been active efforts to discredit the phenomenon of climate change. These comments are in line with allegations that some lobby groups such as the Global Climate Coalition received money mainly from big oil companies to spearhead messages against climate change, including global agreements such as the Kyoto Protocol (Dunlap & McCright, 2013:150).

The Agenda Setting theory has highlighted that the media can play an influential role in shaping public opinion, regulating the flow of information and influencing political agendas, public perceptions and policy-making (Feldpausch-Parker, 2010:50). Hence, the situation is made significantly more difficult by the fact that information about climate change denialism can appear to be equally scientific as climate change propagandists which confuses both the public and policymakers. Therefore, people need to assess the source of information which they receive.

The Department of Environmental Affairs is, have said something about it, they have some programmes that deals with this climate change, but I still don't think it is enough because if they were doing enough they were gonna make sure that this because a topic of the day for everyone. – Participant 3.

Participants also deemed it important to ascertain the parameters that people use to determine if the information they are getting is accurate. They also considered it important to find the best way to present climate change information to the public so that they may be receptive to it and know the best way to respond and adapt.

5.6.1.2.2 Understanding carbon footprints and energy use

Overall, participants had some knowledge of the construct of a carbon footprint. Specifically, they acknowledged the role of day-to-day activities like cooking, using electricity and vehicle emissions in carbon footprints. There were also some concerns that the dependency on coal for electricity generation which is not in the country's best interest in the long term and thus, they thought that there was a need to resort to renewable energy.

As an individual I could use less electricity for starters. Only use it for essential purposes like only at night for lights, I could switch off the geyser, all the energy saving initiatives that are out there I could use them. In terms if car-pooling I could obviously share transportation with other people so that there is less cars on the road. So those are the things that I can be doing to reducing the CO₂. - Participant 2.

While the participants indicated some appreciable knowledge of carbon footprints, they indicated that it would be better if they knew their daily carbon footprint to allow the reduction of emissions. Based on Pannu and Tomar's (2010:51), description of the development support communication (DSC) model, information sharing can enhance participation from the targeted participants. This means that there need to be initiatives that focus on sharing and promoting ways in which people can reduce their carbon footprints.

Some of the participants were also not aware of the causal relationship between individual carbon footprints and climate change, specifically the fact that an increased footprint results in increased chances of climate change.

Look I don't know how much does my stove contribute but I would say when we cook basically whatever that we produce there could be carbon dioxide but I am not sure how much I am emitting but definitely I am emitting. - Participant 6.

In view of the above statement, it is apparent that an understanding of what carbon footprints are and how energy usage contributes to it is vital. The majority of the participants agreed that their carbon footprint was from using electricity for purposes of lighting, cooking and heating. They also acknowledged that the geyser was a huge contributor to the carbon footprint. Participants suggested that they, in their way, have tried to limit the number of hours the geyser is on. They no longer cook foods which take a long time to prepare and have resorted to using solar energy whenever necessary to mitigate the effects of climate change.

5.6.1.2.3 Knowledge of climate change

The majority of participants were conversant with climate change and their responses ranged from the very basic knowledge that climate change is due to changes in the atmosphere because of human behaviour to complex details of the various processes which ultimately lead to climate change. Some of the participants have an intermediate understanding of what climate change is and what causes it.

Climate change and global warming they are interrelated. Firstly, starting off with climate change it is proven that the increase CO₂ in the atmosphere increases the temperature. So as I have said we generate electricity, we drive cars which combust petrol and other things, the amount of CO₂ increases. It is also proven that the number of CO₂ has increases after the industrial revolution where people they started doing manufacturing and all those things. So as the CO₂ increases the amount of temperature increases and the patterns they start changing where you have maybe other persistent heat, persistent cold it is no longer like the same. The seasons are changing gradually. - Participant 3.

All the participants knew that climate change was caused by requests for energy like electricity and the burning of fossil fuels (like petrol) which, when released into the air, contribute to climate change.

Everyone is responsible because we all have a role to play in climate change or emissions into the atmosphere. Everyone has a role to play we are all perpetrators, actually, we are both victims and perpetrators because it affects us now what we do it

affects our health and wellbeing. So everyone is to blame I can't really say that so and so is the only one. Everyone because we are all working in the industries we are all living and we are all doing life which involves emitting stuff into the atmosphere. Without vehicles we wouldn't be going to work without electricity we can't really do much, can't study can't work. So everyone is responsible. - Participant 5.

Participant 5 believes that every individual is contributing to climate change. Therefore, everyone needs to take responsibility for mitigating or addressing climate change. In this regard, people need to be involved in the development and distribution of climate change-related information for them to understand it. If people are allowed to participate in these processes, they might have a greater understanding of the subject. Based on the description of the Participatory Development Communication approach by Kheerajita and Florblt (2013:1), people can change or improve their knowledge, attitudes, and practices by being allowed to voluntarily engage in all relevant activities affecting them.

Participants admitted that they thought they had an advanced knowledge of climate change, which, according to them, is not the norm as many members of the public still were not aware of climate change, what causes it and what its possible effects are.

5.6.1.2.4 Understanding climate change effects

Participants displayed significant knowledge of climate change effects. It is important to note that climate change effects are difficult to identify, especially by laypersons. For example, Jylhä (2016:20) states that since the progression and impact of climate change effects cannot be observed directly, ordinary people may find it hard to form an opinion on the issue. Some of the identified effects include worsening droughts in some areas, flooding in other areas, changing seasons, air pollution and contamination, and extreme weather patterns and incidents.

These days it is too hot and you see in my community we are a farming based community and when rain does not come on time then it affects our farming system. We know that there should be a first rain around the first week in August and then we stay a little bit and then the other rain will start raining end of October going into September and then we start farming but now we are even afraid to farm around that time after the first because we are not sure it will rain in the coming four weeks or even beyond. - Participant 6.

Understanding climate change effects is of key importance in aiding in the mitigation of climate change. Ejembi and Alfa (2012:2) maintain that perceptions of climate change are critical in

establishing the level of understanding and the adoption of methods to mitigate its potentially devastating effects on the production and supply of food. Most people in rural areas rely on subsistence farming, therefore, for them being involved in the development and circulation of climate change information is a necessity. For example, the Participatory Rural Appraisal theory advocates for the inclusion of locals in any programmes that affect their community (Cornwall & Pratt, 2009:263).

Besides the climatic changes, participants also mentioned some effects that are much closer to the public. For example, the Cape Town water shortage was cited by one of the participants as another effect of climate change. Other effects mentioned included increased diseases due to contaminated air induced by human activity. Reduction in agricultural yields due to the fluctuating seasonal changes was also mentioned.

It would be as I said it is probably getting cold even before it is winter months or sometimes very hot. In other areas there are droughts because there is no rain, people cannot grow agricultural activities. It makes it very difficult because we need to live in an environment sustainably because of the effects of climate change. - Participant 7

The above statement is supported by Godfrey et al. (2010: 2), who indicate that the effects of climate change have serious impacts on people who rely on natural resources for survival.

5.6.1.2.5 The role of information diffusion in the understanding of climate change

Participants suggested that to make informed decisions, the information they are presented with needs to be specific to their respective areas not generic climate change information. More emphasis needs to be placed on developing localised climate change information that people could relate to.

I think the message has to be tailored to a specific recipient if you are from this area this is what you have to know about climate change. – Participant 6.

Because there are different scientific opinions and explanations of climate change as a concept, this variability is often transferred to the general public. For example, (Ho, Budescu, Mandeep, Dhimi & Mandel, 2015:44) state that, at times, based on the source of information, people may incorrectly diffuse or interpret the information they receive about climate change.

According to Karakaya, Hidalgo and Nuur's (2014:383) description of elements of the Diffusion of Innovation theory, opinion leaders can have an impact on how innovation is introduced in a social system structure. In this regard, people normally rely on leaders or prominent people for information.

The doubts, uncertainties, controversies and denialism have all been compounded by the fact that most of the information on climate change comes from experts with the general public contributing very little to that knowledge (Cook, Van der Linden, Maibach, & Lewandowsky, 2018:6). This makes it easy to present counter-arguments as the general public have limited sources of options when it comes to reliable information.

5.6.1.2.6 The use and role of language in the understanding of climate change

Several challenges were identified which led the participants to suggest that it might be necessary to make use of local language in disseminating climate change information. The use of subject-specific jargon also made it difficult for the public to fully understand the concept. This is supported by Markowitz, Hodge and Gabriel Harp (2014: i), indicating that in the last two centuries, climate change has mostly been discussed as a scientific phenomenon. This means only scientific language is used in most climate change communication messages. Participants suggested the use of simpler language and jargon to make it easy for the people to understand. Language barriers were also identified as a challenge and it was suggested to reduce the disproportionate use of English so that people can better understand the information.

You have got your Zulu scientist they must just come up with a way of doing it. You have got your Sepedi scientists they must just come up with a way of explaining this in a better language where your old grandmother who is not educated can understand that there is change. - Participant 5.

Hence, the use of vernacular language was suggested for specific areas like the rural areas and townships where the excessive use of English might exclude a significant portion of the intended audience. This is supported by Kumar (2011:7) in his analysis of the DSC model which encourages the distribution of information in a language that can be understood by those affected or involved. This means climate change information must be communicated in the local vernacular.

There is a need to use local languages in disseminating climate change information, but the participants also noted that there were some challenges associated with the use of local languages. For example, considering that there are eleven official languages when using

television, it would mean there would be multiple broadcasts of the same language so that it can reach a maximum audience. While this is the ideal situation, it is hardly practical considering the logistics and resources needed to achieve that. Another challenge is that some of the terminologies used climate change lexicon cannot be readily translated into vernacular languages. For example, it might be difficult to distinguish between oxygen, nitrogen, carbon dioxide and carbon monoxide in different languages while still retaining the essence of the message.

5.6.1.3 *Climate change perceptions*

Under the theme of climate change perceptions, several sub-themes emerged like (a) the first-hand experience of participants (b) priorities, (c) perceived injustices, (d) climate change denial and (e) alternative measures.

5.6.1.3.1 Perceptions based on first-hand experiences of climate change

According to Harris and Roach (2016:1) and the National Academy of Sciences (2014:2), more than ninety-seven percent of published scientific journals confirms that human beings are the main drivers of climate through their activities that release large amounts of GHG emissions into the atmosphere. This was supported by the participants when asked to give their first-hand climate change observations. They mentioned some developments and anecdotal experiences which they believe when taken collectively, suggest that there is climate change. Some of these include flooding, water scarcity, temperate winters and erratic rainfall.

It is real when I was growing up winter was winter and summer was summer. Your spring time would come in a fixed time but these days it is possible to rain in winter and when I was growing up there was no rain in your dry season in winter and you see there had been a lot of shifting you find that your spring jumps into your summer season and your summer season jumps into your...you cannot predict the weather these days its changing as it pleases. There is quite a lot of things that is happening as climate is concerned there is climate change. – Participant 5.

Although there is consensus on the existence of climate change, the lack of first-hand experience of climate change effects is one of the main reasons why some people are not taking any action to mitigate climate change (Spence, Poortinga, Butler & Pidgeon, 2011:1). Even today, there are still those who do not believe in climate change as a reality.

Not really as such because my perception is that I'm thinking it was something that was bound to happen to say like at a particular point in time climate will change and

weather as such will be bound to change as the weather cycle changes as well. – Participant 1.

The statement above is a clear indication that the participants agree that climate change exists. This shows that people do not adopt an idea or a concept at the same time and for some people, it could be earlier, while some are laggards. For example, based on the diffusion of innovation theory, members of a society might take some time mainly because individuals are likely to adopt a certain concept or invention at different stages (Sáenz-Royo, Gracia-Lázaro & Moreno, 2015:1). In this instance, the experiences of climate change incidences act to support the notion of climate change.

Overall, the participants provided the general features of climate change, not their personal experience with climate change except in two instances. First, one of the participants indicated that the first clue that there was climate change was water shortage in their village with frequent water cuts because the water was not enough. The second case was when the participants indicated that because of the new climatic conditions they were no longer able to grow some winter crops in their garden like they used to do.

5.6.1.3.2 Perceptions of addressing climate change as a priority

In the report published by the Regional Climate Change Programme Southern Africa in 2011, climate change was identified as one of the most significant threats to the achievement of the Millennium Development Goals (MDGs) especially those related to eliminating poverty and hunger and promoting environmental sustainability (Chapman, Midgley, Chesterman, Spalding-Fecher & von der Heyden, 2011:iv). It is in this regard that addressing climate change was prioritised in the MDGs as one of the focal points for a fifteen years' period between the years 2000 and 2014.

From the reports that were given, the majority of the participants do not see climate change as a priority. Their daily behaviour patterns did not include measures to reduce climate change and the damage they can do to the environment. It seems like behavioural patterns are some of the reasons why they do not view addressing climate change as a priority. Participants are used to certain habits of doing things, therefore, it becomes difficult for them to try and adopt new ways of life, especially their daily routines such as household energy usage and transportation.

We are used to lights like I am saying, we don't utilise candles anymore, we don't utilise those paraffin used lights or bulb, so now we are used to electricity, we feel like we cannot live without electricity even if we can live with it. But we have already made it

our basic need to have electricity at home. We do, we are no longer using paraffin as a source that we cook our food with, so without electricity, we cannot have food to eat, we cannot have light, we cannot have light, our cell phones won't work because the worst part about our cell phones and laptops is that they cannot work without energy. Unlike cooking, we can make and we cook, but with technologies such as laptops, cell phones, they need electrical energy in order to ... to... function. - Participant 3.

Based on the above statement, it can be argued that changing a habit is a process that requires time. It is postulated in the Diffusion of Innovation theory that time plays an integral part when it comes to how people adapt to new ideas or ways of doing things. If changing behaviour to address climate change involves economic or non-economic factors that might affect the public, people are not likely to adopt the new idea or the innovation (Tutore, Ferretti & Simoni, 2013:698).

Some participants noted that the general public might not prioritise climate change because they have been doing the same thing (like using firewood for cooking) for decades with no apparent consequences and hence, they might not see the need to change now. These sentiments are best captured by the quote below:

Your general public is concentrating on a couple of things. I wake up I go to work I take care of my family. So climate change is not a priority when I go the shop when I buy something I don't care whether you are going to affect whether it is going to contribute to the climate change or not. I just buy it for consumption for as long as it won't kill me, cause sickness to me because that is how the general public is living. – Participant 6.

From the quote above it is ascertained that, while some members might have heard of climate change and possibly made some measures to mitigate climate change, for them to adopt those measures, they need to be consistent in their new daily routines and energy use to reduce their carbon footprints.

5.6.1.3.3 Perceptions of climate injustice

Participants thought that there was no single person or group that can be blamed for climate change as the contributing factors leading to climate change are as a result of collective action. However, there is a notion that affluent countries or individuals contribute and benefit from the emission of greenhouse gases that in turn contribute to climate change, while the poor, the eco-system, and future generations are the most vulnerable to the negative effects of climate change (Hallegatte et al., 2016:ix; Jylhä, 2016:14). However, participants indicated that each person is both a victim and perpetrator of climate change effects.

Most of the things right now that I am using most of them are not energy efficient, the fridge, and the stove. If one could afford and migrate from using an electric stove to gas stove that would actually count a lot towards the carbon footprint or reducing the carbon footprint and looking at the amount of time or the period that I use a phone. If I can maybe switch it on for three hours and then maybe that may help us to reduce the carbon footprint at home. - Participant 7

Another theme that emerged was that, while the rise in carbon emissions was a shared occurrence, there was very little the general public could do to slow down their carbon emissions. This is because there is a need for industries to produce the necessary goods and people need electricity to achieve most daily functions and vehicles are still necessary to move from point to point. As a result, the general perception was that while people can reduce their carbon emissions, it will have a negligible impact.

I think to change your perception will be one way to go about because once you are able to change people's thinking and a way of doing things then it's a whole new arena altogether because they will be able to know and understand exactly what you are talking about when you are talking about climate change and they find ways on what we perceive is the right thing in terms of fighting against climate change. So if we can be able to change minds or behaviour I think that for me would help. - Participant 7.

Lastly, looking specifically at climate change, one specific case was raised regarding rural communities. The participants' observation was that while they had a minimal carbon footprint compared to those who live in urban areas, they appeared to have borne the brunt of climate change. Scholars such as Saraswat and Kumar (2016:67) have referred to this practice as climate injustice, whereby those who emit less are most likely to fall victim to climate change effects. This is because one of the most discernible impacts of climate change is seasonal changes which has affected agricultural production because of either too little water during droughts or too much water during floods and the poor mainly lack information on how to adopt or mitigate such effects. For example, one of the main concerns of institutions such as the UN Food and Agriculture organisation is that despite their greater exposure and vulnerability to several climate-related risks, disadvantaged people tend to be excluded from climate-related negotiations and decision making (Jylhä, 2016:15).

The World Bank Group proposes that rural people need to participate meaningfully in all projects that affect them. For example, in its support for rural people participation, the World Bank Group subscribes to the Participatory Rural Appraisal which refers to methods or approaches that emphasises the importance of local communities' involvement in the

appraisal, analysis and planning of the projects that affect them directly or indirectly (Uddin & Anjuman, 2014:72).

5.6.1.3.4 Perceptions of climate change uncertainties

Arguments about the existence of climate change are mainly based on issues relating to various controversies and demands for tangible or physical evidence as well as differences in various measures to address climate change. This section will focus on the identified uncertainties that participants mentioned that could potentially affect perceptions and the understanding of climate change and its mitigation and adaptation measures.

Climate change existence and impact still face some political and social contention despite the scientific proof that confirms the reality of this global environmental problem (Dunlap & McCright, 2013:144). This is evident based on the responses given by the participants that included several anecdotes of what they perceived to be physical and tangible evidence of climate change. Furthermore, it could also be as a result of many dismissive discourses that focused mainly on casting doubt on climate science over the past years (Jylhä, 2016:15). One of those anecdotes indicated some long held farming practices that are no longer applicable as the seasons have shifted which has disrupted food production.

Agriculture is getting affected because of climate change as I said just because in the village we don't emit as much CO₂ it doesn't mean we are not affected because greenhouse gasses travel they don't stay in one spot. They affect the whole atmosphere not one section. - Participant 4

Other responses indicated recent extreme weather conditions that were not there in previous years. The forest wildfires in Knysna in 2018 was cited to have started due to extreme heat.

Your Knysna incident where the whole community was affected by a very strong fire burnt wind that burnt their houses and all. In South Africa we never had such incident it is a new thing. – Participant 5.

Lastly, there were some participants reported where some boreholes which used to produce water reliably no longer do so as the water table has gone down due to limited precipitation in the past three years.

Another thing we use at home bore water for past ten years. In the past two years there is less water coming in because the water level in the ground is less because there hasn't been enough rain for the past two to three years so now. So it is also affecting in that way, so I believe in climate change. – Participant 2.

Participants agreed that climate change is a reality based on their personal experiences related to climate change effects.

5.6.1.3.5 Perceptions of measures that could address climate change

Several alternative measures were suggested by participants regarding the reduction of carbon footprints. Some of the measures included replacing the coal-produced electricity with something renewable like solar or wind energy.

I believe that we need to get other methods than can continue to produce electricity that can continue to produce energy or any other resources that we need in the world that we need in the world without producing emission or bad air that will cause carbon dioxide or that will cause climate change. We need to save the atmosphere, the environment by also trying to avoid to cut off some trees, try not to utilize moto, moto vehicles that utilizes lot of energy that produces bad air, stopping to do fire, burning plastics, burning anything that produces dirty air. - Participant 3

The views expressed are supported by Bui et al (2018:1039) who highlight that the environmental lobby group perceive CCS as a technology that is expensive and the fact that there are already alternative sustainable solutions such as renewables and energy efficiency.

Participants also suggested that electricity should be produced from biogas since most people and homes produce waste. They suggested that vehicle manufacturers should produce vehicles which use neither petrol nor diesel to reduce carbon emissions. Some suggested the need to reduce, reuse and recycle material like paper to reduce the overall carbon footprint. There was a general acknowledgement by the participants that some of the appliances they were using like stoves and fridges were not energy efficient.

Most of the things right now that I am using most of them are not energy efficient, the fridge, and the stove. If one could afford and migrate from using an electric stove to gas stove that would actually count a lot towards the carbon footprint or reducing the carbon footprint and looking at the amount of time or the period that I use a phone. If I can maybe switch it on for three hours and then maybe that may help us to reduce the carbon footprint at home. - Participant 7

This would require a switch to more energy-efficient methods like using a gas stove instead of an electric stove. Some of the alternative methods that were suggested related to behavioural changes by the public. For example, people should replace some electric appliances with those using alternative energy. Additionally, people should arrange to carpool instead of using

multiple cars to go to the same destination. However, the main challenge is that most of the suggestions made are only suitable for urban areas.

No tangible solutions or alternative measures were provided for people in rural areas. It highlights the need for the application of the tenets of the Participatory Rural Appraisal (PRA) theory since they are deemed effective in gathering information from rural communities (Cavestro, 2003:3). The central assumptions allow for community engagement and foster self-determination.

5.6.1.3.6 Use of technology to address climate change

The participants identified three broad technological areas that can be used to address climate change. These include specific technology to encourage sustainable energy use, the dissemination of information and the promotion of energy-efficient technologies. Participants proposed the use of green technologies such as solar lighting and geysers. However, participants expressed concerns that while these technologies may play a significant role in reducing carbon emissions, their adaption rate may be slow due to lack of information, high installation costs and market availability.

There is not much I can do because I don't produce the resources that I use on a day to day. I rely on the manufacturers and the market what they bring. – Respondent 5

Participants also suggested the use of energy-efficient appliances which use less energy and may reduce carbon emissions. For example, they mentioned that while in the past it was not imperative that household appliances were energy-efficient, the market is generally pushing for high-efficiency technologies and appliances. The IEP published by the Department of Energy has highlighted technology transfer and minimisation of greenhouse gases (GHG) emissions as are part of factors that as part of the country's integrated energy planning process (DoE, 2013:6).

Those things they use less energy if it is your washing machine it uses less water so at the end of the day there is a vital role to play as well because technology is there technology is driven by energy. So if we change the technology the energy consumption will also change. - Participant 3.

Hence, there is a call to move towards energy efficiency appliances since decreased energy use will also result in a corresponding decrease in carbon emissions and reduced climate change impact.

Participants also identified carbon capture and storage technology (CCS) as one way of addressing climate change identified as one of the Near-Term Flagship Programme in the 2011 National Climate Change Response White Paper (Department of Environmental Affairs, 2011:32. Despite CCS being one of the government's near-term flagship programmes, there have been some differing views on whether it is a suitable method to mitigate against climate change or not. These three broad categories are addressed below.

The following section will focus mainly on people's understanding, perception and communication of CCS technology.

5.6.2 Carbon Capture and Storage Technology

With CCS being identified as one of the climate change mitigation measures, the participants differed on the role that CCS could play in mitigating against climate change. The focus in the following sections is mainly on the perceptions, understanding and communication of CCS technology in South Africa.

5.6.2.1 Perceptions of CCS Technology

The perceptions of CCS technology are based on its role in mitigating climate change, the challenges for CCS technology in South Africa, the perceptions on the acceptance of the technology in South Africa and other alternatives to CCS technology.

5.6.2.1.1 Perceptions of the role of CCS in mitigating climate change

Although participants raised concerns about CCS technology, it appears that there is a belief that CCS technology has a role to play in the fight against climate change especially since the technology will assist in securing CO₂ safely in underground storage formations. This is supported in a report titled "*Carbon Capture: A Technology Assessment*", whereby CCS technology has been identified along with other technologies as part of the methods that can be used to mitigate against climate change through the reduction of the GHG emissions into the atmosphere.

I think, I just heard that this technology can fasten our process, so I believe it's a good thing that they came with it and it is also shows that something is done in order to reduce this problem. We need to actually applaud all the stakeholders who are working on that technology to capture carbon and to store it safely. - Participant 3.

The statement above indicates that there is a need to provide support to the development of the technology in South Africa. However, this is likely to depend on how the technology is positioned or framed. This can be supported by extrapolating from Stephens, Markusson and

Ashii (2011:6250) who state it will be difficult to change how CCS is framed in the latter stages as people are not likely to change their views on the technology regardless of any new developments. This means the people's first impressions about the technology will have a significant or long term effect on how CCS technology is framed, perceived and understood in society.

5.6.2.1.2 Challenges for CCS technology in South Africa

The researcher described the carbon capture and storage technology to the participants and asked them to give their opinion on the technology. When giving their perceptions about the possible challenges of Carbon Capture & Storage technology, one of the recurring perceptions was that there is not much that is known about the technology and it might be creating more challenges than it is attempting to solve. Below is a quote from one of the participants outlining his reservations about Carbon Capture and Storage technology:

It is the ripple effect that I am talking about you try to sort out one problem and then you create another. If you are storing it underground how much can you do? It is quite creating its own problems like distracting the environment in itself because I believe you would have to clear vegetation or whatever it is and it would create some environmental issues in itself. I don't know about it being stored underground I am a bit sceptical about that idea. - Participant 6

Markusson, Shackley and Evar (2012:2) have highlighted that despite CCS being in full-scale deployment during the past few decades, the technology still faces some hesitation due to certain uncertainties, limited information about its technical, scientific, regulatory, economic and financial components. This is what normally happens if the technology or the concept being introduced is still new. This is supported by both Sáenz-Royo, Gracia-Lázaro, Moreno, (2015:1) and Sahin, (2006:14), who indicate that the society tends to adopt a new concept or innovation at different stages, with some being laggards.

5.6.2.1.3 Perceptions of the acceptance of CCS technology

Markusson, Shackley & Evar (2012:2) have highlighted that CCS technology deployment has been faced with acceptability mainly due to hesitation from the general public and its technical and scientific uncertainties. The participant below indicates that he will have difficulties in accepting the technology in the areas proposed. This is mainly due to fears that the CO₂ might have some devastating effects on potable water or the environment in general (Mazzoldi, Rinaldi, Borgia & Rutqvist, 2012:434-435).

I would not agree that could create problems for me who is staying in that area. How sure are they that the storage will not create issues for me, what if it bursts or what if it

leaks into our water like ground water there is no certainly I would not agree at all. - Participant 6.

The above statement is supported by Rogers (2003:19), who indicates that if the people are not familiar with a new concept or innovation, there will be some challenges in getting that concept accepted by the people. The acceptability challenges may be based on people's varied view on the concept (Rogers, 2003:19).

One of the big issues that arises was the relevance of CCS technology, especially whilst it has to compete with other mitigation methods such as renewable energy. The issues relating to CCS relevance in relation to its alternatives are discussed below.

5.6.2.1.4 Perceptions of alternatives to CCS technology

While the general perception was that the carbon capture and storage might pose some risks, some participants perceived the technology as a bridging point between the current coal-based electricity generation technology and renewable energy. There is a notion that technology is relevant to the country's current energy generation methods. Below are some of the verbatim quotes from some of the participants with that perception:

CCS will prolong the coal industry and also lubricate the transition from coal to renewable because you cannot just take an abrupt turn and go straight to renewable. Participant 2.

Not necessarily CCS only also other technologies. As a combination of technologies yes. - Participant 3.

The statements above indicate that although CCS technology has the potential to mitigate the effects of climate change, it is not the only solution. The participants indicated that some other methods or technologies can be used to combat climate change. This is supported by Folger (2013: i), who indicates that together with other portfolios of technologies, CCS has a role to play in the global efforts to mitigate climate change.

CCS technology, like many other innovations in society, needs to find a place in the existing or common societal practices and industries. For example, CCS can find a place within the coal energy generation sector since the country mainly relies on coal for its energy usage.

This is supported by Sahin (2006:15), who indicates that the diffusion of any technology can be influenced by existing social systems and norms.

5.6.2.2 Understanding CCS technology

The understanding of CCS technology is based on how its overall value chain is understood, along with the risks and socio-economic dynamics associated with the technology. The importance of CCS educational information in the understanding of the technology will also be discussed.

5.6.2.2.1 Understanding of the CCS Value Chain

Despite CCS being around for over two decades, the understanding of how the technology works remain one of the main challenges towards its deployment. This is supported by Sahin (2006:14) who states that innovation is not always a new concept or invention, it might have been in existence or invented for a long time in other areas. Specifically, there are fears and uncertainty regarding some stages of the CCS value chain, especially the storage phase.

I am not that scientific person but if carbon is too dangerous for the ozone layer will it not be too dangerous for underground? – Participant 5

This is supported by Gough, O'Keefe and Mander (2014:100) who indicates that although there is a reasonable level of general knowledge about CO₂ across the lay public, understanding of its specific properties is more limited. This is further emphasised by Løvseth and Wahl (2012:324) who indicate that CCS is a technology that comprises of different stages, from when the CO₂ is captured at a power station and when it is safely stored in a selected storage site. This whole value chain needs to be understood first in order for people have a position on the deployment of the technology.

Therefore, it is important to note that the acceptance and understanding of CCS technology are likely to take some time. The uncertainties about CCS technology are mainly about issues related to risks, which is outlined below.

5.6.2.2.2 Understanding of risks associated with CCS technology

Although there is a belief that the technology is currently relevant, questions still arise on the nature and the potential consequences of deploying CCS. According to Stephens (2015:7), the delays that have led to the universal application of CCS technology relate to concerns

about the health and safety risks of storing CO₂ underground. The participants were concerned about the technology's impact on the environment and their surroundings.

The question is what impact the technology will have on itself and on the environment. So if the aim is just to capture carbon and store it I believe it is doable. My question is what impact the actual technology will have? - Participant 4.

Another participant also indicated that as much as CCS can address climate change, the people should be provided with information on the long term effects of CCS technology deployment.

My first response would be what are going to be the side effects? If you are going to put carbon underground and I am farming based community is it not going to affect my day to day life in the next 20 years? How dangerous is carbon can it really penetrate through the ground and come back to me? – Respondent 7.

Based on the statements above, the participant seems to lack enough information about the risks, as well as their impact making it difficult for the participant to understand the technology. Therefore, as stated by Yoro and Sekoai (2016:2), lack of knowledge of the technology can minimize or hinder people's participation in the project.

5.6.2.2.3 Socio-economic dynamics of CCS technology

CCS technology deployment is viewed as an expensive (Brown et.al, 2012:2; Folger, 2013:1, Ash, 2015:11) and uneconomic investment climate change mitigation method (Ash, 2015:11). The complexity of CCS technology, especially with regards to socio-economic impact, has been identified as one of the main challenges towards its deployment (Pietersen, Pearce & Vernon, 2013: xii-xiii) For example, CCS technology does not have direct benefits to the communities (De Coninck & Benson, 2014:262; Hardisty, Sivapalan & Brooks, 2011:1460). Some participants were more concerned about the value or impact of the technology on their community than the cost of its deployment.

I might be acceptable to it but if I don't see any value from it then I wouldn't want it in my area. Participant - 4.

If storing it underground does not affect the water that we know we also use on our daily basis I think it's a good thing and I think more needs to be done to create lot of that storage so that we can save it in that space and it does not affect our atmosphere anymore. - Participant 1.

This is supported by Tutore, Ferretti and Simoni (2013:698), who indicate that economic and non-economic social factors can have an impact on how the process of any concept or innovation is diffused and deployed in the society. Therefore, it is of utmost to ensure that educational information about a new concept or innovation is made available.

5.6.2.2.4 Development of specific content driven by CCS educational information.

Since the Environmental NGOs have been known to oppose the deployment of CCS technology mainly because they believe that CCS prolongs the use of coal (Global CCS Institute, 2011:12), it is suggested that CCS campaigners should lobby for the universal deployment of the technology as part of climate change mitigation efforts. For example, some of the participants felt there was a need to bring in some role models that they can identify with so that they can champion the technology and campaign for it.

I think with any new technology you need to identify some role models for either communities or groups of people. – Participant 7

The next section will focus on the communication methods of CCS technology information in South Africa.

5.6.2.3 CCS Communication in South Africa

It is important to note that such communication should not just be about sending and receiving messages but to ensure that the stakeholders have access to essential or useful information to be able to reduce possible anxiety in changing situations [brought to by the deployment of the technology] (Bourne, 2015:1; Lunenburg, 2010:2). The following section will focus mainly on various CCS communication sub-themes.

5.6.2.3.1 Access to information on the advantages and risks associated with CCS technology

Questions were posed to the participants on how best the possible risks and advantages of the technology can be communicated to the communities. The participants proposed that information which is tailored specifically for CCS can change or drive a message quickly to different recipients. This is supported by Ashworth (2010:10) who indicates that identifying better communication content and engagement methods that can be easily understood by the lay public could assist in creating more awareness of CCS technology. This is supported by Barker (2001:4-5) who states that the main focus of development communication models is to exchange information that can contribute to addressing developmental challenges faced by society.

I believe that communication which is tailored specifically can change or drive a message quickly to different recipients because just to sort of dissect it because currently as we have said is that the information is still concentrated within the scientists. So we need to drill down and get to the average person on the street. So to me communication is key. – Participant 2.

It is important to note that there were some concerns about the implications of carbon storage. For example, participants felt that the public needs to be informed to address concerns such as the fracturing and activation of underground faults that might lead to induced seismic activities. Participants expressed a need to communicate adequately with those who are likely to be affected by any CCS related activities. This suggestion is also addressed by Mazzoldi, Rinaldi, Borgia and Rutqvist (2012:434-435).

Serious public consultation because you know we are a developing country and some of the things people will decide. - Participant 2.

The participants seem to be concerned that the technology might go on to create more dire environmental catastrophes like earthquakes. Therefore, project developers need to address the concerns raised about the possible side effects through various communication channels. This is supported by Shahzad and Bokhari's (2014:2) principles of the DSC model that encourages the use of all available means of communication to motivate the intended audience towards change. Furthermore, although CCS has been in existence for some time from the responses gathered, it seems that the level of awareness of the technology is still low.

5.6.2.3.2 The awareness of CCS technology

Although some of the participants admitted to having heard of the technology before, they were not aware of its finer details. The participants thought that communities need to be made aware of the CCS technology before it could be deployed. This view is supported in the report titled *The CCS in Developing Countries* released by the World Bank Group in 2011. The report indicated that supporting knowledge sharing initiatives is vital in improving public awareness of CCS technology (Kulichenko & Ereira, 2011:68).

I have never really heard of that but from my view, it would be if that technology promises to be safe yes, I can give you the go and say let's try it but on the other hand, like with any technology there are consequences so then my concern would be wouldn't it have far reaching consequences that we imagine? – Participant 1

CCS is a technology that is still in a developmental phase, and therefore, it is important to ensure awareness of the technology is raised through proper dialogue with those who are likely to be directly or indirectly affected by its deployment. Even those who are aware of the technology seemed to be challenged when communicating with others about CCS technology.

Before I was not aware there was such technology. I only became aware after I became involved. That is why it is still a struggle whenever I am communicating with some of my peers that this is the kind of technology that I have heard of even the people in the energy sector not all of them know about this technology. – Participant 2

According to Barker (2001:6) and Pannu and Tomar (2010:51), in their description of the development support communication (DSC) model, dialogue and information sharing should be central to enhance participation from the targeted participants. Dialogue and information sharing can play major roles in creating more awareness of the technology.

In order to address the issue of low awareness of CCS technology, first, there is a need to ensure that the information about the technology is readily available to stakeholders and other sectors of the society such as governments, NGOs and the industry.

5.6.2.3.3 *Decentralising CCS information*

CCS technology is still perceived as a scientific concept and therefore identifying better communication content and engagement methods that are easily understood by the lay public could assist in creating more awareness and [understanding] of CCS technology (Ashworth, 2010:10). This was evident as participants also expressed that the current information or communication about the technology is still concentrated within the scientific community.

It is a technology that is still concentrated on the sphere of scientists. It has not drilled down to the general public that okay after we have used fossil fuels we generate CO₂ so maybe we can capture that CO₂ and store it somewhere. - Participant 2.

The decentralisation of CCS technology information can be achieved through proper communication. It is through communication whereby the public can learn about the basics of climate change and CCS technology, as well as understand and be able to differentiate between various climate change response techniques (Bradbury, Greenberg and Wade, 2011:5). Decentralising information about CCS technology also requires a proper consultation process with various CCS stakeholders. Hence, relevant stakeholders need to be identified and consulted in order to ensure that their views are considered.

5.6.2.3.4 Stakeholder consultation for CCS technology in South Africa

The participants emphasised the need to consult the people, regardless of their background. The participant below provided an example of how people from developed nations are involved in decision-making processes as compared to developing countries' counterparts.

In your developed countries, people will decide. People will decide through referendum we want this we don't want this. So let the people decide if carbon should really be captured and stored somewhere rather than government deciding on behalf of the people and we are going to do this. Ten years to come there are side effects and the government cannot manage it. Rather start consulting now and do serious research, we are a very educated country and I believe people can do serious research. – Participant 5.

Both the development support communication model and the rural appraisal participatory theory advocate stakeholder involvement in a project or activity that affects them. According to Pannu and Tomar (2010:51), in development support communication (DSC) there should be dialogue and information sharing to enhance participation from the targeted participants. This is an indication that information about CCS technology should be shared with stakeholders, especially those who are likely to be affected by the projects.

The Participatory Rural Appraisal (PRA) emphasises the importance of local communities' involvement in the appraisal, analysis and planning of the projects that affect them directly or indirectly (Alam & Ihsan, 2012:270; Uddin & Anjuman (2014:72). Reaching out is not just about engaging with the affected stakeholders, but also ensuring that they understand the concept or the technology.

You would then have to understand the people that you want to communicate your technology to and find ways to reach out to them in a way that they will understand. – Participant 7.

It is also important to note that, for stakeholders to understand the technology, communication has a role to play in raising awareness about the advantages and the inherent risks of CCS technology (Corry & Reiner, 2016:12). Other communication methods that can be applied in communicating CCS includes the use of the media.

5.6.2.3.5 The role of media to communicate CCS technology to the society

Some of the possible ways to communicate the technology include mainstream and social media, promotions and physical demonstrations by representatives already conversant in the

field. The media's role as defined by Berger and Freeman (2011:2) is to disseminate information that is deemed to be important for public consumption. The participants also identified the media as one of the platforms that can be utilised to share information about CCS technology.

I think media coupled with your promotions, outdoor promotions whereby people who work within that area should go to people with their outreach programs to explain to people what carbon capture and storage is about and in terms of media there should be more shows covering the issue. – Participant 1

The media, in particular, has been rallied as one of the key roleplayers in creating awareness and educating the public and other industry stakeholders about CCS technology (Global CCS Institute, 2017:9). The mainstream media, coupled with social media is still regarded as the main player in distributing CCS related information across different segments of the society.

If you can put it in mainstream media, the best bet is tv everybody watches tv have like an advert or have a program that is dedicated to talking about such things. I know in the science tv channels there maybe such things but quite a few people just go out and open that science tv channel so I think the only other way is exposure on to Facebook and Twitter and all other social networks is the best bet for me. - Participant 6.

The way in which the media reports about CCS technology will influence how the public and specific stakeholders perceive the technology.

5.7 CONCLUSION

In conclusion, while there are several initiatives on climate change, there has been a failure to adequately communicate these to the participants so that they take the requisite steps to reduce their carbon footprint. It emerged that climate change is still a scientific concept, widely communicated in scientific and academic circles but rarely in the public domain. Third, it also emerged that participants believe that there is a large section of the international community who still believes that climate change is not real but a manufactured concept. Hence, denialism counter-narrative is being presented. Fourth, the participants had significant knowledge of climate change, its causes, its consequences and some of the measures that can be adopted to mitigate it. Lastly, when carbon capture and storage were presented as a possible solution, there was a general resistance to the idea with the majority of the participants citing the fact that it might have some unforeseen and unintended consequences.

CHAPTER SIX

FINDINGS, LIMITATIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

In this chapter, the findings of the study with reference to the main research questions and the data analysis and interpretation as were discussed in Chapter Five are presented. In Chapter One, the purpose of this study was started as an exploration of factors in the perception, understanding and communication of Climate Change and Carbon Capture and Storage technology in South Africa as a developing country. Specifically, the focus was on identifying aspects that could influence how a group of South African stakeholders understand and perceive climate change and CCS technology communication. Hence, in this chapter, the research questions are addressed, given that the research problem was indicated as being a lack of relevant of timeous and relevant information on the mitigation of climate change and CCS. The contribution of the study to the discipline of communication and media studies is also discussed and explained. Limitations of the study are addressed and recommendations for the discipline of communication and media, practice and further research are made.

6.2 RESEARCH FINDINGS

The findings of the study have been grouped based on whether the main research questions were able to help address the research problem and achieve the aims and the objectives of the study.

6.2.1 Climate change

The findings on climate change dimensions are divided into three sub-categories namely: (i) climate change perception; (ii) climate change understanding; and (iii) climate change communication, which are then drilled down into themes presented below.

6.2.1.1 *Perceptions of climate change*

The first research question was to explore factors that affect the perceptions of climate change of the members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). The findings are presented as summaries derived from the analysis and interpretation of data

6.2.1.1.1 First hand experiences and climate change denial

The reduction in agricultural yields due to the fluctuating seasonal changes was one of the main findings highlighted by the participants in this study. The participants mentioned flooding, water scarcity, temperate winters and erratic rainfall as some of their climate first-hand climate change experiences. This indicates that there is a consensus that climate change does exist. The actual reasoned experience of climatic changes hence supports the notion of climate change. It could be reasoned that the successful articulation of climate change should be supported by reference to actual experiences. This finding supports the statement by Ashworth (2010:10) since the indiscernible causes of climate change make it difficult for laypersons to accept its existence, actual noticeable changes should be highlighted.

6.2.1.1.2 Priorities

The participants do not view addressing climate change as a priority. This was due to participants living their lives without giving conscious thought to how it may affect climate change. They tend to focus mainly on issues that interest them, or that they feel are more relevant to achieving their immediate and long-term goals like education, food and security. Daily customs and patterns of behaviour seem to drown out their scientific knowledge in favour of the existence and making a living. This finding supports Glazewski et al (2012:39) observation that a constraint in climate change awareness is prioritising the need to meet daily basic human requirements. This could indicate that information provided on climate change mitigation should address how ordinary citizens could deliberately and consciously adjust their daily routines and behavioural patterns in support of the mitigation of climate change.

6.2.1.1.3 Perceived injustices

Ironically, while participants thought climate changes were more discernible in rural areas due to their direct experiences, they also indicated that rural areas might have a minimal carbon footprint compared to those who live in urban areas. However, in their opinion, rural areas suffer the weight of climate change injustices since they are directly affected mostly due to subsistence farming practices in rural areas. Participants acknowledged that climate change is both the result and responsibility of shared causes and efforts.

6.2.1.1.4 Alternative measures and the use of technology

There was a consensus that the broader use of technology can be used to address climate change. More emphasis should be placed on technologies that encourage sustainable and efficient energy use and technologies that facilitate the dissemination of information more

effectively to stakeholders. There were concerns that the lack of information, high installation costs and market availability of various technologies may hamper climate change mitigation efforts

6.2.1.2 *The understanding of climate change*

The second research question was to determine factors in the understanding of climate change by the members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). Findings of the understanding of climate change are presented below.

6.2.1.2.1 Climate change and the validity of climate change information

All participants had an understanding that climate change was caused by the greater demand for energy use such as electricity and the burning of fossil fuels (like petrol) which, when released into the air, contribute to climate change. However, they mentioned several aspects that could impede the broader understanding of underlying concepts. It emerged that participants were of the opinion that it would be difficult for stakeholders to discern the trustworthiness and credibility of the sources of climate change information mainly because of the different and sometimes competing sources of information.

6.2.1.2.2 Carbon footprints, energy use and climate change effects

The participants displayed significant knowledge and understanding of climate change effects. Some of the climate change effects identified in this study included the worsening droughts in some areas, flooding in other areas, unpredictable changing of seasons, air pollution and contamination, and extreme weather patterns and incidents. However, one of the main findings that emanated from the study is that participants felt that stakeholders were not aware that they are seriously contributing towards environmental degradation at a time when they should be adopting measures to mitigate the impact of climate change.

6.2.1.3 *The communication of climate change.*

The third research question study was to explore how the communication of climate change is perceived by the members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng). Findings on how communication of climate change is perceived are presented below.

6.2.1.3.1 Access to, and frequency and diffusion of climate change communication

Participants indicated that most programmes or initiatives aim to address climate change were only suitable for urban areas and the solutions or suggestions provided were not suitable for

people in rural areas. They expressed the fact that climate change information available in the public domain is limited in frequency and appears in specific columns or sections that the general public hardly have access to or reads. They could recall only one climate change communication initiative that was effectively targeted. It was also mentioned that due to education levels, distinguishing between information about climate change denialism and authentic scientific findings on the legitimacy of climate change could confuse both the public and policymakers. A salient point raised was the apparent lack of stakeholder participation and consultative processes used that could greatly contribute to effective communication campaigns delivering essential messages relating to climate change mitigation. Additional initiatives such as school visits and projects to involve stakeholder groups were mentioned as ways to raise awareness and stimulate communication. Government institutions could be utilised as important sites for delivering campaign messages. Specifically, local structures such as municipalities should provide platforms to address aspects of how changing daily routines could alleviate energy use.

6.2.1.2.2 Language

The use of scientific language made it difficult for stakeholders to understand climate change communication messages. Furthermore, language barriers, especially the disproportionate use of English were identified as a challenge for Non-English speaking recipients of the information. Also, the nature of scientific terms and how to translate them into the local vernacular was seen as a communication problem. In order to increase the frequency of climate change communication to various stakeholders, it is necessary to ensure that the climate change information disseminated through various platforms that are easily accessible and presented in a language that even a layperson can understand.

6.2.1.2.3 The role of traditional and new media

Participants suggested the use of social media and mainstream traditional media like radio and television as important avenues of delivering climate change communication. Specifically, *Twitter*, *Facebook* and *Instagram* were mentioned as potential social media platforms for climate change communication. The interactive nature of these platforms could facilitate feedback in terms that stakeholders will understand. These platforms could also be utilised by campaign organisers to determine users' opinions and direct experiences as reported on these sites.

6.2.2 Carbon capture and storage technology

The findings on the capture and storage technology dimension are divided into three sub-categories namely: (i) CCS perceptions; (ii) CCS understanding; and (iii) CCS communication and are presented below.

6.2.2.1 Perceptions of carbon capture and storage technology

The perceptions of the members of the Gallery of Academic Leaders and Eskom Expo for Young Scientists (Gauteng) are presented below.

6.2.2.1.1 The role and challenges of, and alternatives to CCS technology

Participants consider the technology relevant to the country's current energy generation methods and perceived it as a bridging point between the current coal-based electricity generation and renewable energy in the future. One of the recurring perceptions towards CCS technology was that there is not much known about the technology and it might be creating more challenges than it is attempting to solve. Participants indicated that they were not likely to accept the deployment of the technology in their areas. They were concerned that the technology might have devastating effects on agriculture, potable water or the overall environment. They indicated that some other methods or technologies can be used to combat climate change instead of CCS technology, as there is a perception that it might pose unanticipated risks.

6.2.2.2 Understanding of carbon capture and storage technology

There is a consensus that as much as CCS technology can mitigate climate change, there should be transparency in providing information about the inherent risks and long term effects of CCS technology deployment. The findings on the factors in the understanding CCS technology are presented below.

6.2.2.2.1 CCS value chain and risks

The participants had minimal or no understanding of how the overall CCS technology value chain works and could be one of the main challenges with regards to its deployment. Most of the uncertainties about CCS technology are related to risk factors. There are concerns that the deployment of CCS technology as part of climate change mitigation measures might go on to create even more dire environmental catastrophes like earthquakes. Although CCS technology was perceived to be expensive, the participants were more concerned about the negative impact the technology might have on their community than the cost of its deployment.

Although the large scale deployment of CCS technology has been in existence for more than two decades, from the responses gathered, it seems that the level of awareness of the technology and what it entails is still low.

Participants indicated that there is a need to inform stakeholders on CCS technology and campaigners could play a role in the education and lobbying of the local deployment of the technology as part of climate change mitigation efforts. The introduction of public figures to champion and campaign for the technology should be considered as part of educating stakeholders about CCS.

6.2.2.3 *Communication of carbon capture and storage technology*

Participants indicated that current communication about CCS technology is still concentrated within the scientific community. Information should be tailored specifically for stakeholders potentially affected by and involved with the deployment of the technology. Participants indicated multiple communication platforms should be utilised to distribute information about CCS technology. These platforms should include social media, mainly targeting young members in rural communities. Community media was also considered more relevant as they mainly broadcast in languages that are understood by the community. It is important to note that way in which the media reports on CCS technology could influence how the public perceives the technology. The participants also noted that those stakeholders likely to be directly or indirectly affected by the deployment of CCS technology need to be consulted and engaged in the decision making processes.

6.3 CONTRIBUTION OF THE STUDY

The findings garnered from the in-depth interviews contribute to a deeper understanding of how a group of young educated professionals and students as members of Eskom Expo Gauteng and the Gallery of Academic Leaders perceive and understand aspects of climate change communication and the deployment of CCS technology. Considering that climate change and CCS technology are complex issues, the study contributes to the body of knowledge in terms of the perception, understanding and communication of climate change and CCS technology in a local context. These members' views and sentiments are crucial in the endorsement of current and future initiatives associated with the communication of climate change mitigation and the deployment of CCS technology. Their opinions and insights can be used as a springboard for future research in communication efforts in the mitigation of climate change and perceptions regarding the deployment of CCS technology. An illuminating insight

was that most participants are aware of climate change effects, but are at a loss of how to implement daily routines to mitigate those effects and how to measure their carbon footprints. Additionally, the notion that climate change effects are not prioritised at the face of daily being and living, indicate that efforts should address challenges at grassroots levels.

6.4 LIMITATIONS OF THE STUDY

Limitations of the study include the use of a relatively small sample size. However, since this was a qualitative study aimed at gaining a deeper understanding and not the generalisation of results, the size was deemed sufficient. It should also be borne in mind that a critical aspect is to establish when the data saturation point has been reached. In this study, definite patterns of responses were identified and it is doubtful if richer data would have been mined from more participants with the same questions asked. Additionally, as purposive and snowball sampling was used, and it can be argued that the researcher selected the samples based on personal preferences or bias, thus possibly skewing the findings. However, it is the practice in a qualitative study to source participants who will provide thick and rich data to facilitate deep understanding.

6.5 RECOMMENDATIONS

During the study, it was established that communication can play an important role in the understanding and perception of climate change and various adaptation and mitigation measures such as CCS technology. It is hence recommended that more research be conducted on specific communication initiatives and their outcomes. Future research studies could also focus on perceptions in rural communities that have been identified for CCS technology and those most affected by climate change effects. Additionally, further studies should investigate how citizens could prioritise climate change effects through meaningful consultation and participation in communication projects cast against their basic needs and daily domestic routines.

6.6 CONCLUSION

Information on climate change and CCS technology have to be tailored in such a way that the audience can relate to the information. It emerged that climate change communication should be enduring and continuous, unlike the current situation when the information emerges when there is a climate change summit or conference. Ordinary people must be considered in the processes of planning, developing and distribution of climate change-related information for them to relate to the message.

There is a need to optimise the use of local language in disseminating climate change and CCS related information. The other option was to use simple language without scientific terms and jargon to make it easier for people to understand. More emphasis needs to be placed on developing localised climate change information that people could relate to. Information about CCS technology should be shared with people who are likely to be affected by its deployment. More consultations with the people before the technology can be deployed needs to be facilitated. There is a need to find possible ways to communicate information about the technology through mainstream, community and social media platforms, promotions and physical demonstrations by the people already conversant in the field. The public should be able to identify with champions campaigning the technology.

The study established that for people to understand climate change and various mitigation methods such as CCS technology, they first need to have a basic understanding of what climate change is and how it affects them. Furthermore, for CCS technology, stakeholders need to understand how the technology works and it was very clear from the research finding that the people are still uncertain about the technology.

Climate change communication should be pervasive and ubiquitous so that everyone gets to know of it similar to the way HIV/AIDS awareness campaigns are present on every media platform possible. Climate change education should start at an early stage, preferably at the primary or secondary education level in both formal and informal settings. Stakeholders must be encouraged to take the initiative to do their reading about climate change and various mitigation methods so that they can be better informed.

Factors such as lack of awareness and education, limited information access, exclusion of stakeholders, uncertainties surrounding the validity of climate change information, technology and language usage were identified as the main factors that can have an impact on the perceptions, understanding and communication of climate change and CCS in South Africa.

Reference List

- Adams, A., Harf, A. and Ford, R. (2014). Agenda Setting Theory: A Critique of Maxwell McCombs & Donald Shaw's Theory in Em Griffin's A First Look at Communication Theory. *Meta- Communicate*, [Online] Journals.chapman.edu. Available at: <http://Chapman University Communication Studies> [Accessed 13 Mar. 2018].
- Adelman, D. and Duncan, I. (2011). The Limits of Liability in Promoting Safe Geologic Sequestration of CO₂. *SSRN Electronic Journal*, [online] 22(1), pp.143-166. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1788350 [Accessed 8 Apr. 2016].
- African Union (2013) *African Strategy on Climate Change*. [Online] Addis Ababa: African Union. Available at: https://www.un.org/en/africa/osaa/pdf/au/cap_draft_aucclimatestrategy_2015.pdf [Accessed 10 Feb. 2016].
- Aizstrauta, D., Gintersa, E. and Eroles, M. (2015). Applying Theory of Diffusion of Innovations to Evaluate Technology Acceptance and Sustainability. *Procedia Computer Science*, [online] 43, pp.69-77.
- Alam, A. and Ihsan, S. (2012). Role of Participatory Rural Appraisal in Community Development (A Case Study of Barani Area Development Project in Agriculture, Live Stock and Forestry Development in Kohat). *International Journal of Academic Research in Business and Social Sciences*, 2(8), pp.25-38.
- Alloisio, I., D'Aprile, A., Davide, M., Calliari, E. and Johnson, K. (2016). International Climate Policy. *International Centre for Climate Governance: Bi-Monthly Magazine*, [online] (46).
- Al-Saadi, H. (2014). Demystifying Ontology and Epistemology in Research Methods. *Research gate*. Available at <https://www.researchgate.net/publication/260244813>.
- Alshenqeeti, H. (2014). Interviewing as a Data Collection Method: A Critical Review. *English Linguistics Research*, [online] 3(1), pp.39-44. Available at: <https://www.researchgate.net/publication/269869369>.
- Anafo D. (2019) Between science and local knowledge: improving the communication of climate change to rural agriculturists in the Bolgatanga Municipality, Ghana. *Local Environment*, [online] 24(3) 201-215, DOI: 10.1080/13549839.2018.1557126

- Anney, V. (2014). Ensuring the Quality of the Findings of Qualitative Research: Looking at Trustworthiness Criteria. *Journal of Emerging Trends in Educational Research and Policy Studies*, [online] 5(2), pp.272-279.
- Anup, K.C. (2018). Climate Change Communication in Nepal. In W. Leal Filho, E. Manolas, A.M. Azul, U.M, Azeiteiro, & H McGhie, (Eds.). *Handbook of Climate Change Communication: Vol. 2*. New York: Springer.
- Asante, F. and Amuakwa-Mensah, F. (2015). Climate Change and Variability in Ghana: Stocktaking. *Climate*, [online] 3(1), pp.78-99. Available at: <https://www.researchgate.net/publication/269721523>.
- Ash, K. (2015). *Carbon Capture SCAM (CCS): How a False Climate Solution Bolsters Big Oil*. [online] Washington, DC: Greenpeace USA. Available at: <http://www.greenpeace.org/usa/wp-content/uploads/legacy/Global/usa/planet3/PDFs/Carbon-Capture-Scam-Exec-Summary.pdf> [Accessed 6 Jun. 2016].
- Ashworth, P. (2010). *Communication of carbon capture and storage: Outcomes from an International Workshop to Summarise the Current Global Position*. [Online] London: Global Carbon Capture and Storage Institutes. Available at: <https://hub.globalccsinstitute.com/sites/default/files/publications/5706/communication-carbon-capture-and-storage.pdf> [Accessed 14 Sep. 2015].
- Asiamah, N., Mensah, H. K., & Oteng-Abayie, E. (2017). General, Target, and Accessible Population: Demystifying the Concepts for Effective Sampling. *The Qualitative Report*, 22(6), 1607-1621. Retrieved from <https://nsuworks.nova.edu/tqr/vol22/iss6/9>
- Asian Development Bank (2012). *Handbook on Poverty and Social Analysis a Working Document*. [Online] Mandaluyong City: Asian Development Bank. Available at: <https://www.adb.org/sites/default/files/institutional-document/33763/files/handbook-poverty-social-analysis.pdf> [Accessed 5 Oct. 2016].
- Babbie, E. (2016). *The practice of social research*. 14th Ed. Boston: Cengage Learning.
- Babbie, E. (2014). *The basics of social research*. 6th Ed. Vancouver: Wadsworth, Cengage Learning.
- Barker, R. (2001) Theory and Research. *Communicatio: South African Journal of Communication*. UNISA Press vol. 27 (1) , pp. 3-14.

- Beck, B., Surridge, T., Liebenberg, J. and Gilder, A. (2011). The current status of CCS development in South Africa. *Energy Procedia*, 4, pp.6157-6162.
- Ben-Mansour, R., Habib, M., Bamidele, O., Basha, M., Qasem, N., Peedikakkal, A., Laoui, T. and Ali, M. (2016). Carbon capture by physical adsorption: Materials, experimental investigations and numerical modeling and simulations – A review. *Applied Energy*, 161, pp.225-255.
- Berger L.J., and Freeman M.D.J. (2011) Relevance of Agenda Setting Theory to the Online Community: The Issue of Relevance of Agenda-Setting Theory to the Online Community. (2011). *Chapman University Communication Studies Undergraduate Research Journal*, 1(1), pp.1-2.
- Bezuidenhout, R. (2014). Theory in Research. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Bezuidenhout, R., and Cronje. (2014). Qualitative Data Analysis. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Bezuidenhout, R., and Davis C. (2014). Theory in Research. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Bhattacharjee, A. (2012). *Social Science Research: Principles, Methods, and Practices*. 2nd ed. Florida: Creative Commons Attribution, Non-Commercial-ShareAlike.
- Böhm, A. (2004). Theoretical Coding: Text Analysis in Grounded Theory. In: U. Flick, E. Kardorff and I. Steinke, ed., *A Companion to Qualitative Research*. London: SAGE Publications.
- Boot-Handford, M. E., Abanades J. C., Anthony, E. J. Blunt, M. J Brandani, S. Mac Dowell N. Fernandez, J. R. Ferrari, M.C. Gross, R., Hallett J. P., Haszeldine, R. S. Heptonstall, P. Lyngfelt, A., Makuch, Z., Mangano, E. Porter R. T. J., Pourkashanian M., Rochelle, G., T., Shah, N., Yoo J. G. and Fennell P. S. (2014) Carbon Capture and Storage Update. *Energy & Environmental Science*, [online] 7(1), pp.130-189. Available at: <https://pubs.rsc.org/en/journals/journalissues/ee#!issueid=ee007007&type=current&issnprint=1754-5692> [Accessed 9 Oct. 2016].
- Bourne, L. (2015). *Making Projects Work: Effective Stakeholder and Communication Management*. Boca Raton: CRC Press - Taylor & Francis Group.

- Bradbury, J., Greenberg, S. and Wade, S. (2011). *Communicating the Risks of CCS*. [Online] Canberra: Commonwealth Scientific and Industrial Research Organisation.
- Bradshaw, C., Atkinson, S. and Doody, O. (2017). Employing a Qualitative Description Approach in Health Care Research. *Global Qualitative Nursing Research*, 4, p.233339361774228.
- Broecks, K., van Egmond, S., van Rijnsoever, F., Verlinde-van den Berg, M. and Hekkert, M. (2016). Persuasiveness, importance and novelty of arguments about Carbon Capture and Storage. *Environmental Science & Policy*, 59, pp.58-66.
- Brown, T., Gambhir, A., Florin, N. and Fennel, P. (2012). *Reducing CO2 emissions from heavy industry: a review of technologies and considerations for policy makers*. Briefing Paper No 7. [online] London: London Imperial College. Available at: <http://www.imperial/> [Accessed 15 Aug. 2017].
- Bryman, A. (2016). *Social research methods*. 5th ed. Oxford: Oxford University Press.
- Buhr, K. and Wibeck, V. (2014). Communication approaches for carbon capture and storage: Underlying assumptions of limited versus extensive public engagement. *Energy Research & Social Science*, [online] 3, pp.5-12. Available at: <https://www.sintef.no/globalassets/sintef-energi/nordiccs/d.2.7.1401-communication-approaches-for-carbon-capture-and-storage.pdf>.
- Bui, M. Adjiman, C.S., Bardow, A., Anthony, E.J., Boston, A., Brown, S., Fennell, P.S., Fuss, S., Galindo, A., Hackett, L.A., Hallett, J.P., Herzog, H.J., Jackson, G., Kemper, J., Krevor, S., Maitland, G.C., Matuszewski, M., Metcalfe, I.S., Petit, C., Puxty, G., Reimer, J., Reiner, D.M., Rubin, E.S., Scott, S.A., Shah, N., Smit, B., Trusler, J.P.M., Webley, P., Wilcox, J., and Dowell, N.M. (2018) Carbon capture and storage (CCS): The Way Forward. *Energy & Environmental Science*, [online] 5(2018) pp.1067-1039.
- Capstick, S. (2013). Public Understanding of Climate Change as a Social Dilemma. *Sustainability*, [online] 5(8), pp.3484-3501. Available at: <https://www.mdpi.com/2071-1050/5/8/3484/htm>.
- Capstick, S., Whitmarsh, L., Poortinga, W., Pidgeon, N. and Upham, P. (2015). International trends in public perceptions of climate change over the past quarter century. *Wiley Interdisciplinary Reviews: Climate Change*, [online] 6(4), pp.435-435. Available at: <https://onlinelibrary.wiley.com/doi/full/10.1002/wcc.321>.

- Carciotto, S. and Dinbabo, M. (2013). Role of Development Communication in Fostering Social Change: Evidence from Lesotho. *Journal of Communication*, 4(2), pp.65-70.
- Cavestro, I. (2003). *Participatory Rural Appraisal Concepts Methodologies and Techniques*. Unpublished Masters Research. The University of Padua.
- Chambers, R. (2004). Rural Appraisal: Rapid, Relaxed and Participatory. In: A. Mukherjee, ed., *Participatory Rural Appraisal: Methods and Applications in Rural Planning: Essays in Honour of Robert Chambers*. New Delhi: Concept Publishing Company.
- Chan, E. (2018). Climate change is the world's greatest threat – In Celsius or Fahrenheit? *Journal of Environmental Psychology*, 60, pp. 21-26.
- Chandrappa, R., Gupta, S. and Kulshrestha, U. (2011). *Coping with Climate Change*. Berlin: Springer Berlin.
- Chanza, N. and de Wit, A. (2016). Enhancing Climate Governance through Indigenous Knowledge: Case in Sustainability Science. *South African Journal of Science*, [online] Volume 112(Number 3/4) pp. 1-7. Available at: <https://www.sajs.co.za/article/view/4058/5939>.
- Chapman, R.A., Midgley, S.J.E., Chesterman, S., Spalding-Fecher, R., Von der Heyden, C. (2011) *Climate change and the Millennium Development Goals: Case Studies for Southern Africa. Synthesis Report*. Knowledge for Adaptation Series: 3. Cape Town: Regional Climate Change Programme: Southern Africa.
- Chenail, R. J. (2012). Conducting Qualitative Data Analysis: Qualitative Data Analysis as a Metaphoric Process. *The Qualitative Report*, 17(1), 248-253.
- Chhetri, B. (2017). *Peoples' Participation in Local Self-Government in Sikkim: A comparative study of Samsing-Gelling and Rongay-Tathangchen Gram Panchayat units since 1993*. Master of Philosophy. Sikkim University.
- Chifamba, E. (2013). Confronting the challenges and barriers to community participation in rural development initiatives in Duhera District, ward 12 Zimbabwe. *International Journal of Current Research and Academic Review*, [online] 1(2). Available at: <http://www.ijcrar.com/vol-2/Ephraim%20Chifamba.pdf> [Accessed 13 Jul. 2018].
- Chirisa, I., Matamamba, A. and Mutambwa, J. (2019). Africa's Dilemmas in Climate Change Communication: Universalistic Science Versus Indigenous Technical Knowledge. In:

- F. Leal, E. Manolas, A. Azul, U. Azeiteiro and H. McGhie, ed., *Handbook of Climate Change Communication: Vol. 1: Theory of Climate Change Communication*. [online] London: Springer International Publishing. Available at: https://www.researchgate.net/publication/322145710_Africa's_Dilemmas_in_Climate_Change_Communication_Universalistic_Science_Versus_Indigenous_Technical_Knowledge [Accessed 4 Jan. 2019].
- Chomba, K. (2013). *The Effect of Capital Structure on the Corporate Governance of Companies Listed at the Nairobi Securities Exchange*. Unpublished masters dissertation. University of Nairobi.
- City of Johannesburg (2016). *Integrated Development Plan, 2016-2017: The People's Plan*. City of Johannesburg.
- City of Tshwane. (2014) *City of Tshwane Greenhouse Gas Emissions Inventory 2012/2013*. City of Tshwane.
- Cologna, V., Bark, R.H., & Paavola, J. (2018). The Role of Risk Perceptions in Climate Change Communication: A Media Analysis on the UK Winter Floods 2015/2016. In W. Leal Filho, E. Manolas, A.M. Azul, U.M, Azeiteiro, & H McGhie, (Eds.). *Handbook of Climate Change Communication: Vol. 2*. New York: Springer.
- Cook, J., Van der Linden, S., Maibach, E. and Lewandowsky, S. (2018). *The Consensus Handbook Why the scientific consensus on climate change is important*. [ebook] Cambridge: Climate Communication. Available at: <http://www.climatechangecommunication.org/all/consensus-handbook/> [Accessed 3 Jan. 2019].
- Cornwall, A. and Guijt, I. (2004). Shifting perceptions, Changing Practices in PRA: From Infinite Innovation to the Quest for Quality. *The International Institute for Environment and Development*, [online] (50). Available at: <https://pubs.iied.org/G02107/> [Accessed 6 Sep. 2015].
- Cornwall, A. and Pratt, G. (2011). The use and abuse of participatory rural appraisal: reflections from practice. *Agriculture and Human Values*, [online] 28(2), pp.263-272. Available at: <https://link.springer.com/article/10.1007/s10460-010-9262-1>.
- Corry, O. and Reiner, D. (2016). *It's the society, stupid: Communicating emergent climate technologies in the internet age*. EPRG Working Paper. Cambridge: Energy Policy Research Group.

- Creswell, J.W. (2014). *Research Design: Qualitative, Quantitative & Mixed Methods Approaches*. 4th ed. California: SAGE.
- Creswell, J.W. (2012). *Educational research. Planning, conducting and evaluating Quantitative and Qualitative Research*. 4th ed. California: SAGE
- Davis, C. (2014). Conceptualisation. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, eds., *Research Matters*. Cape Town: Juta.
- Davis, C. (2014). The Research Rationale. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, eds., *Research Matters*. Cape Town: Juta.
- Davis, C. (2014). What Is Research? In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- De Coninck, H. and Benson, S. (2014). Carbon Dioxide Capture and Storage: Issues and Prospects. *Annual Review of Environment and Resources*, [online] 39(1), pp.243-270. Available at: <https://www.annualreviews.org/doi/abs/10.1146/annurev-environ-032112-095222>.
- Department of Energy (2016). *Integrated Energy Planning Report*. Pretoria: Department of Energy.
- Department of Environmental Affairs (2011). *National Climate Change Response White Paper*. Pretoria: Department of Environmental Affairs.
- Department of Justice and Constitutional Development (1996) *Constitution of the Republic of South Africa*. Cape Town: Department of Justice and Constitutional Development.
- Department of Water & Sanitation, South Africa. (2012) *Communication Strategy and Action Plan*. Pretoria: Department of Water & Sanitation.
- Department of Water Affairs (2012) Feasibility Study for a Long-Term Solution to address the Acid Mine Drainage associated with the East, Central and West Rand underground mining basins. Study Report No. 9.1: Communication Strategy and Action Plan- DWA Report No.: P RSA 000/00/16912/1 \.
- Schurink, W. Fouché, C.B. & de Vos, A.S. (2011). Qualitative data analysis and interpretation. In A.S. de Vos, H. Strydom, C.B., Fouché, & C.S.L Delpont. *Research at grass roots*. Pretoria: Van Schaik Publishers.

- Diekers, M. and Von Grote, C. (Eds.). (2005). *Between Understanding and Trust: The Public, Science and Technology*. 1st ed. New York: Routledge.
- Do it for Charity (2018). *Gallery Of Academic Leaders Profile*. [online] Doit4charity.co.za. Available at: <http://www.doit4charity.co.za/charity/1502> [Accessed 15 May 2016].
- Doody, O. and Bailey, M. (2016). Setting a research question, aim and objective. *Nurse Researcher*, 23(4), pp.19-23.
- Drake, J., Kontar, Y. and Rife, G. (2014). *New trends in Earth-Science outreach and engagement: The Nature of Communication*. Cham: Springer.
- du Plooy-Cilliers, F. (2014). Research Paradigms and Traditions. In: F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Dunlap, R.E. and Jacques, P. (2013). Climate Change Denial Books and Conservative Think Tanks. *American Behavioral Scientist*, [online] 57(6), pp.699-731. Available at: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3787818/>.
- Dunlap, R.E. and McCright, A.M. (2015). (Eds.). Organized Climate Change Denial. In R.E Dunlap, and A.M McCright. *The Oxford Handbook of Climate Change and Society: Sociological Perspectives*. Oxford University Press.
- Duraiappah, A., Roddy, P. and Parry, J. (2005). *Have Participatory Approaches Increased Capabilities?*. Winnipeg, Man.: International Institute for Sustainable Development.
- Durdella, N. (2019). *Qualitative Dissertation Methodology: A Guide for Research Design and Methods*. California: Sage.
- Ejembi, E. and Alfa, G. (2012). Perceptions of Climate Change in Africa: Regional Agricultural Perspectives. *Research on Humanities and Social Sciences*, [online] 2(5)), pp.1-7.
- Eskom Expo for Young Scientists (2019). *Home 1 | Eskom Expo*. [online] Exposcience.co.za. Available at: <http://exposcience.co.za/> [Accessed 15 Mar. 2018].
- Etikan, I., Musa, S. A., & Alkassim, R. S. (2016). Comparison of Convenience Sampling and Purposive Sampling. *American Journal of Theoretical and Applied Statistics*, [online] 5(1), pp.1. Available at: European Academies Science Advisory Council (2019). *Carbon capture and storage in Europe*. EASAC policy report 20. Norway: EU Member States.

- Feldpausch-Parker, A., Burnham, M., Melnik, M., Callaghan, M. and Selfa, T. (2015). News Media Analysis of Carbon Capture and Storage and Biomass: Perceptions and Possibilities. *Energies*, [online] 8(4), pp.3058-3074. Available at: <https://doi.org/10.3390/en8043058>.
- Feldpausch-Parker, A.M. Communicating Carbon Capture and Storage Technologies: Opportunities and Constraints across Media. (2010). Doctorate. Texas A&M University.
- Flick, U. (2013). *The SAGE handbook of qualitative data analysis*. Berlin: SAGE Publications Ltd.
- Folger, P. (2013). *Carbon Capture: A Technology Assessment*. Congressional Research Council. [Online] Washington D.C: Congressional Research Service. Available at: <https://fas.org/sgp/crs/misc/R41325.pdf> [Accessed 16 May 2016].
- Fritz, M. (2014). *An assessment of different public engagement and communication techniques for diverse audiences in South Africa with recommendations for the Pilot CO2 Storage Project*. Unpublished Masters. University of the Witwatersrand.
- Fusch, P. I., & Ness, L. R. (2015). Are We There Yet? Data Saturation in Qualitative Research. *The Qualitative Report*, 20(9), pp. 1408-1416. Retrieved from <https://nsuworks.nova.edu/tqr/vol20/iss9/3> [Accessed 16 Feb. 2017].
- Gauteng Department of Agriculture & Rural Development (2015). *The Development of the Gauteng Greenhouse Gas Emissions Inventory: Phase 1. Report on GHG Data Collection and Calculation of Emissions*. Johannesburg: Gauteng Department of Agriculture & Rural Development.
- Gideon, L. (2012). *Handbook of Survey Methodology for the Social Sciences*. New York: Springer.
- Glazewski, J., Gilder, A. and Swanepoel, E. (2012). Carbon Capture and Storage (CCS): Towards a Regulatory and Legal Regime in South Africa. *Institute of Marine and Environmental Law (IMEL) and African Climate and Development Initiative (ACDI)*. [Online] Available at: http://www.law.uct.ac.za/usr/law/downloads/ccsworkshop_sept2012.pdf [Accessed 13 Apr. 2017].

- Global CCS Institute (2014). *The Global Status of CCS: 2014*. Status Report. [online]
London: Global CCS Institute, p.15. Available at:
<https://hub.globalccsinstitute.com/sites/default/files/publications/180923/global-status-ccs-2014.pdf> [Accessed 13 May 2015].
- Global CCS Institute (2015). *Global Status of Carbon Capture and Storage, 2014*. [online]
London: Global CCS Institute. Available at:
<https://hub.globalccsinstitute.com/sites/default/files/publications/180923/global-status-ccs-2014.pdf> [Accessed 5 May 2015].
- Godfrey, A., Le Roux-Rutledge, E., Cooke, S. and Burton, M. (2014). Africa Talks Climate: The Public Understanding of Climate Change in Ten Countries. *Africa Talks Climate*. [Online] London: BBC World Service Trust. Available at:
<http://downloads.bbc.co.uk/rmhttp/mediaaction/pdf/AfricaTalksClimateExecutiveSummary.pdf> [Accessed 12 Mar. 2016].
- Gough, C., O'Keefe, L. and Mander, S. (2014). Public Perceptions of CO₂ Transportation in Pipelines. *Energy Policy*, [online] 70, pp.106-114. Available at:
<https://www.sciencedirect.com/science/article/pii/S0301421514002067>.
- Gray, D.E. (2014). *Doing research in the real world*. London: Sage
- Graziano, A. and Raulin, M. (2017). *Research Methods: A Process of Inquiry*. 6th ed.
Harlow: Pearson Education UK.
- Grbich, C. (2013). *Qualitative Data Analysis: An Introduction*. 2nd ed. Los Angeles: Sage.
- Greenhalgh, T., Robert, G., Macfarlane, F., Bate, P. and Kyriakidou, O. (2004). Diffusion of Innovations in Service Organizations: Systematic Review and Recommendations. *The Milbank Quarterly*, [online] 82(4), pp.581-629. Available at:
<https://www.ncbi.nlm.nih.gov/pubmed/15595944>.
- Hallegatte, S., Bangalore, M., Bonzanigo, L., Fay, M., Kane, T., Narloch, U., Rozenberg, J., Treguer, D. and Vogt-Schilb, A. (2016). *Shock Waves: Climate Change and Development Series Managing the Impacts of Climate Change on Poverty*. Washington, D.C: World Bank Group.
- Hammond, J. and Shackley, S. (2019). *Towards a public communication and engagement strategy for carbon capture and storage in Scotland: A review of research finding*,

- CCS project experiences, tools, resources and best practices. Working Paper. Edinburgh: Scottish Carbon Capture and Storage.
- Hardisty, P., Sivapalan, M. and Brooks, P. (2011). The Environmental and Economic Sustainability of Carbon Capture and Storage. *International Journal of Environmental Research and Public Health*, 8(5), pp.1460-1477.
- Harris, J. and Roach, B. (2016). Global Climate Change: Science and Economics. In: J. Harris and B. Roach, ed., *Environmental and Natural Resource Economics: A Contemporary Approach*, 4th ed. London: Taylor & Francis Ltd.
- Hart, C. (2018). *Doing a literature review*. 2nd ed. London: Sage Publications.
- Hashemnezhad, H. (2015). Qualitative content analysis research: a review article. *Journal of ELT and applied linguistics*, 1(3):54-62.
- Heaver, R. (2001). Participatory Rural Appraisal: Potential Applications in Family Planning, Health and Nutrition Programmes. *RRA Notes*, 1992(16).
- Ho, E., Budescu, D., Dhami, M. and Mandel, D. (2015). Improving the communication of uncertainty in climate science and intelligence analysis. *Behavioral Science & Policy*, 1(2), pp.43-55.
- Hsieh, H-F. & Shannon, S.E. (2005). Three Approaches to Qualitative Content Analysis. *Qualitative health research*, 15(9): 1277-1288.
- Imenda, S. (2014). Is There a Conceptual Difference between Theoretical and Conceptual Frameworks? *Journal of Social Sciences*, 38(2), pp.185-195.
- Intergovernmental Panel on Climate Change (2012). *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. Reports. Cambridge: Cambridge University Press, pp.15-17.
- International Energy Agency (2013). *Technology Roadmap: Carbon Capture and Storage*. Energy Technology Perspectives. [Online] Paris: International Energy Agency. Available at: <https://www.iea.org/publications/freepublications/publication/TechnologyRoadmapCarbonCaptureandStorage.pdf> [Accessed 14 Apr. 2016].
- International Energy Agency (2016). *20 Years of Carbon Capture and Storage: Accelerating Future Deployment*. [Online] Paris: International Energy Agency. Available at:

https://www.eenews.net/assets/2016/11/15/document_gw_04.pdf [Accessed 10 Jul. 2017].

Jacobson, S., Seavey, J. and Mueller, R. (2016). Integrated science and art education for creative climate change communication. *Ecology and Society*, [online] 21(3), pp.30. Available at: <https://www.ecologyandsociety.org/vol21/iss3/art30/>.

Jeffrey, K.W. (2006) "Doing a Literature Review." Naval Postgraduate School, Harvard University.

Johansson, T., Patwardhan, A., Nakicenovic, N., and Gomez-Echeverri L. (2012). *Global energy assessment: Toward a Sustainable Future* Cambridge: Cambridge University Press.

Jooste, J. and van der Vyver, C. (2014). Participatory Communication and Perceptions amongst Staff Members at a Tertiary Education Institution. *Mediterranean Journal of Social Sciences*, 5(7), pp.631-646

Jylhä, K. (2016). Refusing to Acknowledge the Problem of Climate Change Denial. In G. Sosa-Nunez and E. Atkins, (eds.). *Environment, Climate Change and International Relations*. [online] Bristol: E-International Relations Publishing. Available at: <https://www.files.ethz.ch/isn/196627/Environment-Climate-Change-and-IR-E-IR.pdf> [Accessed 18 Apr. 2017].

Karakaya, E., Hidalgo, A. and Nuur, C. (2014). Diffusion of eco-innovations: A review. *Renewable and Sustainable Energy Reviews*, 33, pp.392-399.

Karayannis, V., Charalampides, G. and Lakioti, E. (2014). Socio-economic Aspects of CCS Technologies. *Procedia Economics and Finance*, 14, pp.295-302.

Kheerajit, C. and Flor, A. (2013). Participatory Development Communication for Natural Resources Management in Ratchaburi Province, Thailand. *Procedia - Social and Behavioral Sciences*, 103, pp.703-709.

Kilewo, E. and Frumence, G. (2015). Factors that hinder community participation in developing and implementing comprehensive council health plans in Manyoni District, Tanzania. *Global Health Action*, 8(1), pp.1-10.

Killam, L. (2013). *Research Terminology Simplified: Paradigms, Axiology, Ontology, Epistemology and Methodology*. [ebook] Sudbury: Author. Available at:

https://play.google.com/books/reader?id=nKMnAgAAQBAJ&hl=en_US&pg=GBS.PP3 [Accessed 11 Jun. 2018].

- King, N. and Horrocks (2010). *Interviews in Qualitative Research*. London: Sage.
- Kivunja, C. and Kuyini, A. (2017). Understanding and Applying Research Paradigms in Educational Contexts. *International Journal of Higher Education*, 6(5), pp.26-41.
- Koonin, M. (2014). Validity and Reliability. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, eds., *Research Matters*. Cape Town: Juta
- Korstjens, I and Moser, A (2018) Series: Practical guidance to qualitative research. Part 4: Trustworthiness and publishing, *European Journal of General Practice*, 24:1, 120-124, DOI: 10.1080/13814788.2017.1375092
- Kulichenko, N. and Ereira, E. (2011). *Carbon Capture and Storage in Developing Countries: A Perspective on Barriers to Deployment*. Washington D.C: World Bank Group.
- Kumar, R. (2011). A Purposive Communication with Social Conscience - an Indian Perspective. *Global Media Journal – Indian Edition*, 2(2), pp.7.
- Leung, D., Caramanna, G. and Maroto-Valer, M. (2014). An overview of current status of carbon dioxide capture and storage technologies. *Renewable and Sustainable Energy Reviews*, 39, pp.426-443.
- Løvseth, S. and Wahl, P. (2012). ECCO Tool: Analysis of CCS value chains. *Energy Procedia*, 23, pp.323-332.
- Lunenborg, F. (2010). Communication: The Process, Barriers, and Improving Effectiveness. *Communication Schooling: Sam Houston State University*, 1(1), pp.1-2.
- Luo, Y. (2014). The Internet and Agenda Setting in China: The Influence of Online Public Opinion on Media Coverage and Government Policy. *International Journal of Communication*, 8, pp.1289–1312 [online] 8. Available at: <https://ijoc.org/index.php/ijoc/article/download/2257/1133> [Accessed 7 Nov. 2016].
- Madziwa, F., Betzold, C., Makombe, K. and Harris, P. (2014). *20 years of African CSO involvement in climate change negotiations*. Cape Town: Heinrich Boll Stiftung Southern Africa.

- Magongo, M. (2019). *Ripples of empowerment?: Exploring the role of participatory development communication in the Biesje Poort Rock Art Recording Project*. Unpublished Masters. University of KwaZulu-Natal.
- Markowitz, E., Hodge, C. and Harp, G. (2014). *Connecting on Climate: A Guide to Effective Climate Change Communication*. Columbia: Centre for Research on Environmental Decisions
- Markusson, N., Ishii, A. and Stephens, J. (2011). The social and political complexities of learning in carbon capture and storage demonstration projects. *Global Environmental Change*, 21(2), pp.293-302.
- Markusson, N., Shackley, S., and Evar, B. (Eds.). (2012). *The Social Dynamics of Carbon Capture and Storage: Understanding CCS Representations, Governance and Innovation*. Abingdon: Earthscan.
- Martin, N. and Rice, J. (2014) Rebalancing Climate Change Debate and Policy: An Analysis of Online Discussions. *Environmental Policy and Governance*. Volume 24, Issue 5.
- Marzuki, A. (2015). Challenges in the Public Participation and the Decision Making Process. *Sociologija i prostor*, Pregledni rad. 53 (2015) 201 (1), pp. 21-39.
- Masipa, T. S. (2017). The impact of climate change on food security in South Africa: Current realities and challenges ahead. *Jàmbá Journal of Disaster Risk Studies*, Vol. 9(1).
- Mazzoldi, A., Rinaldi, A., Borgia, A. and Rutqvist, J. (2012). Induced seismicity within geological carbon sequestration projects: Maximum earthquake magnitude and leakage potential from undetected faults. *International Journal of Greenhouse Gas Control*, 10, pp.434-442.
- McCombs, M. and Valenzuela, S. (2007). The Agenda-Setting Theory / La Teoría Agenda-Setting. *Cuadernos Info*, (20), pp.44-51.
- McCombs, M., Shaw, D. and Weaver, D. (2014). New Directions in Agenda-Setting Theory and Research. *Mass Communication and Society*, 17(6), pp.781-802.
- McCoy, S. (2014). *Carbon capture and storage: Legal and regulatory review - Edition 4*. Insights Series 2014. Paris: International Energy Agency.

- McGee-Chiusano, L. (2015). *The Unclouded Mind: Spiritual Insights for Personal Development and Healing*. Bloomington: Balboa Publishers.
- McKie, R. (2018). Climate Change Counter Movement Neutralization Techniques: A Typology to Examine the Climate Change Counter Movement. *Sociological Inquiry*, 89(2), pp.288-316.
- Metz, B., Davison, O., De Coninck, H., Loss, M. and Meyer, L. (2005). *IPCC Special Report on CCS | Global CCS Institute*. [Online] Hub.globalccsinstitute.com. Available at: <https://hub.globalccsinstitute.com/publications/ccs-site-characterisation-criteria/21-ippcc-special-report-ccs> [Accessed 19 Apr. 2015].
- Michel, C. (2008). *Implementing a Forensic Educational Package for Registered Nurses in Two Emergency Departments in Western Australia*. Unpublished Doctorate. University of Notre Dame Australia.
- Miller, J. (2016). *Promoting sustainable development in South Africa: Environmental Regulation in Support of Renewable Energy*. Postgraduate. University of the Western Cape.
- Ming, K. (2005). Research questions and research objectives. *The Family Physician*, 13(3), pp.25-26.
- Mnkeni, P. and Mutengwa, C. (2014). *A comprehensive scoping and assessment study of climate smart agriculture policies in South Africa*. Pretoria: FANRPAN.
- Modiko, P., Ngcobo, W., Tshivhase, T., Raselavhe, R., Surridge, T. and Beck, B. (2014). The Unique Challenges for CCS Public Engagement in South Africa. *Energy Procedia*, 63, pp.7047-7052.
- Monash University (2018). *Ethical Research and Approvals: Human Research Ethics Committee Procedures*. [online] Monash.edu. Available at: https://www.monash.edu/__data/assets/pdf_file/0010/797302/Ethical-Research-and-Approvals-Human-Research-Ethics-Committee-Procedures.pdf [Accessed 18 Nov. 2018].
- Moser, S. (2010). Communicating climate change: history, challenges, process and future directions. *Wiley Interdisciplinary Reviews: Climate Change*, [online] 1(1), pp.31-53. Available at: <https://onlinelibrary.wiley.com/doi/full/10.1002/wcc.11>.

- Msibi, F. and Penzhorn, C. (2010). Participatory communication for Local Government in South Africa: A Study of the Kungwini Local Municipality. *Information Development*, 26(3), pp.225-236.
- Murgan, M. (2015). A Critical Analysis of the Techniques for Data Gathering in Legal Research. *Journal of Social Sciences and Humanities*, [online] 1(3), pp.266-274. Available at: <http://www.aiscience.org/journal/jssh> [Accessed 14 Jul. 2017].
- Naidoo, L. (2010). *The Participatory Development Communication Approach of Thusong Service Centres in Tshwane*. Masters. University of North-West.
- National Academy of Sciences. (2014). Climate Change: Evidence and Causes. *The National Academies of Sciences, Engineering and Medicine*. [Online] Available at: <https://www.nap.edu/catalog/18730/climate-change-evidence-and-causes> [Accessed 14 Jan. 2017].
- National Academy of Sciences. (2017) Communicating Science Effectively: A Research Agenda. (2017). Washington, DC. The National Academies Press.
- Neale, J. (2016). Iterative categorization (IC): a systematic technique for analysing qualitative data. *Addiction*, 111(6):1096-1106.
- Nelson, T., Oxley, Z. and Clawson, R. (1997). Toward a Psychology of Framing Effects. *Political Behavior*, [online] 3(19), pp.221-246. Available at: <http://www.jstor.org/stable/586517> [Accessed 9 Sep. 2017].
- Neuman, L. (2014). *Social Research Methods: Qualitative and Quantitative Approaches*. 7th ed. Essex: Pearson Education Limited.
- Ngwainmbi, E. ed., (2014). *Healthcare Management Strategy, Communication and Development Challenges and Solutions in Developing Countries*. Lanham: Lexington Books.
- Nkwake, A. (2016). *Credibility, validity, and assumptions in program evaluation methodology*. 1st ed. Louisiana: Springer International.
- Noriey, I. (2017). *How to Improve Leadership in Higher Education Institutions: The Impact of the Leadership Skills for Leaders in Higher Education Institutions in Kurdistan*. Bloomington: Author House.

- Norton-Smith, K., Kathy, I., Chief, K., Cozzeto, K., Danatuto, J., Hiza, R., Margaret, K., Linda, E., Maldonado, J., Viles, C. and Whyte, K. (2016). *Climate Change and Indigenous Peoples: A Synthesis of Current Impacts and Experiences*. General Technical Report. [Online] Pacific Northwest: US Department of Agriculture. Available at: https://www.fs.fed.us/pnw/pubs/pnw_gtr944.pdf [Accessed 12 Mar. 2017].
- Nowell, L.S., Norris, J.M., White, D.E. & Moules, N.J. (2017). Thematic Analysis: Striving to Meet the Trustworthiness Criteria. *International Journal of Qualitative Methods*, 16: 1–13.
- Oduniyi, S., Mpandeli, S. and Maponya, P. (2013). Climate Change Awareness in Mpumalanga Province, South Africa. *Journal of Agricultural Science*, 5(10), pp.273-279.
- Oltra, C. and Sala, R. (2014). A Review of the Social Research on Public Perception and Engagement Practices in Urban Air Pollution. *Informes Técnicos Ciemat*, [online] 13(17), pp.3. Available at: https://inis.iaea.org/collection/NCLCollectionStore/_Public/45/046/45046419.pdf [Accessed 12 Oct. 2016].
- Ormston, R., Spencer, L., Barnard, M., & Snape, D. (2014). The foundations of qualitative research. In J. Ritchie, J. Lewis, C. Nicholls & R. Ormston (Eds.), *Qualitative Research Practice: A Guide for Social Science Students and Researchers* (pp. 1-25). Los Angeles: Sage.
- Osborn, D., Cutter, A. and Ullah, F. (2015). *Universal Sustainable Development Goals: Understanding the Transformational Challenge for Developed Countries*. Report of a Study by Stakeholder Forum. [Online] Utrecht: Stakeholder Forum. Available at: <https://library.concordeurope.org/record/1759/files/DEEEP-REPORT-2016-048.pdf> [Accessed 3 Sep. 2016].
- Pannu, P. and Tomar, Y. (2010). *ICT4D information communication technology for development*. New Delhi: I.K. International Pub. House.
- Parker, C., Cockerham, D. and Foss, A. (2018). Communicating Climate Change: Lessons Learned from a Researcher-Museum Collaboration. *Journal of Microbiology & Biology Education*, 19(1): 1-5.

- Pascoe, G. (2014). Sampling. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Pearce, W., Brown, B., Nerlich, B. and Kotevko, N. (2015). Communicating climate change: conduits, content, and consensus. *Wiley Interdisciplinary Reviews: Climate Change*, 6(6), pp.613-626.
- Pereira, L. (2017). Climate Change Impacts on Agriculture across Africa. *Oxford Research Encyclopaedia*, (March 2017).
- Pham, L. (2018). *Qualitative Approach to Research: A Review of Advantages and Disadvantages of Three Paradigms: Positivism, Interpretivism and Critical Inquiry..* MEd Program. University of Adelaide.
- Pidgeon, N. (2012). Climate Change Risk Perception and Communication: Addressing a Critical Moment?. *Risk Analysis*, 32(6), pp.951-956.
- Pietersen, K., Pearce, D. and Vernon, R. (2013). *Impacts of Carbon Capture and Storage (CCS) on South African National Priorities Other Than Climate Change*. Sandton: South African National Energy Development Institute.
- Prangnell, M. (2013). *Communications for Carbon Capture and Storage: Identifying the Benefits, Managing Risk and Maintaining the Trust of Stakeholders*. Publications, Reports & Research. London: Global Carbon Capture and Storage Institute Limited.
- Ponelis, S. (2015). Using Interpretive Qualitative Case Studies for Exploratory Research in Doctoral Studies: A Case of Information Systems Research in Small and Medium Enterprises. *International Journal of Doctoral Studies*, 10, pp.535-550.
- Rahman, M. (2016). The Advantages and Disadvantages of Using Qualitative and Quantitative Approaches and Methods in Language "Testing and Assessment" Research: A Literature Review. *Journal of Education and Learning*, 6(1), p.102-103.
- Rajasekar, S., Philominathan P., and Chinnathambi V. (2013) Research Methodology [Manuscript] at: Cornell University online library.
- Ramdhani, A., Ramdhani, A. and Amin, A. (2014). Writing a Literature Review Research Paper: A step-by-step approach. *International Journal of Basic and Applied Science*, 3(1), pp.47-56.

- Rehman, A. and Alharthi, K. (2016). An Introduction to Research Paradigms. *International Journal of Educational Investigations*, 3(9), pp.51-56.
- Reiner, D., Curry, T., De Figueiredo, M., Herzog, M., Ansolabehere, S., Itaoka, K., Akai, M., Johnsson, F. and Odenbege, M. (2006). An International Comparison of Public Attitudes towards Carbon Capture and Storage Technologies. In *Greenhouse Gas Technology Eight Conference*. London: University of Edinburgh.
- Ringrose, P. (2018). The CCS hub in Norway: some insights from 22 years of saline aquifer storage. *Energy Procedia*, 146, pp.166-172.
- Rogers, E. (2003). *Diffusion of innovations*. 5th ed. New York: Free Press.
- Rojas-Downing, M., Nejadhashemi, A., Harrigan, T. and Woznicki, S. (2017). Climate change and livestock: Impacts, adaptation, and mitigation. *Climate Risk Management*, 16, pp.145-163.
- Roosen, L., Klöckner, C. and Swim, J. (2017). Visual art as a way to communicate climate change: a psychological perspective on climate change-related art. *World Art*, 8(1), pp.85-110.
- Rothmann-Guest, L., Killian, D. and Maharaj, V. (2012). *Carbon Capture and Storage Initiating Stakeholder Engagement: National and Local Stakeholder Engagement Plans*. Pretoria: World Bank Group.
- Rowe, F. (2014). What literature review is not: diversity, boundaries and recommendations? *European Journal of Information Systems*, 23(3), pp.241-255.
- Rudiak-Gould, P. (2012). Promiscuous corroboration and climate change translation: A case study from the Marshall Islands. *Global Environmental Change*, 22(1), pp.46-54.
- Rütters, H. and CGS Europe partners (2013). *State of play on CO₂ geological storage in 28 European countries*. Report No. D2.10. CGS Europe, pp.1-89.
- Sáenz-Royo, C., Gracia-Lázaro, C. and Moreno, Y. (2015). The Role of the Organization Structure in the Diffusion of Innovations. *PLOS ONE*, 10(5), pp.1-13.
- Sahin, I. (2006). Detailed Review of Rogers' Diffusion of Innovations Theory and Educational Technology-Related Studies Based on Rogers' Theory. *The Turkish Online Journal of Educational Technology*, [online] 5(2). Available at: <https://eric.ed.gov/?id=ED501453> [Accessed 14 Apr. 2016].

- Saraswat, C. and Kumar, P. (2016). Climate justice in lieu of climate change: a sustainable approach to respond to the climate change injustice and an awakening of the environmental movement. *Energy, Ecology and Environment*, 1(2), pp.67-74.
- Servaes, J. and Malikhao, P. (2005). Media and Glocal Change: Rethinking Communication for Development. In: O. Hemer and T. Tufte, eds., *Participatory communication: The new paradigm?* Online Book: NORDICOM/CLASCO.
- Shah, H. (2011). *The Production of Modernization: Daniel Lerner, Mass Media, and "the Passing of Traditional Society*. Philadelphia: Temple University Press.
- Shahzad, A. and Bokhari, S. (2014). Development Support Communication: Problems and Suggestions. *Journal of Mass Communication & Journalism*, 04(05), pp.1-6.
- Shaw, E. (1979). Agenda-Setting and Mass Communication Theory. *Gazette (Leiden, Netherlands)*, 25(2), pp.96-105.
- Shome, D., and Marx, S. (2009). *The Psychology of Climate Change Communication: A Guide for Scientists, Journalists, Educators, Political Aides, and the Interested Public*. Center for Research on Environmental Decisions. New York.
- South African Centre for Carbon Capture & Storage (2018). *What is Carbon Capture and Storage (CCS)?* [Online] SACCCS. Available at: https://www.sacccs.org.za/cm4all/iproc.php/FAQs/What%20is%20CCS.pdf?cdp=a&cm_odfile [Accessed 15 Oct. 2018].
- Spence, A., Poortinga, W., Butler, C. and Pidgeon, N. (2011). Perceptions of climate change and willingness to save energy related to flood experience. *Nature Climate Change*, 1(1), pp.46-49.
- Ssali, A., Poland, F. and Seeley, J. (2015). Volunteer experiences and perceptions of the informed consent process: Lessons from two HIV clinical trials in Uganda. *BMC Medical Ethics*, 16(1). pp. 1-14.
- Stephens, J. (2015). Carbon Capture and Storage: A Controversial Climate Mitigation Approach. *The International Spectator*, 50(1), pp.74-84.
- Stephens, J., Markusson, N. and Ishii, A. (2011). Exploring Framing and Social Learning in Demonstration Projects of Carbon Capture and Storage. In: *Tenth International Conference on Greenhouse Gas Control Technologies*. [Online] Amsterdam: Energy

Procedia. Available at: <https://doi.org/10.1016/j.egypro.2011.02.638> [Accessed 10 Aug. 2017].

- Steyn, B. and Nunes, M. (2001). Communication strategy for community development: a case study of the Heifer project – South Africa. *Communicatio*, 27(2), pp.29-48.
- Strydom, A., and Bezuidenhout, R. (2014). *Qualitative Data Collection*. In F. du Plooy-Cilliers, C. Davis and R. Bezuidenhout, ed., *Research Matters*. Cape Town: Juta.
- Stuckey, M. (2009). *Jimmy Carter, human rights, and the national agenda*. College Station, Tex.: Texas A & M University Press.
- Szulczewskia, L., MacMinnb, C., Herzogc, H. and Juanesa, R. (2012). *The lifetime of carbon capture and storage as a climate-change mitigation technology*. Washington, D.C.: United States. Dept. of Energy. Office of Science.
- Tagbo, E. (2010). *Media Coverage of Climate Change in Africa: A Case Study of Nigeria and South Africa*. Fellowship Paper. University of Oxford.
- Takeshita, T. (2006). Current Critical Problems in Agenda-Setting Research. *International Journal of Public Opinion Research*, 18(3), pp.275-296.
- Taniguchi, I., & Itaoka, K. (2016). CO₂ Capture, Transportation, and Storage Technology. In *Energy Technology Roadmaps of Japan: Future Energy Systems Based on Feasible Technologies Beyond 2030* (pp. 343-358). Springer Japan. https://doi.org/10.1007/978-4-431-55951-1_21
- Terwel, B. (2009). *Origins and Consequences of Public Trust: Towards an Understanding of Public Acceptance of Carbon Dioxide Capture and Storage*. Unpublished Doctoral Thesis. Leiden University.
- Thanh, N. and Thanh, T. (2015). The Interconnection between Interpretivist Paradigm and Qualitative Methods in Education. *American Journal of Educational Science*, [online] 1(2), pp.24-27.
- Theron, P. (2015). Coding and data analysis during qualitative empirical research in Practical Theology. *In die Skriflig/In Luce Verbi*, 49(3).
- Thomas, D. and Hodges, I. (2010). *Designing and Managing your Research Project: Core skills for Social and Health Research*. Los Angeles: SAGE.

- Thompson, R. (2014) South Africa's Media and the Strengthening of Democracy. *Rhodes Journalism Review*, 34, Sept 2014, pp. 7-10.
- Thronicker, R. and Lange, I. (2014). Determining the Success of Carbon Capture and Storage Projects. In: *CESifo Area Conference on Energy and Climate Economics*. [online] Munich: *The Electricity Journal*. Available at: <https://doi.org/10.1016/j.tej.2016.08.001> [Accessed 15 Mar. 2017].
- Tola, A. and Contini, V. (2015). From the Diffusion of Innovation to Tech Parks, Business Incubators as a Model of Economic Development: The Case of Sardegna Ricerche. In: *International Educational Technology Conference*. Pp. 115-134. [Online] Chicago: Procedia - Social and Behavioural Sciences. Available at: <https://doi.org/10.1016/j.sbspro.2015.01.502> [Accessed 15 May 2016].
- Tucker, O. (2018). *Carbon Capture and Storage*. Aberdeen, UK: Shell International Petroleum Company Limited.
- Tufte, T. and Mefalopulos, P. (2009). *Participatory Communication: A Practical Guide*. Washington, DC: World Bank.
- Tutore, I., Ferretti, M. and Simoni, M. (2013). Overcoming the Barriers to the Innovations Diffusion through Diffusion-Oriented Policies. *Italian Journal of Management*, [online] 94. Available at: <https://ojs.sijm.it/index.php/sinergie/article/view/178> [Accessed 15 Apr. 2017].
- Uddin, M. and Anjuman, N. (2014). Participatory rural appraisal approaches: an overview and an exemplary application of focus group discussion in climate change adaptation and mitigation strategies. *International Journal of Agricultural Research, Innovation and Technology*, 3(2), pp.72-78.
- UMhlabuyalingana Local Municipality (2017). *2016/17 Annual Report*. Annual Reports. [Online] Manguzi: UMhlabuyalingana Local Municipality, pp.1-50. Available at: http://www.umhlabuyalingana.gov.za/docs/reports/20180504/2016-2017_ANNUAL_REPORT.pdf [Accessed 10 Jun. 2016].
- UNICEF. (2011). Exploring the Impact of Climate Change on Children in South Africa. Pretoria: *UNICEF* South Africa

- United Nations. (2011). Report of the Conference of the Parties on its seventeenth session. In: *COP17*. Washington D.C: United Nations Framework Convention on Climate Change.
- United Nations. (2015) "The Millennium Development Goals Report 2015." United Nations Millennium Development Goals, United Nations.
- Van de Fliert, E. (2010). Participatory planning: Setting the agenda. In: P. Bromley and M. Thomas, eds., *An introduction to communication and social change*. Brisbane: UQ Press.
- Vos, M. and Schoemaker, H. (2006). *Monitoring public perception of organisations*. Amsterdam: Boom Onderwijs.
- Weintraub, S., Thomas-Maddox, C. and Byrnes, K. (2016). *Communicating in Your Personal, Professional and Public Lives - Ecommerce*. 1st ed. Dubuque: Kendall/Hunt Publishing Company.
- Williams, H.T., McMurray, J.R., Kurz, T. and Lambert, F.H., 2015. Network analysis reveals open forums and echo chambers in social media discussions of climate change. *Global Environmental Change*, 32, pp.126-138.
- Willig, C. (2013). *Introducing qualitative research in psychology*. 3rd Ed. Berkshire, England: McGraw Hill Education, Open University Press.
- Willis, J., Jost, M. and Nilakanta, R. (2007). *Foundations of qualitative research*. Thousand Oaks: SAGE.
- Windell, W. (2016). *Managing Climate Change: A Report on South Africa* Warwick Windell. Bachelor of Business Administration. Stenden South Africa.
- Yamauchi, L., Ponte, E., Ratliffe, K. and Traynor, K. (2017). Theoretical and Conceptual Frameworks Used in Research on Family–School Partnerships. *School Community Journal*, [online] 27(2), pp.1-11. Available at: <http://www.schoolcommunitynetwork.org/SCJ.aspx> [Accessed 16 Apr. 2019].
- Yan, B. (2015). *How to Write a Good Research Proposal*. Cape Peninsula University of Technology.
- Yin, R. K. (2011). *Qualitative Research from Start to Finish*. 2nd Ed. New York: The Guilford Press.

Yoro, K. and Sekoai, P. (2016). The Potential of CO₂ Capture and Storage Technology in South Africa's Coal-Fired Thermal Power Plants. *Environments*, 3 (4), pp.2.

Zheng, B. and Xu, J. (2014). Carbon Capture and Storage Development Trends from a Techno-Paradigm Perspective. *Energies*, 7(8), pp.5221-5250.

Zoback, M. and Gorelick, S. (2012). Earthquake triggering and large-scale geologic storage of carbon dioxide. *Proceedings of the National Academy of Sciences*, 109(26), pp.10164-10168.