The Transformative Role of the Planning Profession in Adaptation to and Mitigation against Climate Change: The Case Study of Umlazi Township

By

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DEDICATION

This dissertation is dedicated to my mother, my late father, and my daughter. My mother Regina Eunice Khanyile this is for you for being a prayerful mom and for always being my pillar of strength, with you, I always had a warm shoulder to cry on. My late father, Simon Msawenkosi Khanyile, you would be extremely proud that your little baby girl has been the first in the family to obtain a master's degree, it is through your love and guidance from heaven that I was able to achieve this. This is also dedicated to my beautiful daughter Uyapha Yamkelwa Mbotheni. I hope one day you will read this and be inspired to work even harder than I did. Grow up to be something bigger than your mother and instill the same courtesy to your own kids one day.

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LIST OF ACRONYMS

APA : American Planning Association

CBD : Central Business District

COGTA : Department of Cooperative Governance and Traditional Affairs

CO^2 : Carbon Dioxide

CPWF : Challenge Programme on Water and Food

DCCS : Durban Climate Change Strategy

DFA : Development Facilitation Act 67 of 1995

DMOSS : Durban Metropolitan Open Spaces System

DRDLR : Department of Rural Development & Land Reform

EPCPD : Environmental Planning and Climate Protection Department

GEF : Global Environment Facility

GHGs : Greenhouse Gases

IPCC : Intergovernmental Panel on Climate Change

LRB : Limpopo River Basin

MDGs : Millennium Development Goals

NDRC : National Defense Resources Council

NCCARF : National Climate Change Adaptation Research Facility

NDC : Nationally Determined Contributions

NDP : National Development Plan

NHBRC : National Home Builders Registration Council

NDRC : National Defense Resources Council

OECD : Organisation for Economic Co-operation and Development

PPA : Physical Planning Act

RDP : Reconstruction and Development Programme

RSA : Republic of South Africa

SDGs : Sustainable Development Goals

SPLUMA : Spatial Land Use and Management Act 16 of 2013

TRC : Truth and Reconciliation Commission

UK : United Kingdom

UNFCCC : United Nations Framework Convention on Climate Change

UNDP : United Nations Development Programme

WCED : World Commission on Environment and Development

ABSTRACT

In a 4th industrial revolution world, cities are recognized as essential places for tackling the prominent environmental issue of climate change, both by reducing greenhouse gas emissions and adjusting to the adverse impacts of climate change. In its accelerating form more especially in developing countries, it is best to address both the causes and the impacts climate change has holistically. Besides, allowing both these strategies to take place enables other professions to contribute towards achieving the common goal of reducing or rather eradicate climate change. The main purpose of this research study is to investigate the transformative role that the town planning fraternity plays in adaptation to and mitigation against climate change using Umlazi Section H, eThekwini Municipality, as a case study. The research method used for this study was qualitative approach. The method was used in conjunction with in-depth interviews, focus groups and observation to gather data. The study revealed that the planning profession plays a vital role in conjunction with other departments/branches such as the environmental planning and climate protection and the department of transport in achieving climate change adaptation and mitigation. The study found that this is achieved through monitoring and reducing greenhouse gas emissions from both private cars and public transport, advocating for green building designs, and transitioning from coal-based energy to renewable energy, and managing land use. To build on this success, the researcher recommends that the collaborative teamwork between the involved departments continues and for each department to play its role to ensure effectiveness and efficiency of these strategies.

1. Chapter One: Introduction

1.1 Background of the study

There is a natural amount of carbon dioxide (CO^2) in the atmosphere, which, combined with other greenhouse gases, helps hold the Planet at an average temperature of 15°C and maintains a stable global climate (Department of Rural Development and Land Reform (DRDLR), 2013). However, increased human activity, especially the combustion of fossil fuels, has exceeded the natural CO^2 balance in the atmosphere, causing the Earth to rapidly warm (DRDLR, 2013). Global warming is triggering climate changes such as extreme weather trends, increasing sea levels, and changes in precipitation (DRDLR, 2013). These environmental changes result in what is known as climate change, which threatens the way societies relate to and live inside the natural world globally (DRDLR, 2013).

In March 2018, UN Secretary-General Antonio Guterres described climate change as "the most violent and systemic threat to humanity" (Welborn, 2018). Climate change is a global phenomenon that has sparked widespread concern as a significant current and potential public problem that affects all facets of life. It is one of the most pressing issues facing both local and global communities (Francis, 2015), posing a challenge to long-term development, poverty reduction, and Millennium Development Goals (MDGs) achievement, especially in Africa. It is one of the most urgent issues facing both local and global communities (Francis, 2015), posing a challenge to long-term development, poverty reduction, and environmental sustainability (Francis, 2015). Climate change's negative effects are already being felt on the continent and across the world, with more regular instances of climate disasters like storms, droughts, and heat waves (African Development Bank Brochure, 2012). For instance, the director of Australia's National Climate Change Research Facility (NCCARF), who took over in 2008, indicates that climate change is also evident in Australia. Amongst other things, Burton (2014) mentions that he has seen a record-breaking heat wave in the southern capitals, floods in Queensland and devastating bushfires in Victoria and Tasmania (Burton, 2014).

As a consequence, the American Planning Association (APA) expresses that town planners will play a critical role in preparing or adjusting communities to future climatic conditions. This has been taken into account since, as previously mentioned, ending poverty and combating climate

change are two of the most pressing issues of our time (Scerdeczny et al., 2017). According to Scerdeczny (2017), anthropologists are seeing the local effects of climate change, as well as larger social, cultural, and political issues, with their field partners (Scerdeczny et al., 2017). He further expresses that, "Everywhere we go, we meet people sharing similar stories about the weather and climate changes they notice." Northern Canada and Greenland, for example, are concerned about sea ice thinning and melting, northern Fennoscandia is concerned about shifting prevailing winds and the loss of precious pasture for their herds, Sub-Saharan African villagers are concerned about the depletion of their glaciers, their primary source of water, and facing increasing desertification, and while South Pacific islanders are concerned about rising tides that threaten to swallow their homes and are at loss for words (Change, 2016).

Owing to a lack of physical infrastructure, the poor and those living on the outskirts of cities are becoming more vulnerable to climate change as the impacts of climate change become more apparent across the world. Adaptation and mitigation have been receiving increasing attention as an action to respond to observed climate events. Most communities have already adopted adaptation and mitigation strategies in the form of policies for predicting and reacting to climate change disasters (Washington Chapter, 2015). As a response to climate change, international and national initiatives such as the Intergovernmental Panel on Climate Change (IPCC) and the National Development Plan (NDP) have been developed. The IPCC works on national adaptation and mitigation policies, which act as a common point of reference for climate change and a platform for articulating the country's national climate change adaptation and mitigation priorities to provide overarching guidance to all sectors of the economy (RSA, 2017).

On a global scale, the IPCC assesses empirical evidence related to various aspects of the climate change crisis, such as greenhouse gas emissions, to ascertain the environmental and socio-economic consequences of climate change (IPCC, 1996c). The National Development Plan, on the other hand, offers realistic guidance to assist parties to international climate change treaties in developing national greenhouse gas inventories (NDP, 2011, 2013, 2018). Climate change planning varies in that it considers future climate conditions, which will continue to change. Climate policies are usually focused on optimizing the positive aspects of climate impacts (e.g., a good growing season) while minimizing possible negative impacts (e.g., a reduction in flood vulnerability), considering the budgetary costs and benefits of alternative courses of action (Washington Chapter, 2015).

Provided that climate change has been and is continuing to be an overarching challenge worldwide, it is in the interest of this research study to use the case of Umlazi Township (Section H) at eThekwini Municipality, to investigate the transformative tools used by the planners to enable the society in adapting to and mitigate climate change. The eThekwini Municipality will be used as a case study in this research since it is one of Africa's largest cities and ports, facing immense developmental problems, and has also been repeatedly impacted by climate change tragedies, with few writings about the magnitude of the harm it causes in communities.

For instance, just recently Umlazi Township community was badly affected by the disaster and an emergency catastrophe of climate change symptom, flooding. According to the IOL News Reporter (Dludla, 2019), floods struck Umlazi Township on April 28, 2019, destroying at least 124 homes and claiming the lives of more than 14 people in Umlazi Township alone. On a Tuesday, this was when heavy rains and flooding wreaked havoc on Durban's low-lying areas (Dludla, 2019). However, even after such a traumatic experience for Umlazi Township and eThekwini community at large, there are still not much detailed writings, while the questions of how it occurred, what might have been a cause of this symptom and of how the problem can be cured are increasingly manifesting.

1.2 Research Problem

EThekwini Metropolitan Municipality hosted the 17th United Nations Framework Convention on Climate Change (UNFCCC) in 2011, reminding the world that climate change is the biggest threat to global health, the environment, social and economic development, and poverty alleviation (Taylor et., 2014). Climate change has had the potential to jeopardize all South Africa's advances in economic development since 1994, as well as exacerbate the issue of our already vulnerable societies. The frequency and duration of extreme weather events like hurricanes, drought, rising sea levels, as well as the frequency and intensity of flash floods and coastal storms, threatens lives in these front-line communities. It was noted that Greenhouse Gases (GHGs) are a major cause of global warming.

This study concentrates on the impacts that climate change has in the built environment. According to the Intergovernmental Panel on Climate Change (1995), warmer atmospheric temperatures associated with greenhouse warming lead to a more vigorous hydrological cycle of extreme rainfall events which further leads to flooding (IPCC, 1995). Ezeabasili and Okonkwo (2013) observes flooding in urban areas where the impacts of extreme rainfall are exacerbated by high

concentrations of impervious surface, infrastructure, buildings, property, and people (Ezeabasili and Okonkwo, 2013). Flooding has serious implications for both buildings and physical infrastructure, as extreme flows of water during heavy rainfall events damages both overland and underground stormwater management infrastructure and road pavements (Ezeabasili and Okonkwo, 2013). According to Ashley et al., (2005), flood risk is further complicated by the performance of the urban drainage system, which responds to highly localized effects such as blocked culverts or overwhelming hydraulic capacity of sewers (Ashley et al., 2005).

Apart from flooding, climate change also tends to weaken agricultural land through soil erosion (Nearing et al., 2004). Most South African crops are grown in areas that are only just climatically suitable and with limited water supplies. But that climate is set to change for the worse as soil, which is essential for healthy crops and ecosystems is being lost faster than it is forming (Nearing et al., 2004). Crop (2019) revealed that the planet has lost around one-third of its arable land in the previous 40 years, in large part due to climate change disasters and poor conservation (Crop, 2019).

As climate events worsen, people are also threatened by more gradual changes such as rising temperatures and declining rainfall. Drought is another main challenge of climate change. According to Hoffman et al., (2009), warmer temperatures enhance evaporation, which reduces surface water and dries out soils and vegetation. This makes periods with low precipitation drier than they would be in cooler conditions (Hoffman et al., 2009). Drought alone impact around 55 million people every year, and the damage hits the agriculture industry – the primary source of food and income for many people in developing countries (Crop, 2019). Moreover, extreme heat is another popular effect of climate change which hit hard on vulnerable populations health. Extreme heat's link to heat waves and air pollution makes conditions ripe for more heat-related illnesses such as heat stroke, asthma, and heart attacks, according to the Environmental Protection Agency (McGill, 2016).

Therefore, "Climate change is a prominent issue in South Africa" (Ziervogel et al., 2014) and there is a need for intervention as the more these impacts become prevalent in underprivileged and vulnerable communities, the bigger the problem it becomes for future generations. In short, climate change puts people's lives at risk by undermining development and creating shortages of necessities, like food, water, and shelter. As a result, the aim of this research is to look at the

planning profession's transformative position in climate change adaptation and mitigation, as climate change poses a major challenge to achieving global sustainable growth.

1.3 Objectives and Key Questions

The study's aim was to accomplish the following objectives:

1.3.1 Main Objective

This thesis' aim is to investigate the transformative role that can be played by the planning profession in adaption to and mitigation against climate change.

Sub-objectives

- To investigate the effects of climate change in the built environment at Umlazi Township.
- To examine the current measures taken by the planning fraternity to help communities to adapt to and mitigate climate change.
- To determine the extent to which the current planning measures mitigate climate change.
- To investigate the barriers and constraints faced by planners in climate change adaptation and mitigation.

1.3.2 Research Question

The thesis' key question is: What is the planning profession's transformative position in climate change adaptation and mitigation?

Subsidiary Questions

- How has climate change affected the built environment at Umlazi Township?
- What are the current measures taken by the planning fraternity to help communities to adapt to and mitigate climate change?
- To what extent do the current measures taken by the planning fraternity mitigate climate change?
- What are some barriers and constraints faced by planners in adaptation and mitigation of climate change?

1.4 Conceptual Framework

A conceptual framework, according to Miles and Huberman (1994), is a set of principles, assumptions, desires, values, and theories that underpins and informs research and the relationships between them. As per the provided definition, to clearly understand the meaning ascribed by this research study, it was crucial to provide relevant definitions of the key concepts applicable to this study as per how the researcher applied them.

1.4.1 Climate Change

The climate change phenomenon, according to Riordan and Rundel (2014), is described as the global rise in air temperatures, which most scientists believe is caused by increased greenhouse emissions into the earth's atmosphere (Riordan and Rundel, 2014). Carbon dioxide (CO^2), methane (CH4), and nitrogen dioxide (N2O) are examples of greenhouse gases, according to the United Nations Framework Convention on Climate Change (UNFCCC), and their rise is said to have resulted in an increase in the amount of heat kept in the earth's atmosphere. Human activities, especially the burning of fossil fuels such as oil, coal, and gas, have increased atmospheric CO2 concentrations since the beginning of the industrial revolution (UNFCCC, 2006c). This increase in heat has triggered the greenhouse effect, which has resulted in climate change (UNFCCC, 2006c).

1.4.2 Adaptation

Adaptation is not a new concept. In the face of climate change, the international communities, countries, and local communities are acting along two main lines, one of which is climate change adaptation (Abramovitz, 2001). It was originally used by ecologists to define the mechanism by which living organisms adapt to new environments (Abramovitz, 2001). While the IPCC TAR (2001a) describes it as a shift in natural or human processes that mitigates harm or capitalizes on beneficial opportunities in response to actual or expected environmental changes and their consequences. There are various types of adaptation, according to the IPCC TAR, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation (IPCC, 2001). Adaptation, according to the UNDP (2005), is a process in which strategies are improved, developed, and enforced to mitigate, cope with, and benefit from the effects of climatic events. Nonetheless, adaptation is often used in connection with the concept of resilience, which, in this study serves as a theory upon which the research is underpinned – hence they go hand in hand (Nordic Council of Ministers, 2017).

Regardless of how many meanings there are for adaptation, according to Abramovitz (2001), the mechanism and acts of adaptation are all a reaction to vulnerability. For the purposes of this study, the IPCC describes adaptation as "action or practices directed at the vulnerable system in response to actual or expected climate stimuli with the goal of reducing harm from climate change or exploiting opportunities" (IPCC TAR, 2001a). Adaptation was chosen for this study because, according to the Department of Environmental Affairs (2011), it is often more powerful in the

local context than mitigation, and its effects are also more immediate and concrete, such as an increase in local environmental quality (Department of Environmental Affairs, 2011). Hence, South Africa amongst developing countries faced with poverty challenges could use a faster process. However, there is no question that their cumulative influence is far greater than the amount of their individual effects, which is precisely what this analysis seeks to accomplish.

1.4.3 Mitigation

As a second core strategy in the international climate change process, adaptation was adopted alongside mitigation (Bodansky, 1993). The United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC) define mitigation as "human interventions that help to reduce the rate and degree of climate change by reducing human-generated greenhouse gases (GHGs) or land-use activities that contribute to climate change, such as deforestation" (Bodansky, 1993; Habitat, 2011). The UNFCCC describes a "sink" as "forests, trees, or soils that can reabsorb CO2," which is the most important contributor to the greenhouse effect (Bodansky, 1993). While in other simple terms, Simmons (2006) states that it refers to making necessary investments of time, money, and planning prior to the occurrence of natural disasters which results in reduction of the impact of natural disasters when they inevitably occur (Simmons, 2006).

Climate change mitigation, according to the Isle of Man Government (2015), is described as efforts to minimize or prevent greenhouse gas emissions. Mitigation may take the form of introducing new technology and renewable energy sources, updating older facilities to be more energy efficient, or altering management or customer behavior (Isle of Man Government, 2015). It can be as compound as a city plan.

Maskrey (1989) goes on to say that mitigation refers to actions that can be done to mitigate the severity of a catastrophe by reducing the damaging and harmful impact of hazards (Maskrey, 1989). Regardless of how many different definitions there are for mitigation, the overall goal is to reduce the number of people killed or injured because of disasters by a significant amount (Coburn et al., 1994). The term "mitigation" applies to a variety of practices and safety measures, ranging from the physical to the formal, such as standard protocols for incorporating hazard assessment into land-use planning (Coburn et al., 1994).

1.4.4 Planning Profession

A profession is a broad term that refers to a particular category of people who work in the same industry. Professionals are given to occupations whose practitioners take responsibility for the affairs of others and provide a service that is necessary for the public good (Kultgen, 1988). In other words, having a societal mandate to provide services in a particular area (community development, engineering) is a fundamental characteristic of a career (Carmon, 2013).

The Physical Planning Act (PPA), Act 36 of 2002, describes the planning profession as "persons registered as nominee planners, technical planners, or professional planners in terms of section 13 (4)" (Republic of South Africa (RSA), 2002). According to Rugui (2015), the town and regional planning profession in South Africa, as elsewhere in the world, has traditionally been smaller in numbers and less developed than other built environment professions such as architects, engineers, and surveyors (Rugui, 2015). In comparison to other occupations, the urban and regional planning profession in South Africa is distinguished by the following characteristics: its organisation through a Statutory Council that guides, transforms & ensures autonomy of members; its focus on specialisation in spatial planning matters; speciality in spatial & land use planning & management; its community specialised persons; and provision of services to benefit & protect society (Rugui, 2015).

1.4.5 Transformation

Tanner and Bahadur (2012) describes transformation as "radical change involving creativity and testing of new approaches." This necessitates the development of new knowledge as well as a fundamentally different way of doing things (Tanner & Bahadur, 2012). Further, transformation also involves being mindful of and questioning inherited ways of thinking, perceptions, and prejudices (Tanner & Bahadur, 2012). The transformation concept was used in this study subject due to the growing need for transformational approaches to address the challenges facing development in the face of climate change (UN Habitat, 2011). More aggressive measures would be needed if existing attempts to prevent dangerous climate change and adapt to the changes we've already seen aren't enough.

1.4.6 Resilience

According to Sogoni (2014), resilience was initially introduced in the 1970s by a Canadian professor (Crawford Holling), as the concept used to discover how ecology reacted when confronted by disasters or hazards (Sogoni, 2014). Since then, the concept increasingly became a

common word in the climate change vernacular. The US government describes resilience as the capacity to withstand and recover rapidly from deliberate threats, injuries, natural disasters, as well as unusual pressures, shocks, and challenges to the economy and democratic system (Center for Climate and Energy Solutions, 2019). Similarly, resilience is defined by UN Habitat (2011) as a city's or town's ability to withstand impacts and rebuild or reorganize itself when necessary. According to the National Academy of Sciences, it is the ability to anticipate, prepare for, absorb, recover from, and better respond to unfavourable events (Center for Climate and Energy Solutions, 2019).

The idea of resilience was implemented in this study to investigate how resilient the current adaptation and mitigation methods used by urban planners towards this ever-changing climate are, as well as how resilient they will be in the future, given the importance of resilience in any comprehensive climate action plan, particularly considering recent extreme weather events (Center for Climate and Energy Solutions, 2019).

1.5 Justification for the Study

The study's main goal is to investigate the transformative role that is played by the planning profession in adaptation to and mitigation against climate change. Initially, the study was undertaken using a case study research design where there were several flooding occurrences resulting from climate change. Hence, the study contributes in determining the role that planning plays in such instances and in determining whether the current approach implemented is efficient and effective enough for vulnerable communities like Umlazi Township, which were formed on the basis of apartheid planning. The study will assist the planning profession, if not all the professions, to figure out if there are more ways of intervening needed to adapt to and mitigate climate shocks successfully.

1.6 Structure of Dissertation

Chapter 1: Introduction

This chapter serves to present the entire research study as well as provide background information on the research subject. The research issue, research objectives and questions, hypothesis, as well as the research design and theoretical framework are all briefly defined in this chapter. The chapter also justifies the significance of the chosen topic. This chapter further identifies and unpack concepts and theories which contributes to a rich understanding and significance of the topic.

Chapter 2: Literature Review and Theoretical Framework

This chapter offers a summary of the related literature, situating the thesis within it and presenting alternative viewpoints on the research subject. The chapter also lays a foundation for the research from the main themes by others, identifying gaps or questions which have not been covered. Apart from that, this chapter further outlines theories relevant or influencing this study which will further be applied to research findings.

Chapter 3: Research Design and Methodology

The research methodology used in this study is listed in this chapter. In this chapter, the researcher explains the strategy in greater depth. The type of research design, research methodology used, data collection methods, sample size and sampling plan, type of data analysis, and the research study's limitations are all discussed in this chapter.

Chapter 4: Historical Background of the Study Area Umlazi Section H

This chapter provides a historical background of Umlazi. It discusses how Umlazi came about, who lived there and the conditions which they lived under. This chapter also presents the topography information relating to Umlazi, including the physical arrangement of roads and houses. The land suitability of the study area is also examined.

Chapter 5: Research Findings, Data Analysis, and Interpretation

This chapter summarizes the study's main results and interprets their significance based on the researcher's interpretation. To be precise, this is the part where the collected data is summarized. The chapter entails the analytical and logical interpretation of the data gathered throughout the whole study, and to determine the relationships and patterns that can be drawn. The chapter also tries to show that the study goals were achieved.

Chapter 6: Conclusion and Recommendations

This is the study's final chapter, which includes a concise overview of the research study by highlighting the study's main results and proposing recommendations for future research.

2. Chapter Two: Theoretical Framework and Literature Review

2.1 Introduction

There are two parts to this chapter. The first section presents a theoretical framework or collection of theories that direct and inform this research, while the second section elaborates further on the first section of the literature that supports the research. The theoretical framework seeks to trace the origins of collaborative planning theory, resilience theory, and sustainable development theory/approach. Secondly, it will further outline the meanings ascribed by these theories, discuss how they inform this research study and lastly discuss some of the critiques projected to them. In this research study, these theories form a foundation from which the research study knowledge is constructed (literally and metaphorically). They offer a perspective of the research that is based on contemporary planning academic discipline. Equally important is that the theoretical framework provides the research structure through showing how the researcher defines her study both analytically and philosophically.

The literature review is aimed at showing the reader that the information used in the study is indeed about what is currently happening worldwide. It draws on and highlights different viewpoints and national authors' perspectives and opinions on the research subject. The study goals and/or questions drive it. The theoretical structure and literature review discussed in this chapter are equally relevant because they serve as a model for the entire investigation.

2.2 Theoretical Framework

2.2.1 Collaborative Planning Theory

Collaborative planning theory is a modern approach to planning for today's dynamic society that focuses on resolving disputes between parties by consensus-building. According to Duma (2002), the collaborative planning theory is based on the critical theory of communicative activity, which explores the various interactions of the general knowledge/power/action relationship (Duma, 2002). To be precise, it enables people to engage in dialogue in an atmosphere of equal empowerment and shared knowledge, to learn new ideas through mutual understanding to achieve innovative outcomes, and to improve institutional capacity (Innes and Booher, 2004; Healey, 2006). It appears that this theory is the only planning theory that considers the various ways in which power connects and constructs information (Duma, 2002). Maginn (2007), for example,

claims that collaborative planning will help policymakers get more efficient group engagement (Purbani, 2007).

Furthermore, collaborative planning theory is a form of practice that is focused on a mix of sociological and economic theories (Tewdwr-Jones and Allmendinger, 1998). The collective planning paradigm, according to Healy (1997), is the product of a complex intertwining of two distinct bodies of theoretical work, namely the communicative approach to planning theory and institutionalist sociology and regional economic geography (Healey, 1997). Communicative planning theory provides the foundations and fundamental concepts of collective planning in the sense of devising preferred types and methods (Tewdwr-Tones and Allmendinger, 1998). As a result, collaborative planning based on interpretive approaches, can be interpreted as an interactive process with the potential to create relations and dialogue that will lead to the development of new cultural formations through collaboration rather than technical design, research, and management processes (Purbani, 2017).

Healey (2006) continues by defining collaborative planning processes as a combination of "soft" and "hard" infrastructure, which he refers to as "institutional architecture." "Soft infrastructure" she defines as "informal collaborative strategy-making processes, such as social learning through which stakeholders communicate with one another and build social, intellectual, and political capitals," while "hard infrastructure" she defines as "the design of political, administrative, and legal processes through which people alter power relations in networks."

Against this backdrop, the primary purpose of this theory in this study is to promote collaborative and science-based climate resilience planning that will build on existing plans and related research, and that will broaden our vision to take on the new challenges we face because of climate impacts (Leiter et al., 2021). According to Leiter et al., (2021), overcoming deeply ingrained economic and cultural patterns that result in resource depletion, climate instability, and economic and social stress requires holistic problem solving that blends the best scientific understanding of existing conditions and available technologies with the public resolve to act (Leiter et al., 2021). Planning processes allow communities to look past immediate concerns, evaluate options for how best to proceed, and to move towards a better future. Leiter et al., (2021) identifies four distinct “audiences” that need to work collaboratively to meet challenges that communities face, i.e., planners; scientific researchers, community members and organizations; and policy makers (Leiter et al., 2021).

As urban planners are responsible for analyzing how communities and our natural landscapes will be affected by the changing climate, and for developing plans and policies that allow us to respond effectively through processes that are inclusive, science-based, and cost-effective (Brand et al., 2007). To that end, they are charged with preparing the planning documents that will guide the responses of public agencies, non-governmental, and public to climate change impacts – those impacts already occurring and this expected in the future (Leiter et al., 2021). According to Leiter et al., (2021), for planners this collaboration provides guidance on how to engage a cross-section of collaborators to frame and formulate science-based plans and recommendations to policy makers (Leiter et al., 2021).

Scientific researchers, whether in universities, private companies, or non-profit organizations researchers perform the vital task of identifying and documenting climate change vulnerability and impacts, and then devising means of reducing or mitigating them to achieve climate resilience (Flick, 1998). In this regard, researchers will provide guidance needed to collaborate with planners, grant makers, and other stakeholders to better communicate the need for applied research that can best inform solutions at the local and regional level (Flick, 1998).

Moreover, environmental groups, community-based organizations, policy advocates, and other participants in the planning process rely on an understanding of existing plans, opportunities for input, and the work of scientific researchers to inform development of programs and outreach (Brand et al., 2007). In this regard, the community members and organizations describe how these participants can engage most effectively in the process of developing and implementing plans for climate change (Leiter et al., 2021).

Lastly, at all levels of government, policymakers rely on the work of planners and scientists, as well as communications with the community, as basis for adopting programs, policies, and regulations addressing climate change impacts and achieving climate resilience (Leiter et al., 2021). For policymakers, collaboration with these specialists provides a guide to understanding these processes and attaining the desired results (Leiter et al., 2021).

Nevertheless, Healey (1997) criticizes that collaborative planning does not rest easily defined as a theory (Healey, 1997). For instance, one argument is that the work is not of an explanatory character and has limited application in wider contexts. Collaborative planning is characterized as a type of planning that is based on a collection of theoretical assumptions and foundations (Healey, 1997). In essence, the focus is on the fact that proponents of collective planning have yet to

advance it as a philosophy, and this could form the boundaries within which discussion and other criticism can take place (Tewdwr-Jones and Allmendinger, 1998).

Moreover, Tewdwr-Jones and Allmendinger (1998) also argue that collaborative planning theory is too idealistic and utopian in nature, therefore it is said to be only attractive theoretically, but not in practice (Tewdwr-Jones and Allmendinger, 1998). The reason behind this criticism is that the theory tends to act as if dealing with power relations is an easy task, while it is a complex configuration (Jukuda, 2010). Nonetheless, as idealistic collaborative planning theory may be, however, it facilitate problem-solving and build new relations amongst different stakeholders (Salsich, 2000), as a result, collective and effective decisions are accomplished.

2.2.2 Resilience Theory

According to Kim and Lim (2016), the term "resilience" comes from the Latin verb "resilire," which means "to bounce back" (Klein, Nicholls and Thomalla, 2003). The concept was coined in the fields of ecology and natural sciences (Walker and Cooper, 2011), but it has since spread to other fields such as social sciences, community development, engineering, and psychology (Kim and Lim, 2016). In recent years, resilience has emerged as a core term for comprehending and adapting to a slew of looming urbanization and climate change challenges (Kim and Lim, 2016). It's a central idea in the ongoing climate change, adaptation, and mitigation debate.

The Intergovernmental Panel on Climate Change (IPCC) (2014) describes resilience as “the capacity of social, economic, and environmental structures to cope with a hazardous event or disruption, reacting in ways that preserve their critical role, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation,” (IPCC, 2014). As a measure to respond to climate change threats that may be concentrated predominantly in urban areas, the report suggests developing a climate-resilient pathway (Kim and Lim, 2016). In other words, to achieve long-term development, we must alter our economic, social, technological, and political decision-making and behaviour (Kim and Lim, 2016).

According to Antonovsky (1979), the focus of social work literature in the early 1990s was on the causes of disease or a breakdown in social well-being, which led to the development of resilience as a theory (Antonovsky, 1979). Its roots can be traced back to the study of adversity and a fascination with how traumatic life experiences affect people (Van Breda, 2018). As a result, resilience theory is described as the capacity of a person or group of individuals to respond or bounce back well in the face of adversity, trauma, tragedy, misfortune, obstacles, or even major

sources of stress (American Psychological Association, 2014). Cities are important targets for climate change adaptation in this strategy because, like an organism, they are continuously evolving, they include multiple interdependent, closely related sectors and activities (Seeliger & Turok, 2014).

Even though resilience theory is a modern addition to planners' discursive collection, Davoudi et al., (2012) claims that it is not a new idea (Davoudi et al., 2012). Physical scientists, he says, invented the word resilience to define the characteristics of a spring, as well as the hardness of materials and their resistance to external shocks (Davoudi et al., 2012). Resilience first appeared in the field of ecology (environmental science) in the 1960s, according to Davoudi et al., (2012), along with the growth of systems thinking theory, where various interpretations of the term arose, each rooted in different world views (Davoudi et al, 2012). Thus, suggesting that resilience theory gained its significant momentum within development circles during this time. Furthermore, since climate changes are uncertain, communities need to be better prepared for the unexpected, resilience has emerged as a much-needed theoretical approach to explaining and understanding change (Davoudi et al., 2012). In addition, international donors such as the Global Environment Facility (GEF) believe resilience is critical to achieving the Sustainable Development Goals (SDGs) (O'Connell et al., 2015).

Nonetheless, the Organisation for Economic Co-operation and Development (OECD) outlines how cities can use a resilience strategy to sustain growth and development in the face of climate change (Kim and Lim, 2016). A resilient city, according to this approach, has the capacity to withstand, recover from, and plan for potential shocks, whether they be economic, environmental, social, or institutional (Battisti et al., 2018). Climate mitigation and adaptation are essential to the concept of a climate-resilient city (Battisti et al., 2018). Mitigation seeks to mitigate the negative effects of climate change that can contribute to increased energy usage and emissions (Santamouris, 2014), while adaptation aims to reduce the other negative effects of climate change and prepare the built environment for climate emergencies (European Environmental Agency, 2016).

The resilience approach, therefore, provides a useful framework for this study as it guides its questions and objectives, which, in different point of views, seek to demonstrate the transformative role played by the planning profession in adaptation to and mitigation against climate change. Resilience theory first enables the researcher to zoom into the measures taken by planners towards

adapting to and mitigating climate change. Second, it helps the researcher investigate the effectiveness of these measures through scrutinizing the amount of aid they provide or achieve in urban communities, particularly township communities. The effectiveness could easily be investigated by comparing the affected and unaffected sections of the study area. In the unaffected section, the researcher might look at what measures' planners took to avoid climate changes, as well as the communities' ability to maintain resilience in the face of prolonged adversity. Resilience thinking, according to Brown (2016), has the potential to strengthen not only our scientific understanding of social and ecological change processes, but also our policy responses to improve well-being and life opportunities, particularly for the vulnerable (Brown, 2016). As a result, proponents of resilience theory claim that the definition has a lot of potential to guide climate policy (Mikulewicz, 2019).

Further, resilience approach does not only help the researcher investigate the role that planning plays, but it also enables planning actors to note if their adaptation and mitigation measures towards climate change are effective or not, and thus allowing for opportunities to improve if need be. As a result, not only the current generation, but also future generations will benefit because the effects will be less serious than they are now, allowing for sustainable growth. Furthermore, the planners' adaptation and mitigation measures' resilience could mean that countries' limited financial resources will be saved because there will be no need to develop new solutions that are successful enough to last a lifetime.

Nonetheless, other social science strands have slammed resilience's success, as well as the methodological focus on social-ecological processes that it has popularized (Mikulewicz, 2019). According to them, they were quick to cast doubt on the prevailing IPCC principle of adaptation, resulting in a proliferation of resilience-based approaches (Mikulewicz, 2019). For example, Pelling (2011) defines adaptation as "the process by which an actor can focus on and enact change in those activities and underlying processes that generate root and proximate causes of risk, frame capacity to cope, and further rounds of climate change adaptation" (Mikulewicz, 2019). This more normative definition attempts to address the IPCC's prevailing, apolitical perspective. However, it is argued that Pelling's list of root causes does not include floods, droughts, hurricanes, or rising sea levels. Rather, as shown by variables such as fitness, education, and income levels, they are the product of social and economic amplification (Mikulewicz, 2019; Adger et al., 2009).

Apart from that, while resilience focuses on the effect of exogenous stimuli on a given social-ecological context, one of the concept's major shortcomings is its inability to account for large-scale social processes that inevitably affect how people respond to environmental change (Mikulewicz, 2019). Several political ecology studies, for instance, have looked at the various impacts of neoliberal natural resource governance on the ability of local people to adapt (Mikulewicz, 2019). As a result, more transformational approaches like material redistribution within the agrarian climate (Pelling, 2011) – let alone political or social reform – are ruled out, with the socioeconomic status quo preserved (Mikulewicz, 2019). As a result, sustainability and resilience thinking can be seen as a divisive movement aimed at depoliticizing growth and depriving local people of political power and subjectivity (Evans and Reid, 2013).

Furthermore, resilience is argued to be dependent on the relationship between coupled social and ecological processes, as well as the related effects of negative stimuli on the approach has been sceptical about the complex social dynamics that determine how communities or populations work internally (Mikulewicz, 2019). In response to this, social resilience has been suggested as an approach that considers the quantity and quality of social networks between different actors at various scales, taking resilience closer to a more systemic understanding of how social systems operate and how their responses to change are determined (Adger et al., 2003). As a result, resilience thinking is unable to comprehend the emergence of "winners and losers" in adaptive processes promoted by development policies across the Global South, owing to the oversight of unequal access to power and resources, as well as the resulting inequalities (Adger et al., 2003).

2.2.3 Sustainable Development Theory/Approach

During the 1990s, the concept of sustainable development gained momentum in mainstream development circles. According to Emas (2015), the Brundtland report, entitled Our Common Future, published in 1987 by the United Nations-sponsored World Commission on Environment and Development (WCED), attempted to link the issues of economic development and environmental stability (United nations General Assembly, 1987). Despite its infamous uncertainty and vagueness, this study was a significant political watershed moment for the concept of sustainable development (Mebratu, 1998). The World Commission on Environment and Development (WCED) described sustainable development as "growth that meets current needs without jeopardizing future generations' ability to meet their own" (WCED, 1987). Since then, thousands of campaigns have been initiated at the local, national, and global levels to address

different aspects of environmental issues, and this concept has been crucial in shaping a "global vision" of our planet's future (Mebratu, 1998).

The concept of “sustainable development”, also known as “sustainability”, has ever since, been widely recognized and discussed in the 21st century. According to Paul (2008), its meaning consists of two major concepts: first, the concept of "needs," especially the critical needs of the world's poor, to whom top priority should be given; and second, the concept of "limitations" placed on the environment's ability to meet present and future needs through technological and social organization (Paul, 2008). According to Emas (2015), the sustainable development strategy aims to maintain economic growth while maintaining the environment's long-term value, as well as offering a framework for environmental policies and development strategies to be enforced (United Nations General Assembly, 1987).

In order to address the needs of future generations, intergenerational equity is thus incorporated into the normative definition of sustainable growth (Dernbach, 1998). According to the polluter pays principle, “governments should require companies to bear the costs of their emissions rather than forcing those costs on others or the environment” (Emas, 2015). This means that government policy should aim to internalize environmental costs wherever possible, thus reducing externalities (Emas, 2015). The precautionary principle informs the sustainable development strategy, which states that “where there are risks of serious or permanent damage, a lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to avoid environmental degradation” (United Nations Conference on the Human Environment, 1992). As a result, the promoter of an operation is responsible for demonstrating that it will not cause substantial damage (Emas, 2015).

Overall, Munasinghe (2008) argues that the core principle of sustainable development is the integration and balance of three key pillars: social, economic, and environmental problems into all areas of decision-making (Emas, 2015). These three pillars reflect a sphere and a structure, each with its own guiding forces and goals. The social realm emphasizes the enrichment of human relationships as well as the achievement of personal and group goals (Munasinghe, 2008). In terms of economics, a sustainable approach focuses on increasing human well-being, primarily through increased consumption of goods and services (Munasinghe, 2008). It also aims to maintain economic growth and productivity, as well as broaden markets. The environmental domain relates to the maintenance of ecological systems' integrity and resilience (Munasinghe, 2008).

According to Emas (2015), the ultimate objective of sustainable development is long-term economic and environmental prosperity, which can only be achieved by involving and understanding social, economic, and environmental problems in decision-making processes (Emas, 2015). This strategy, according to Hove (2004), is focused on the assumption that focusing solely on economic problems ignores and obstructs social and environmental security, while integrating multiple avenues for improving conditions in developed countries is more successful (Hove, 2004). Furthermore, the international community accepted both the Sustainable Development Goals (SDGs) and the Paris Agreement in 2015 (Winkler, 2018). Dangerous climate change was discussed as something that needs to be understood to understand humans in the twenty-first century, especially in South Africa (Winkler, 2018). Beyond the study, it was discovered that the challenge is to reduce greenhouse gas (GHG) emissions, which is why this research is being performed.

The research questions are inspired by the sustainable development strategy since they are concerned with addressing the three foundations of sustainability in communities: social, economic, and environmental pillars by planning in the face of climate change shocks. According to Joscelyne (2015), the sustainable development approach has been advocated as a method for dealing with the environmental challenges brought on by the nineteenth industrial revolution. As a result, since it is generally accepted that sustainability is related to planning, sustainability goals are incorporated into planning (Joscelyne, 2015). As a result, the approach to sustainable development offers guidance and an ideal that can drive the issues that arise from planning agendas (Joscelyne, 2015).

Further, as the concept of "development' is mentioned in this approach, it is difficult not to pay attention to how the natural environment is destructed during the erection of buildings, excavation and road construction among other activities. As professions dealing with climate change disasters have already asserted, such notions could be blamed on the industrial revolution which instilled the idea that for a lifestyle to be complete, people must vest into the built environment and exploit nature in a careless manner (Harris, 2000). As a result, the aim of this study is to find out how the human-made environment or growth has led to the perpetuation of climate change, as well as what steps planners can take to reduce environmental degradation.

In addition, considering that the "sustainable development" concept advocates for sustainability, it is also difficult to not pay attention on how climate change catastrophes undermine sustainable

development and the livelihoods of humans. For instance, Benson (2016) discovers that climate change result in injuries and loss of life, sometimes with life-changing consequences. They also destroy social and economic infrastructure including homes, clinics, hospitals, schools, roads, markets, and other public buildings (Benson, 2016).

In the other hand, the approach to sustainable development is questioned. The concept of sustainable development is said to be too broad and all-encompassing, resulting in ambiguity about what it means and a gap between rhetoric and policy initiatives (Hove, 2004). Hove (2004) goes on to say that this lack of clarification leads to a broad variety of policy options, many of which are contradictory and incoherent (Hove, 2004). After analysing the approach's assumptions and roots, the authors say that it becomes apparent that sustainable development is only a new version of the old discourse, unable to break free from its ethnocentric immoralities (Hove, 2004; Fernando, 2003).

Furthermore, the sustainable development paradigm has been chastised for failing to reconcile two opposing goals: environmental conservation and economic growth (Hove, 2004). By failing to reconcile this disparity, Hove (2004) argues, it conveniently avoids a harsh criticism of the West's role in underdevelopment and other global inequities, allowing us to continue rising without meaningful reform (Hove, 2004). According to Escobar (1995), sustainable development prioritizes economic growth over environmental protection: "By adhering to the principle of sustainable development, two old enemies, growth and the climate, are reconciled, and the economy, not the world, must be maintained" (Hove, 2004). As a result, according to Escobar (1995), this approach claims that “only minor improvements in market structure are needed to usher in an era of environmentally sustainable development, obscuring the fact that the economic system cannot hope to meet environmental requirements on its own” (Escobar, 1995). In essence, one of the most serious shortcomings in the sustainable development strategy is that it ignores excessive consumption in the west, as well as the fact that it is unsustainable (Hove, 2004; Fernando, 2003).

2.3 Literature Review

2.3.1 The Growth of Climate Change

The amount of carbon dioxide (CO^2) in the atmosphere is natural, and this amount, along with greenhouse gases (GHGs), helps maintain the Earth at an average temperature of 15°C and maintains a stable global environment, with any changes occurring over very long time periods

(Department of Rural Development& Land Reform (DRDLR), 2013). Today, however, a wide variety of human activities, including various socioeconomic and political processes, can trigger or at the very least escalate accidents (Disaster Management Southern Africa, 2003). Scholars argue that human activities are disrupting the planet's natural equilibrium at the most fundamental level, interfering with the atmosphere, oceans, forest cover, and other natural pillars that make the earth a livable home (Canon, et al., 1993).

In other terms, the CO^2 balance in the atmosphere is being exceeded, and the Earth is increasingly warming as a result (DRDLR, 2013). Increased complexity, expanded infrastructure, denser populations, and increased demands on the immediate environment and critical natural resources accompany rapid economic development (Mathapo, 2006). As a matter of fact, the earth's average temperature has been increasing since the Industrial Revolution. Human activities, especially the burning of fossil fuels, have increased atmospheric CO^2 concentrations by about 0.8°C since the beginning of the Industrial Revolution (Cicerone and Nurse, 2014). According to Cicerone and Nurse (2014), this results in greenhouse gas emissions including nitrous oxide (N2O) and methane (CH4), which absorb heat (infrared radiation) emitted to the earth's surface, increasing global temperatures.

For one thing, the warming over this time is largely due to increased CO^2 concentrations. Warming, on the other hand, is causing changes in the earth's atmosphere, such as changes in precipitation patterns, a rise in sea level, an increase in the frequency and length of weather events, the melting of glaciers, and the breaking up of ice in rivers and lakes, to name a few. Climate change refers to environmental changes caused directly or indirectly by human activity, altering the global atmosphere's structure, and posing a challenge to how people around the world relate to and live within the natural environment (DRDLR, 2013).

Therefore, as extreme weather conditions are becoming more frequent, its effects on livelihoods, basic services, housing, infrastructure, and health are increasingly palpable. South Africa, like the rest of the planet, has adjusted to dealing with the consequences of climate change (DRDLR, 2013). Climate change poses a significant threat to developing countries, especially those like South Africa, which are still struggling with problems such as poverty and a shortage of basic services (DRDLR, 2013). Climate change would exacerbate already existing development problems such as a deteriorating environment and slowing economic growth, as resources become scarcer as demand for vulnerable people rises (DRDLR, 2013). As a result, the DRDLR (2013)

stresses the urgent need to implement successful plans that will help people become more resilient to climate change and help them not only prosper but also protect their livelihoods (DRDLR, 2013).

2.3.2 The Impacts of Climate Change on the Built Environment

Climate change has led to an increasing consensus that the economy, infrastructure, ecology, and settlements are all at risk because of its effects (Wilby, 2007). These impacts are local and global, societal, or environmental, water and non-water, and sometimes can only be expressed in monetary terms depending on the area they are occurring (IPCC, 1996c).

Water sources (water availability), urban drainage and flood risk (from sea level rise, the groundwater levels, and rivers), water shortage (drought), and hurricanes are all likely to be affected by climate change, according to the evidence gathered by Magadza (2000). Wilby (2007) claims that industrialized economies have a substantial effect on local climate and environment, and those urban areas are already vulnerable to a range of weather-related threats such as energy demand, air pollution episodes, heat waves, and flooding (2007). Many disadvantaged populations in low-income communities already face water shortages and poor sanitation, and often live-in high-risk areas such as floodplains and coastal zones (Hain et al., 2006).

As a result, in places where the economic fabric and climate are fragile, such as developing countries, these complex, large-scale shocks appear to have the greatest impact on deprived populations, while in developed countries, economic and environmental resilience will reduce the direct effects of these events on human life (Magadza, 2000). Equally important is the effect of climate change on human settlements in developing countries, like South Africa, depends on localities of the settlements (Magadza, 2000). The following are induced climate change impacts on the built environment that result in deaths, evictions, property damage, and isolation of large areas of the world due to the loss of vital social and economic infrastructure such as power plants, water supplies, highways, hospitals, and schools (Ngcamu, 2011).

2.3.2.1 Flooding

One of the popular impacts of the changing climate, particularly in developing countries, is flooding. When the amount of greenhouse gases in the atmosphere increases, the climate system warms as these gases trap more heat. In this regard, the oceans are also warming, especially near the surface, resulting in higher evaporation rates and, as a result, an increase in the water vapour in the atmosphere. More water vapour is held in a warmer atmosphere, which leads to more intense

rainfall (Climate Council, 2017). Storm surges are also becoming more devastating as a result of climate change due to rising sea levels. Many coastal flooding events are linked to high sea level events and heavy rainfall events in coastal catchments (Climate Council, 2017).

In several regions the rainfall events have increased as opposed to decreasing. According to Hettiarachchi (2018), this intensification of rainfall extremes and their increasing volume has been related to the higher temperatures expected due to climate change (Hettiarachchi, 2018). As a result, damaging flood events are a danger posing a threat to both life and infrastructure in the built environment, particularly in urban areas where existing infrastructure (such as drainage and sewage systems) was not designed to cope with increased volume capacity because of population growth (Hettiarachchi, 2018).

Furthermore, the Climate Council (2017) claims that periods of heavy rain will endanger human health and well-being. Drowning and being swept against hard objects are two of the most common causes of death and injury when it rains heavily. While intermediate levels of rainfall can cause property damage, heavy rainfall causes immediate death and injuries from drowning and being swept against hard objects (Hales et al., 2003). Furthermore, if floodwaters become contaminated with human or animal waste during and after both catastrophic and non-catastrophic flooding, health risks arise. Diarrhoea was the most common ailment, followed by respiratory infection, according to a survey of people displaced by devastating floods in Bangladesh in 1988 (Hales et al., 2003).

Furthermore, the Climate Council (2017) notes that heavy rainfall can have catastrophic economic consequences. According to the survey, the Queensland floods of 2010/2011 were one of the worst flooding events in Australia because of heavy rainfall (Climate Council, 2017). In late 2010, a strong La Nia event caused intense and extended rainfall across large areas of Queensland, resulting in record-breaking and extremely damaging flooding in Queensland in December 2010 and January 2011 (Climate Council, 2017). According to the Climate Council (2017), nearly 2.5 million people were affected by the catastrophe, with 29,000 homes and businesses flooded in some way (Climate Council, 2017). The flood's economic loss was estimated to be in the billions of dollars (Climate Council, 2017).

Floods are thus one of the many dynamic natural disasters that can cause significant social and economic damage (Maghsood et al., 2019). Adapting to such extreme storm scenarios, however, will be both economically and socially expensive, according to Doocy et al (2013). Nonetheless,

given the projection that urban populations will grow from 54 percent to 66 percent of the global population by 2050, properly addressing the increased flood risk will become even more important.

2.3.2.2 Water Availability

Another predicted effect of climate change is water availability, which will result in increased temperature and rainfall irregularity (Jiménez et al., 2014). The degradation of carbon sinks may accelerate this trend. According to Jiménez et al., (2014), water is the agent that delivers many of the impacts of climate change to society, including energy, agriculture, and the transportation sector. According to indicators such as water availability, water demand, and water pollution, water safety is now a major threat to around 80% of the world's population (Vrsmarty et al., 2010). Climate change has the potential to change water availability, making water safety more complicated (Jiménez, 2014). According to mounting data, climate change has a detrimental effect on hydrological cycles both locally and globally (Rochdane et al., 2012). Anthropogenic climate change changes river flow volume and timing, brings existing water infrastructure and management structures to the test, and raises the risk of water scarcity and floods (Rochdane et al., 2012).

Temperature and precipitation patterns can affect the hydrologic process and the availability of water supplies for agriculture, population, mining, industry, aquatic life, and hydropower (Rochdane et al., 2012). For instance, in the northern parts of Durban there was projected increase in rainfall, whilst in the west areas there was projected increases in short duration rainfall in the future (eThekwini Municipality, 2014). This will have an effect on dams' capacity to catch and store ample water, as well as the amount of water available for human consumption and industrial use (eThekwini Municipality, 2014). Rising temperatures, according to Golder Associates Africa (2010), lead to higher evaporation rates, which affects water availability.

Since South Africa is situated in a mid-latitude and semi-arid region of the world, it can expect a rise in temperature as well as less and more intermittent rainfall (Challenge Programme on Water and Food (CPWF), 2003). Furthermore, extreme water shortages are expected for such a large and rapidly increasing population. The Limpopo River Basin (LRB) supports a population of approximately 14 million people, evenly divided between rural (52%) and urban (48%) areas (CPWF, 2003). Water usage in the LRB is projected to be significantly restricted due to a shortage of facilities and an increasingly rising population. According to the CPWF (2003), this has been a

limiting factor for economic development in the basin, as it has been in many other basins in developing countries with dry climates, limited water resources, and rapidly growing populations.

2.3.2.3 Drought

Almost like the water availability issue, Ludwig et al., (2007) also identifies drought as another apparent impact which will be projected by climate change, more especially in developing countries. Drought is a long-term and extreme climate condition induced by a temporary lack of water, which can be caused by a lack of precipitation, soil moisture, stream flow, or any combination of the three occurring at the same time (Carro et al., 2016). A significant hydrological imbalance is caused by a prolonged period of abnormally dry weather (Hales et al., 2003). Drought, unlike other climate change phenomena, occurs everywhere, except for desert areas, where it has no impact (Carro et al., 2016).

Moreover, According to Carro et al., (2016) drought develops slowly and is caused by a prolonged period of precipitation (months to years) that is below the usual or expected value in each region. One of the potential consequences of climate change on global drought would be an increase in the frequency of droughts (Matuszewska, 2009). In South Africa, for example, the west is expected to become hotter and drier, while the east is expected to become hotter and likely wetter, but this will not protect the country from the effects of increased drought (Jourbet, 2008). Warmer temperatures will result in longer periods between rainstorms, more droughts, and more intense storms, all of which will lead to drought stress (Matuszewska, 2009). According to Matuszewska (2009), the world's semi-arid, mid-latitude, and subtropical regions would become drier and more drought prone (Matuszewska, 2009). Droughts are expected to become more frequent in southern Africa as temperatures increase, precipitation decreases, and the climate becomes more arid (Matuszewska, 2009).

2.3.2.4 Cyclones/Hurricane

Cyclone Dineo is a sobering reminder of how severe weather can endanger people's lives, property, and critical infrastructure (Climate Council, 2017). Climate variability and change (for example, mean sea-level rise, warmer temperatures, and increased storm intensity and storm surges) can have a major impact on coastal transportation systems and facilities like ports and other coastal transportation hubs and networks (United Nations, 2013). Sogoni (2014), outlines that 1995 to 2007 was a period that a new generation of severe cyclones came to life. Cyclone Gavin, for example, breached sea walls on Fiji's Vanua Levu Island’s north coast in 1997, flooding Labasa

city, the island's largest urban area. Big waves wreaked havoc on Niue Island in New Zealand following Cyclone Heta in 2004, destroying much of the island's infrastructure (Walsh et al., 2012).

Nonetheless, Cyclone Dineo which recently occurred in South Africa in 2017 illustrates that this is still an ongoing problem. According to the initial report by the International Federation of Red Cross and Red Crescent Societies, the most affected province in South Africa was Inhambane in Southern Mozambique, where Tropical Cyclone Dineo made landfall with powerful winds exceeding 100 km/h, high-rough seas, and heavy rain (Department of Cooperative Governance and Traditional Affairs (COGTA), 2017). Furthermore, the storm caused flooding, cut off and displaced multiple communities, caused fatalities, and destroyed infrastructure (power and roads) and property in the affected areas (Department of COGTA, 2017).

With these issues in mind, it's important to acknowledge that climate change has a significant impact on the built environment in several ways. Various studies have drawn different links between the contemporary built environment issues and climate change and are still projecting further impacts associated with this phenomenon as the population is continuing to grow and if more effective interventions are not discovered.

2.3.3 Planning as a Profession

Planning (also referred to as urban, city, or regional planning) is a dynamic, nuanced, and ever-changing discipline. It was created as a means of regulating and controlling land use (Joscelyne, 2015). The planning discipline, as well as the laws and instruments that govern land use planning, have evolved over time to become the dynamic area that it is today (Joscelyne, 2015). Nowadays, planning involves the planning and designing of existing and future land use developments (Matuszewska, 2009). It has developed as a response mechanism to phenomena and challenges that societies have faced, and as a result, it takes into account a broad variety of variables and physical features, such as topography, water availability, population, infrastructure and municipal service provision, environmental and climate impact, and land growth (Matuszewska, 2009). According to UN Habitat, planning is also involved in growth management, environmental planning, solid and liquid waste management, housing and building construction (UN Habitat, 2011). These variables and physical features, according to Matuszewska (2009), are critical issues in planning because they shape and decide how plans are planned for current and future cities (Matuszewska, 2009).

Working with and for people is a central guiding principle in planning, which aims to improve the built environment's quality of life for everyone (Carmon, 2013). It is a diverse career that aims to enhance people's and communities' well-being by creating more convenient, equal, safe, effective, and appealing environments for current and future generations (Carmon, 2013). According to Carmon (2013), planning allows leaders, corporations, and residents to play a significant role in building societies that enrich people's lives. As a result, Carmon (2013) proposes that good planning aids in the creation of neighbourhoods that have better options for where and how people live, as well as the ability to imagine their future (Carmon, 2013). It also aids communities in striking the right balance between new construction and critical services, environmental conservation, and creative change (Carmon, 2013). Planning is a profession that envisions and plans, not just the present, but it is mostly concerned with our limited knowledge of the future. The need to demarcate land for use in the best interests of societies is at the heart of the planning profession, and to do so, environmental, and social issues must be considered (Joscelyne, 2015).

2.3.4 The Link between Planning and Climate Change

Planning (urban planning) is concerned with diverse aspects of a city including design, sustainability, creation, and development, depending on the city position and surroundings, its function, accessibility, and extent (Matuszewska, 2009). According to Matuszewska (2009), this suggests that preparation is founded on the difficulty of forecasting the future while depending on circumstances based on past and current experience (Matuszewska, 2009). As a result, planning ability is based on knowing and recognizing facets of a variety of professions, such as geography and engineering, among others (Matuszewska, 2009). This breadth of expertise provides planners with a broader perspective and awareness of the various factors that influence planning (Matuszewska, 2009).

According to UN Habitat (2011), there is a strong and direct connection between healthy, sustainable urban development and climate change. Understanding the concept of environmental planning is critical when considering the relationship between planning and climate change. According to Lein (2003), environmental planning blends environmental and earth science principles with planning (Lein, 2003). Humans depend on the environment for survival now and in the future because it provides us with necessities including oxygen, food, and water. Environmental planners help to safeguard and improve habitats, environmentally vulnerable regions, and ecosystems (United Nations, 2011). Environmentally vulnerable areas such as

wetlands, estuaries, and marine ecosystems may be relocated, minimized, or prohibited with the assistance of planners (UN Habitat, 2011). Holding construction out of these areas will help a community better defend itself from problems like river flooding and deforestation, as well as storm surges (United Nations, 2011). As a result, good planning practices are inherently climate smart planning practices.

Furthermore, according to Lein (2003), environmental planners seek to optimize the benefits to humans and the environment while mitigating the effects of human development (Lein, 2003). Since the environment is a valuable and scarce resource, environmental planning ensures and safeguards our sustainability and that of future generations (Matuszewska, 2009). Matuszewska (2009) believes that if environmental degradation continues at its current pace, especially because of climate change, it will have devastating implications for all life on Earth (Matuszewska, 2009). Environmental planning encompasses climate change because it encompasses not only the changes in the climate that planners are trying to keep humans away from, but also the effect those changes have on urban environments (Matuszewska. 2009). Climate change, according to Matuszewska (2009), is a part of our atmosphere, and thus can be regarded as an environmental problem because it induces changes in our environment and, as a result, in the lives of society (Matuszewska, 2009). Planners are actively engaged in influencing and monitoring physical land use and development patterns to minimize the effects of climate change. Urban form is a crucial factor in assessing how vulnerable individuals, locations, and industries are to climate change (UN Habitat, 2009), so planners must have adaptive ability and resilience to solve these issues.

Furthermore, as already mentioned under the "planning as a profession" theme, planning plays an excessive role in designing and structuring of future cities. Since climate change is a global environmental problem, planning has always been and will continue to be related to it. According to Matuszewska (2009), urban planning, as an aspect of the environment, inexorably determines the design of future cities, and plans are based on and driven by the environment, which is being harmed by climate change (Matuszewska, 2009). As a result, city planning is crucial in reducing the impacts of climate change.

2.3.5 The Role Played by Planning During the Apartheid Era

Given Carmon's (2013) widely accepted and agreed-upon theory that planners aim to enhance quality of life for everyone in the built environment, planning indeed played a role in the apartheid period. While not as systematic as it is today, planning dates to the apartheid period and had a

major impact on South Africa's urban planning and spatial trend. To be precise, the history of spatial planning in South Africa is interesting because the new planning structures were fragmented and vague, and they were mainly concerned with racial segregation, which included the classification of areas for different races (Joscelyne, 2015). Physical and spatial considerations have historically been the subject of planning, which has translated into development control. Apartheid laws were followed by legal instruments that regulated and controlled how land could be used and established, particularly in urban areas (Joscelyne, 2015).

On a national level, the contentious 1913 Black Land Act divided land into "scheduled areas" and "released areas" for the exclusive occupation and acquisition of African citizens (Van Wyk and Oranje, 2014; Mabin, 1991). Since the new spatial planning framework was "supplemented" with a different method that was specifically applicable to "black land," the 1913 Act and its predecessors had major planning consequences (Van Wyk and Oranje, 2014; Mabin, 1991). According to Mabin (1991), places were established outside of these regions on the outskirts of 'white' towns to accommodate African people who were supposed to lead the country's economy (Mabin, 1991). This division of land and separation of citizens, according to Van Wyk and Oranje (2014), necessitated and culminated in the introduction of separate spatial planning legislation for each of the various regions.

Cities during the apartheid era were planned with a fixed population size in mind, and with the aim of restricting growth, as stated earlier on (Haughton and Hunter, 2004). African townships were also developed with a fixed population size in mind and were consequently situated in areas of the city where they were naturally bounded by watercourses and major buffer zones unsuitable for construction (Haughton and Hunter, 2004). When they could no longer expand, these areas densified, with large numbers of informal settlements built in the backyards of formally constructed house. When they couldn't spread any more, these areas became denser, with vast numbers of informal communities springing up in the backyards of formally established homes. When these communities' densification hit its height, the only way to grow was outward. Apartheid cities, on the other hand, are overcrowded in certain areas, causing infrastructure services such as water supply, power, sewer systems, and storm water drainage to fail.

As a result, due to the peculiar spatial inconsistencies that cities created at the time, my perspective on the role of planning in adaptation to and mitigation against climate change during the apartheid era is that it played a significant role in allocating citizens, especially African people, in hazardous

areas. Despite the introduction of the urban master/structure plan in the 1970s, which sought to improve the regulation-centred planning system, things remained segregationist (Van Wyk and Oranje, 2014). According to Oranje (1998), the master plan was hampered by the apartheid state centrally administered local powers, a lack of legislative support for the forward plans, and a lack of interaction between these plans and government financial planning and budgeting (Oranje, 1998). If the proposal did not help the production, it was discarded as a fictitious representation of one of several potential futures (Oranje, 1998). This shows that the plans still supported what the property developers and municipalities wanted – which is separate developments for Africans in limited and environmentally sensitive areas away from the city privileges. Apartheid spatial planning also has a major impact in the present-day consequences.

Nonetheless, with the support of the South African Truth and Reconciliation Commission (TRC), a balance between a painful past and a peaceful future was unavoidable, as it was part of the new South Africa's transition between past and future (Jardine, 2010). In his book *No Future without Forgiveness*, Archbishop Desmond Tutu (2000) argues that true reconciliation cannot be achieved when someone cannot be forgiven (Tutu, 2000). As a result, the TRC marked a landmark moment in South Africa's growth as a democratic country. According to Jardine (2010), it was developed as a means to an end, as a way for the nation to begin the healing process following the end of apartheid and to put an end to the misery that many South Africans had endured (Jardine, 2010). With so much animosity and vengeance between races because of segregationist apartheid legislation, it mitigated the possibility of a bloody and protracted war in favour of truth and forgiveness, and eventually the rebuilding of our nation (Brankovic, 2013). As a result, the TRC is a watershed moment in South African history.

2.3.6 Present Role of Planning towards Adaptation to and Mitigation against Climate Change

As a consequence of the nineteenth-century Industrial Revolution, which resulted in increased environmental and social pressures, planning in the apartheid era tends to differ from that of today. Although industrialization came with vast economic and social changes such as improved infrastructure, efficient transportation, improved food production and growing body of wage (Mgbemene and Nnaji (2016). Authors such as Mgbemene and Nnaji (2016), on the other hand, suggest that it is also the outcome of anthropogenic activities linked to industrialization causing a long-term shift in weather patterns. Presently, environmental issues are extremely high with a drive

towards sustainability. According to Joscelyne (2015), this was fueled by the technological revolution as well as the introduction of toxic substances emitted by automobiles because of industrialization (Joscelyne, 2015). Furthermore, with a domestic economy dependent on coal resources to produce electricity and liquid fuels, South Africa is one of the world's 20 largest CO2 emitters, with the highest per capita emissions among developing countries (Ziervogel, 2014).

To bring an end to, or at least lessen this, planning and its laws have grown to include a broader variety of aspects and regions, necessitating convergence with other sectors to overcome the problems that the industrial revolution brought about (Joscelyne, 2015). According to Joscelyne (2015), these problems included increasing emission levels, rising population density, and worsening environmental standards, all of which promoted filth and unsanitary living conditions (Joscelyne, 2015). The growth and need for planning were sparked by the unsanitary living conditions and declining quality of life. According to Joscelyne (2015), environmental policies must be incorporated into other facets of society, such as land use planning, to overcome the environmental problems raised by the Industrial Revolution and economic development (Joscelyne, 2015). As a result, we are currently in the process of transitioning to sustainable development, which meets the needs of current generations without jeopardizing future generations' needs (United Nations, 2013).

Faced with these challenges, planning has been elevated from a facilitator and advocate of climate conservation to a mitigation tool for climate change impacts (Mgbemene and Nnaji, 2016). The Disaster Management Act of 57 of 2002 mandated that state, regional, and local governments be in charge of an integrated and organized disaster strategy aimed at preventing or reducing disaster risk (RSA, 2002). One of the key policy areas of planning that can assist in both mitigation and adaptation to climate change is spatial planning. Indeed, according to Davoudi (2013), spatial planning can be viewed as a conceptual phase in which both can be seen in the sense of long-term growth (Davoudi, 2013). The Development Facilitation Act (DFA) of 1995 established spatial planning, which was later repealed by the Spatial Land Use and Management (SPLUMA) Act 16 of 2013. This Act required that all levels of government in the Republic of South Africa provide spatial planning and land use management in their planning schemes, among other things (RSA, 2013).

2.3.6.1 Adaptation Measures

Adaptation, as described in chapter one, is the process by which societies plan for an unpredictable future environment (UN Habitat, 2011). According to UN Habitat (2011), adaptation does not mean that the harmful consequences of climate change will be absolutely avoided; rather, they would be less serious than they would be if no planning had taken place. It's also worth noting that a city with greater adaptability is more flexible, better able to withstand, manage, and mitigate climate change risks (UN Habitat, 2011). Furthermore, according to UN Habitat, there are four main areas in climate adaptation planning that must be addressed: improving adaptive capacity, addressing and managing the socio-economic impacts of climate change, particularly on vulnerable communities, and improving opportunities for collaboration and cooperation between and among climate stakeholders; and climate change adaptation is being integrated into current city plans, strategies, programs, and planning processes (UN Habitat, 2011). The following are some of the measures that planners take to help communities adjust to climate change:

- **Spatial Planning**

According to Busayo et al., (2019), spatial planning will help communities respond to climate change by improving their resilience to it. This is particularly true in urban areas. Spatial planning is often thought of as a holistic method used by planners to form spatial developments and observe the interrelationships and impacts of spatial steps over time (Biesbroek et al., 2009). As previously stated, under apartheid, spatial planning was monitored and managed with the aim of planning urban centers. According to Busayo et al. (2019), the United Kingdom (UK) adopted national urban planning Acts to reduce dilapidation and address social issues (Busayo et al., 2019). As a result, other countries, such as South Africa, have adopted the same strategy to step away from reactive preparation and toward a more constructive approach (Agbola and Falola, 2016). In recent years, urban planning laws have expanded to include a broader range of topics, such as the introduction of planning processes into various sectors to address social issues including climate change adaptation.

As a result, urban planning is regarded as an important part of land use planning and a key tool for achieving sustainable development and coping with climate change (Biesbroek et al., 2009). Space planning exemplifies a forward-thinking and pragmatic approach to climate change adaptation (Busayo et al., 2019). This approach includes land improvement and utilization programs. For

example, in 1994, South Africa initiated the Reconstruction and Development Programme (RDP) policy framework/program to achieve integrated and cohesive socioeconomic reform and undo the effects of apartheid. This initiative (now known as Breaking New Ground (BNG) reflects a vision for South Africa's fundamental transformation. It is an infrastructure program that has provided many traditionally deprived people with modern and efficient services such as electricity, water, transportation, health, and training (RSA, 1994). According to scholars, the South African government passed the Development Facilitation Act 67 of 1995, which was later amended to the Spatial Planning and Land Use Management ACT No.16 (SPLUMA) in 2013, to boost spatial resilience and ensure sustainable livelihoods in communities in the face of environmental shocks and climate change (Busayo et al., 2019).

Furthermore, it has been discovered that spatial planning, especially in urban areas, is crucial for improving climate change adaptation and resilience (Chu et al., 2016). According to James et al., (2016), the contemporary understanding of city-making is a function of urban planning that makes cities safer, more resilient, and sustainable to withstand external forces and the impacts of climate change. Hughes (2003), for example, claims that it is critical in ensuring that the negative effects of floods are held to a minimum by ensuring that flood-prone areas are still left undeveloped (Hughes, 2003). Furthermore, through its benefits to the construction of spaces, spatial planning helps in climate change adaptation. For instance, as the need to make growing cities more resilient to global warming has increased, urban layout designs that adjust to climate change impacts have become increasingly relevant (Busayo et al., 2019). South Africa is working to correct segregated apartheid spatial planning and strengthen community resilience to climate change and other related hazards that threaten human social, economic, and environmental health (Busayo et al., 2019).

As a result, the adoption of SPLUMA in 2013 resulted in a shift in the country's spatial planning, with a focus on increasing communities' resistance to climate change's impact. The role of spatial planning in developing, both adaptation and mitigation strategies to reduce climate change effects, needs more attention due to its proclivity for addressing multifaceted climate change problems (Davoudi et al., 2009).

- **Physical Land Use Planning**

Through paying careful attention to physical land use and urban form, planners will track and respond to the effects of climate change (United Nations, 2011). According to Gurran et al., planners use land use planning as a method to adapt to climate change's impacts and other natural

hazards (2008). For example, planners are involved in land use classification and may assist in the creation of settlement patterns to reduce and minimize vulnerability to lands and climate hazards (for example, steep and unstable hills, flood-prone areas, and coastal areas susceptible to sea level rise and storm surges) (United Nations, 2016). City plans that promote more compact development patterns, according to United Nations (2011), would create favourable conditions for renewable energy (e.g., district energy) and efficient public transit systems, reducing energy use and greenhouse gas emissions (United Nations, 2011).

Furthermore, as urban populations continue to expand drastically, effective land use planning is becoming increasingly significant. This is especially true in developing countries like South Africa, where local governments have little power over economic development (United Nations, 2011). According to the Department of Human Settlements, slum and informal settlement projects pose a significant challenge since they are often located in areas that are vulnerable to multiple climate hazards (United Nations, 2011). As a result, forward-thinking planning processes that consider climate change will help in directing development and growth to more appropriate areas, as well as better managing growth now and in the future (United Nations, 2011). The water, sea level rise, economic, and transportation themes in Durban include responses to the need to plan and manage land use in a way that promotes protection from climate change impacts and minimizes GHG emissions (eThekwini Municipality, 2014).

2.3.6.2 Mitigation Measures

Mitigation efforts, as defined in Chapter 1, help to slow, or halt climate change by lowering human-caused greenhouse gas emissions (United Nations, 2011). According to United Nations (2011), these are gases released into the atmosphere as fossil fuels are burned for energy production (United Nations, 2011). Land use practices that intensify global warming (for example, deforestation) are frequently affected by urban growth or consumption patterns. Although most adaptation approaches concentrate on spatial and land use planning, planners may also help communities manage climate change by taking the following steps:

- **Improvement of Transport Networks**

Improving transport networks through reducing urban traffic and supporting of greener modes of transport (e.g., public transport transit system, walking) is considered as another form of intervention by planners in mitigating climate change (United Nations, 2016). According to the United Nations (2011), as car ownership rates increase in developing countries and urban

development expands, splitting the distances between where people live, work, and shop, greenhouse gas emissions associated with transport will continue to rise. As a result, planners can help minimize greenhouse gas emissions by adopting policies such as compact, high-density, mixed-use construction to reduce car miles traveled and urban congestion (United Nations, 2016). Furthermore, by identifying transportation networks that are impacted by climate change impacts (e.g., storm-surge-prone bridges, flood-prone roads), the transportation plan improves road, pedestrian, bus, and bicycle connections and infrastructure (United Nations, 2016).

Several studies have attempted to establish a link between urban form, land use, and travel patterns (Mgbemene and Nnaji, 2016). While socioeconomic factors are said to explain trip-making differences more effectively than land use factors (Hickman & Banister, 2005), evidence shows that land use characteristics such as construction density, settlement size, and access to facilities and services have major impacts on regional and city travel behavior (Banister and Anable, 2009). In terms of facilitating walking and cycling, density has a greater influence than settlement size (Mgbemene and Nnaji, 2016).

The main conclusion about the effect of land use on travel behavior is that, although planning can play a smaller role in the short term relative to economic measures, it plays a much larger role in the long run (Mgbemene and Nnaji, 2016). This is achievable through fostering sustainable location choices closer to the city. Furthermore, given South Africa's unequal distribution of GHG emissions from personal car travel (Brand and Boardman, 2008), the role of planning in providing local services and access to them through sustainable modes of transportation is critical to ensuring accessibility for lower-income groups (Mgbemene and Nnaji, 2016). In general, the location of new housing and other initiatives in the United Kingdom has major repercussions for the use of different modes of transportation, travel lengths, and the level of demand on transportation systems (Brand and Boardman, 2008).

- **Green Roof/Rooftop Gardens**

According to Ismail and Abdullah (2016), green roofs/rooftop gardens will aid in the resolution of climate change-related issues such as global warming, floods, deforestation, high carbon dioxide emissions, and biodiversity loss (Ismail and Abdullah, 2016). According to Booth et al., (2012), the reduction of green space in cities due to rapid urbanization – which results in less area sufficient to absorb CO2 pollution in the atmosphere – is the primary contributing factor to the climate change phenomenon (Booth et al., 2012). Therefore, Greenstone (2009) also recommends that

rooftop gardens are indeed a solution to mitigating some of the climate and change issues. Through rooftop gardens, he notes that the efficiency of buildings improves, and thus decreasing the number of emissions during energy generation when coal is burnt (Greenstone, 2009).

Other researchers, such as McDonald (2014), Zhang et al., (2015), and Czemiel (2009), notes that the benefits of green roof in water run-off. Green roofs, according to these researchers, slow storm water run-off and can also act as a source of water during water shortages, reducing the risk of urban flooding (Ismail and Abdullah, 2016). Green roofs are also credited with preventing contaminated water from leaking onto impervious surfaces and into waterways (Getter & Rowe, 2006). Using experimental plots, Zhang et al. (2015) discovered that green roofs can efficiently retain storm water run-off, with an average retention of 77.2 percent (Ismail and Abdullah, 2016). While similar results from Nawaz et al., (2015) confirm that green roofs can retain 66 percent of water runoff (Ismail and Abdullah, 2016). Given the different results produced by experimenters - which tend to reduce reliability of the claims, various authors explain the factors causing the differences in water quality leaving green roof as including vegetation type, green roof designs (where the urban planners come in), study duration (Czemeil, 2009), fertilization rate, and intensity and duration of rainfall (Nawaz and McDonald, 2014).

Apart from that, green roofs are said to help in the reduction of air pollution because trees, which are an important component of green roofs, have a direct impact on air pollution reduction (Currie and Bass, 2008). Plants use leaf stomata to filter out particulate matter and gaseous contaminants in the air, according to Ismail and Abdullah (2016), it is important to reduce air pollution problems in urban areas because they pose a major threat to human health, causing issues such as decreased lung capacity and respiratory distress (Getter and Rowe, 2006). As a result, countries such as Chicago make efficient use of the green roof system, with studies indicating that intensive green roofs remove approximately 1,675kg of air pollutants annually (Ismail and Abdullah, 2016). Green roofs, as a result, play a critical role in reducing carbon dioxide emissions and mitigating climate change. Early in the planning process, planners are brought in to assist with the implementation of green roofs.

2.3.7 Barriers to Climate Change Adaptation and Mitigation

Although there are several advantages to adaptation and mitigation, the literature also addresses possible barriers and weaknesses to these acts (Dow, 2013). According to Biesbroek et al., (2011), several challenges obstruct the development and implementation of climate change adaptation

strategies (Biesbroek et al., 2011). For the purposes of this study, we define barriers as constraints or obstacles that cause actors (individuals, organizations, and governments) to pause, impede, redirect, or obstruct the creation and implementation of climate change adaptation and mitigation strategies (Biesbroek et al., 2011).

Uncertainty, the cost of adaptation and mitigation initiatives, market failures, fragmentation, rigidity, a lack of awareness and coordination, a lack of information and leadership, a pre-existing lack of confidence that climate change is a severe problem that must be tackled, and a lack of understanding of the possible effects of climate change are all factors that tend to be impediments to action (Biesbroek et al., 2011). Case studies were conducted in a variety of disadvantaged industries and regions. According to Watkiss and Climato (2018), these factors make it difficult to make decisions or act, even when action is required (Watkiss and Climato, 2018).

According to Biesbroek et al., (2011), future climate change is marked by high uncertainty and plays a significant role. It is currently unclear where the earth stands in terms of possible emissions, i.e., whether global average surface temperatures would rise by 2°C or 4°C (Watkiss and Climato, 2018). The difference in uncertainty between these two scenarios has a major effect on the amount of mitigation necessary (Watkiss and Climato, 2018). However, they also state that even if the future course were understood, the outputs of various climate models would still be fraught with uncertainty (Watkiss and Climato, 2018). Furthermore, different models do not always agree on the direction of change (for example, whether rainfall will increase or decrease because of climate change in a particular area) (Watkiss and Climato, 2018). Consequently, uncertainty is a major roadblock to short- and long-term adaptation and mitigation. It has the capability of delaying or discouraging decision-making.

When it comes to adaptation behavior, Dercon (2002) states that the willingness of low-income communities to respond successfully to adaptation strategies is the primary concern. This, according to Dercon (2002), is due to their inadequate response strategies in the face of anthropogenic climate change (Dercon, 2002). While Burton (2009) adds that this high sensitivity by low-income groups is caused by the existence of an “adaptation deficit”. According to Burton (2009), low-income communities are less likely to cope with climate disasters because they lack the structural, financial, and technological capacity to respond effectively (Burton, 2009). Inefficiencies in the provision of adaptation programs or the sufficient distribution of available capital to more urgent needs often contribute to deficits (Burton, 2009). Meanwhile, Dow (2013)

is worried about such theories alone, given that potential climate threats could be much more serious than current climate variability's consequences (Dow, 2013).

With business failures as a roadblock, Watkiss and Climato (2018) argue that leaders with the ability to make improvements will do so when it is in their best interests, that is, when the advantages outweigh the costs (Watkiss & Climato, 2018). Market failures may occur for a variety of reasons, including a lack of knowledge about potential climate effects, the difficulty of markets in providing or allocating public goods for adaptation, such as large-scale flood defenses, a gap in information access among different actors, and misaligned incentives. These business weaknesses obstruct the market's ability to take effective adaptation measures and, as a result, market solutions (Watkiss and Climato, 2018). As a result, the importance of adaptation and mitigation is not expressed in consumer rates or the returns received by individuals or businesses, and the level of adaptation and mitigation would be lower than the economically effective level (Watkiss and Climato, 2018).

Fragmentation is another barrier that is said to play a major role in climate change adaptation (Biesbroek et al., 2011). Any governance framework that solves a difficult and complex policy problem, according to Biermann et al., (2011), faces fragmentation. In this context, fragmentation refers to a lack of coordination and cooperation at different levels and scales between agencies, organizations, individuals, and policies (Biesbroek et al., 2011). Fragmentation problems are likely to escalate as climate change adaptation is a multi-level and multi-sector problem. It may take many forms, for example, responsibility for adaptation may be divided among different organizations; or decisions may need to be made at several levels, with decisions made at one level having negative effects at other levels (Biesbroek et al., 2011).

A lack of information and coordination is one of the factors impeding effective climate change adaptation and mitigation (Biesbroek et al., 2011). Communication is crucial for raising public awareness about climate change's consequences, levels of risk, and the need to begin adapting (Biesbroek et al., 2011). However, without contact, society would remain unaware of its position and mutual (governmental) adaptation efforts (Moser, 2010). In the literature on climate change adaptation, a basic understanding of social and political issues is needed. Different media have an impact on public belief and perception, which can be detrimental at times; for example, recent news coverage about errors in the IPCC assessment reports has had a negative impact on public sentiment on climate change (Biesbroek et al., 2011). Consequently, a lack of communication on

climate change adaptation between science, policy, and society will lead to a low level of knowledge and denial (Leiserowitz et al., 2010).

Nonetheless, overcoming these roadblocks is crucial for advancing climate-friendly growth. Watkiss and Climato (2018) argue that long-term planned adaptation is crucial for future economic growth in the face of these obstacles. They claim that planned adaptation and mitigation takes potential climate risks into account when locating and constructing infrastructure, planning urban and rural land use, and managing ecological resources including natural systems (Watkiss & Climato, 2018). According to Watkiss and Climato (2018), investments made today have long lifetimes (5-40 years) and will be exposed to climate change in the future, so failure to act early will lock in future risks (Watkiss and Climato, 2018). If climate change becomes more serious, there is an opportunity to make some early investment decisions that are "climate-smart" by considering potential threats and considering early adaptation and mitigation options (Watkiss and Climato, 2018).

2.4 Conclusion

The aim of this chapter was to establish a theoretical framework and review relevant literature for the research topic. The theoretical framework has proved that theories discussed are undeniably practical on the field. While research from the past and present has shown that the planning community plays an important role in climate change adaptation and mitigation, although they are not recognized and acknowledged enough, responses by planners have multiple benefits to the society and it has been observed that they tend to resolve more than just one problem. Further, more focus is needed on the barriers to adaptation and mitigation as they cause a delay to the process of mitigating climate change which, is already causing severe impacts, hence, there urgently need to be sustainable decisions taken by policy makers.

3. Chapter Three: Research Methodology

3.1 Introduction

According to experts (Kothari, (2004); Creswell, (2013); and Walliman and Walliman, (2011), research methodology is the conceptual background in which the research is conducted or the foundation on which the research is based. It is a science that studies how research can be conducted and the methods by which information is obtained (De-xin, 2018). In essence, research methodology is described by Igwenagu (2016) as a systematic, theoretical analysis of the methods techniques used in a field of study (Igwenagu, 2016). Equally important is to note that the research methodology is significant in a study as it locates the reader to how you plan to tackle your research problem.

The entire research process is described in this chapter. The chapter looks at various research methods that were adopted in the study to investigate adaptation and mitigation approaches used by planners against climate change in Umlazi Township. In essence, research methodology is described by Igwenagu (2016) as a systematic, theoretical analysis of the methods techniques used in a field of study (Igwenagu, 2016). To put it another way, it's a how-to manual for science (Igwenagu, 2016). The Umlazi Section H area in the eThekwini Metropolitan Municipality was used as a case study for this study.

3.2 Research Design

Sogoni (2014) maintains that every research must have a design which will guide it to the direction the researcher desires (Sogoni, 2014). Burns and Grove (2001) describe a research design as "a set of specifically specified frameworks within which the analysis is carried out" (Burns & Grove, 2001). In general, a design functions as a "glue" that binds all the elements of a research project together (Akhtar, 2016). It is used to structure the research, to show how all the major parts of the research project work together to try to address the main research questions (Kerlinger, 1978). As a result, the research design is important because it decides the research study's desired outcome.

3.2.1 Case Study: South African Context - eThekwini Municipality Flooding

The physical effects of climate change catastrophes on the atmosphere were calculated using a case study approach. A case study, according to Baxter and Jack (2008), is a research method that employs a variety of data sources to analyze and comprehend a phenomenon and complex issues within its context (Baxter and Jack, 2008). Case studies are beneficial in research because they

ensure that the topic of interest is thoroughly investigated, and the essence of the phenomenon is revealed. The case study method has the advantage of allowing a researcher to analyze data in a specific context. In most cases, a case study process selects a particular geographic region or a limited number of people to be the study's subjects (Zainal, 2007).

According to Yin (2012), a case study must be connected to a routine or daily event; therefore, the chosen case must be an influential context for the study to add to the current literature (Magubane, 2016). Umlazi Township H-Section in eThekwini Municipality was selected as a case study to collect primary data. The area was identified appropriate due to the most recent occurrences of the climate change catastrophes, this enables the latest data to be contributed to the current literature as Yin (2012) noted. According to Dludla (2019), Umlazi Township recently experienced the catastrophe of flooding, which destroyed at least 124 houses and took away more than 14 lives in Umlazi Township alone (Dludla, 2019). Another reason why this case study is suitable is because there are limited studies which discuss the climate change disasters in Townships which previously served as Bantustans or Homelands are scarce in South Africa. Therefore, this calls for more research in the parts of Umlazi about what happened spatially when these Townships were established since they are usually the most affected ones when it comes to climate change. Umlazi Section H was chosen as the best part since it consists of the most recent disasters.

3.3 Research Approach

The qualitative and quantitative approaches to conducting research are the two main approaches. Qualitative analysis, according to Denzin and Lincoln (2000), necessitates an interpretative and naturalistic approach, which means qualitative researchers investigate phenomena in natural settings, seeking to make sense of or interpret phenomena in terms of the meanings people ascribe to them. The quantitative method, on the other hand, includes using numerical data and analyzing it using complex statistical methods to answer questions like who, how much, where, how many, and how (Apuke, 2017). However, since quantitative approaches are inadequate in describing the phenomenon, they wish to analyze on their own (Ospina, 2004), many researchers prefer to collect data using qualitative methods. According to Rahman (2017), the positivism research model is

unable to account for how social reality is shaped and maintained because it lacks conventional definitions of social phenomena (Rahman, 2017).

The qualitative analysis method used in this study was exploratory and descriptive in nature, and it was used to examine the lived experiences of Umlazi Township Section H residents during climate change disasters (Streubert and Carpenter, 1999). This study used qualitative analysis because it highlights the dynamic, holistic, and unique aspects of the human experience while still trying to capture those experiences in their entirety, within the context of those who are experiencing them (Streubert and Carpenter, 1999). According to Flick (2014), qualitative analysis is a situated practice that places the researcher in the environment. Inferring that qualitative researcher study phenomena in their natural settings, trying to describe or interpret phenomena in terms of the meanings people attach to them (Flick, 2014). Apart from that, qualitative research is less costly because it requires small groups of participants, as opposed to quantitative research, which can necessitate large groups of participants and/or expensive measuring instruments due to the use of mathematical methods (Patton, 1990).

Therefore, the summarized advantages of choosing qualitative research method are:

- a unique interpretation of the experience's reality (Munhall, 2001).
- The researcher can communicate directly with the participants to evoke their feelings and feedback on the planning approaches towards climate change adaptation and mitigation (Rahman, 2017).
- the researcher can construct social realities under study through hearing different perspectives from the participants who have experienced the feel of the issue under investigation.
- it offers visions to the matter at hand by enabling the researcher to investigate in depth and zoom into how the event occurs.
- Cost effective.

The key goal of the exploratory study method is to see how planners treat climate change impacts in townships and to see how well the approaches used to address the effects work. This study utilized a case study approach together with in-depth interviews, focus groups and observation method to investigate this in-depth.

3.4 Tools to Collect Primary Sources of Data

Historians and others typically consider primary sources of data to be first-hand data written (or otherwise created) by people directly involved at a time contemporaneous or near contemporaneous with the period under investigation, according to Sapsford & Jupp (1996). In other words, primary sources are the foundational and original materials used to provide raw evidence to the researcher (Sapsford and Jupp, 1996). Similarly, Kadam et al., (2013) describe primary sources of data as an investigator's first-hand data that provides evidence in relation to a particular subject under investigation (Yale, 2008). This research will use several approaches to obtain feedback from stakeholders in the planning environment, including in-depth interviews, focus groups, and participant observation.

3.4.1 Interviews

According to Robbins, interviews are one-on-one information gathering discussions between a competent interviewer and researcher subjects (2008). According to Robins, researchers conduct interviews in person (face-to-face) or over the internet, using structured or unstructured questionnaires (2008). Face-to-face interviews can take place one-on-one between the interviewer and the respondent, or in a focus group environment (Robbins, 2008). Both types of interviews are conducted in an unstructured way, with respondents answering qualitative, open-ended questions rather than choosing from a list of options (Robbins, 2008).

In-depth interviews were used in this study to allow for a more in-depth discussion of the research subject with the planning group and ward councilors. In-depth interviews involve conducting intensive individual interviews with a small number of respondents to explore their perspectives on an idea, program, or circumstance. They were useful in this study because they allowed the researcher to delve deeper into a person's emotions and behaviors in response to climate change disasters, as well as focus on new issues. This research used semi-structured interviews to gather accurate details about the person's viewpoint. Semi-structured interviews were chosen because their questions are more convenient and versatile than straight-forward question and answer formats. Instead of a straight-forward question and answer format, they are open-ended and allow for a dialogue with the interviewee (Kishita et al., 2018). According to et al., (2018), the interviewer prepares the questions; however, this will not necessarily be obliged to answer them all, accordingly, hence allowing the interviewer to comprehend what the interviewees say (Kishita et al., 2018).

Providing information from the perspective of the implementing planning professionals, the interview with the planning fraternity offered an insight of the role that the planning profession as a discipline can be or is used for adaptation and mitigation against climate change. This enabled a researcher to identify some of the challenges that they face when implementing their methods against climate change. Further, the interview with the ward councilor provided insight of the kind of relationship the ward councilor has with the community members, and when and how the planning fraternity usually gets involved in the community disasters.

3.4.2 Field Observation

Observation is another method used to collect data. Prior to the focus group interviews, the researcher went on site to investigate the negative impact that climate change has caused on the study area environment because of its catastrophes. According to Zinn (1979), this was a non-participant observation as the researcher observed the site without interacting with anyone. It was also an unstructured observation as the researcher was specific to when and where to observe because of a specific event that occurred in the area (Zinn, 1979). The purpose was to have a visual evaluation of the topography that the affected infrastructure was situated and organized with the aim of investigating if the land that they are situated at is suitable to resist such structures. The checklist of the infrastructure that will be focused at was developed and includes buildings (houses), roads and water drainage system.

3.4.3 Focus Groups

According to Robbins (2008), this is a form of face-to-face interview in which the interviewer functions as a facilitator, asking an infinite number of questions of the whole audience, which is typically composed of ten or less individuals (Robbins, 2008). According to Robbins (2008), the responses of the participants lead to additional conversations and questions that yield informative, qualitative results (Robbins, 2008). Focus groups, in other words, brings together a group of people to investigate a topic that both they and the researcher are interested in (Morgan and Spanish, 1984). Denzin (1978) argues that, while focus groups are a modern research method for social scientists, they do offer an opportunity to promote triangulation in research (Morgan and Spanish, 1984). The principle of addressing any issue with multiple approaches is one that most of us hold dear (Morgan and Spanish, 1984). For this study, adult households were purposely selected to respond to the focus group interviews.

The focus groups methodology was used to learn more about how people think and obtain a deeper understanding of the climate change phenomena under investigation. Focus groups, according to Nagle (2013), enable researchers to gather more detailed information at a lower cost than individual interviews. Hence, the researcher designed the interviews in such a way that it gathers information on the participants' age, how long they had lived in the Township of Umlazi, what climate change experiences have they come across, what kind of disasters had they experienced, how often do they happen and how it affected their livelihoods. The interviews also sought to discover the contributions of the planning fraternity during those trying times, however, hearing it from the resident's perspective. The researcher records the focus groups interviews using a recording device (audio tape) (Robbins, 2008). The latter, in an open-group discussion allows the participants to answer the questions openly while reminding each other of the forgotten climate change instances.

Further, as this study was conducted during covid-19 existence, all the strict health protocols were adhered to. As the mass gatherings/meetings were prohibited, the focus group interviews were conducted in three sessions divided into 4 people per session, and one and a half metres (1.5m) social distance from each other was observed.

3.5 Secondary Sources of Data

According to Boslaugh (2007), secondary data is any dataset not collected by the author or investigator, or the study of data collected by others for their primary research purposes that contains basic research concepts (Martins et al., (2018) and Mohaj, (2018). Secondary sources of data, according to Sapsford and Jupp (1996), reproduce, interpret, or judge material contained in primary sources (Sapsford and Jupp, 1996). Secondary data is information that has already been collected and is being considered for use in new questions for which the data was not originally collected (Martins et al, 2018). May (2001) suggests that secondary data is cheaper and quickly obtainable than primary data which is time and resource consuming (Tenza, 2018). The secondary sources of data in this research study include predominantly journal articles, books, eThekwini Municipality publications, newspaper articles, previous theses, and online films. This dataset was a vital source for this study as it provided further information and incite about the research question, and saved time and resources.

3.6 Sample Size and Sampling Method

According to Lyell (1998), researchers have various types of sampling methods which can be applied in a research study (Diako, 2013). Sampling is the method of analyzing certain parts of a population to estimate something about the whole population (Diako, 2013). According to Crabtree and Miller (1992), study participants are selected because they can explain their facial expressions in detail and are willing to share their experiences, resulting in a wealth of information that will both enrich and challenge the researcher's understanding (Diako, 2013).

The Umlazi Section H participants were selected at purposeful sampling. According to Lopez and Whitehead (2016), this is a non-probability sampling also known as 'judgmental sampling' involving the participants who have required status or experience (Lopez and Whitehead, 2013). In other words, it is selective in nature and allows the researcher to predefine which participants are to be included in the study and to approach the sample having a prior purpose in mind suitable for the study (Alvi, 2016). Further, this sampling technique is said to be tied up to the objectives at hand, meaning that the sample is guided by researcher's objectives (Sogoni, 2014). The researcher purposefully chose the participants of Umlazi Section H with an aim of ensuring that the findings of the research remain in line with the research's objectives. Out of a sample size consisting of approximately 100 units of Umlazi Township H Section, 12 participants were purposely chosen to partake in the study, the criteria being subjective to the research study's objectives.

The municipal officials were selected using convenience sampling. Convenience sampling occurs when people are invited to participate in the study because they are conveniently available regarding access, location, time, and willingness (Lopez and Whitehead, 2013). Considering the Coronavirus Disease (Covid-19) regulations, the municipal officials were selected based on their availability and willingness just so if they were from the correct department that is in line with the study. The first municipal official was from the Environmental Planning and Climate Protection Department (EPCPD), the one was from the Strategic Planning division under the development planning department of eThekwini Municipality, and the third one was the Ward Councilor of Umlazi Section H.

3.7 Data Analysis

Marshall and Rossman (1999) describe data analysis as "the process of adding order, structure, and meaning to a large volume of data in order to support the research project's work, goals, and plans." According to Henning et al. (2004), it is a continuous, evolving, and repeating process in which transcribed data from interviews is examined (Vosloo, 2014). Simply put, this is where field observation and the conducted interviews with the respondents i.e., the municipal officials; the ward councilor; and Umlazi H section community members, is modelled and made valuable for the purpose of building coherent interpretation of data and answering research questions.

In this research, thematic analysis was used to analyze the data and comprehend the various meanings ascribed to the issue at hand. According to Braun et al., "thematic analysis is a qualitative method for systematically identifying, organizing, and providing insight into patterns of meanings (themes) across a data collection" (Braun et al., 2019). According to Boyatzis (1998), it is used to explain data in depth and to deal with a variety of subjects through interpretations (Alhojailan, 2012). As a result, the researcher chose a thematic approach for this analysis to make sense of the participants' collective meanings and experiences, as well as to discover using interpretations of these meanings (Alhojailan, 2012).

3.8 Limitations of the Study

During developing this study, there are three main limitations that the researcher experienced, namely, time, finance and Coronavirus Disease (Covid-19), which further delayed the completion of this study. The time difficulties faced was getting hold of municipal officials and ward councilor as they away from the offices because of work backlog after level 4 lockdown regulations which had required them to shut down the municipal offices. Furthermore, the financial difficulties included having to travel a long distance from Howick (home) to Durban (Umlazi) for data collection. This process would have been much easier and cheaper if the researcher was still residing at the University residence located near the study area. Another challenge was the covid-19 pandemic outbreak regulations which limited the number of participants in the study, the researcher had initially desired to interview 22 residents, but ended up interviewing 12 residents and dividing them into 3 sessions of 4 people. This was timeous as the researcher had to ask the same questions to three different groups and cutting the number of participants to 12 undermined the aimed quality of the study.

Therefore, the way in which all these limitations were overcome was through perseverance and believing in oneself. Continuous calls were made to get hold of the ward councilor and continuous data was loaded in order to communicate with the municipal officials via electronic devices as contact meetings were prohibited. Further, although getting hold of the 12 respondents from Umlazi was financially straining and timeous, at least all 12 of them were reached through splitting them into three sessions.

3.9 Conclusion

In closing, the research methodology used in this study has been extensively explored in this chapter. It went over the qualitative method that was used and what it entails. It also identified and addressed the primary and secondary resources that were used. It also went through the study's research design, sampling process, and sample size, as well as how the data would be analyzed. The chapter concluded by with stating the limitations of the study, which basically describes the challenges that the researcher came across to during the study.

4. Chapter Three: Historical Background of the study area Umlazi Township, Section H

4.1 Introduction

This chapter attempts to provide a comprehensive historical overview of the study area where the research was undertaken. The factors that the chapter will focus on are its geographical location within eThekwini Municipality, the general background of townships and Umlazi Township history including when and how it was established. This chapter will also provide the housing development, landfill sites, storm water infrastructure, and the spatial development background of the area. The specific selected area within Umlazi is H Section, which is one of the sections within Umlazi that was recently affected by catastrophic flooding.

4.2 Location of Umlazi Township H Section

Umlazi is strategically situated east of the Durban International Airport and west of the N2 freeway. As shown in figure 4.1 on page 50, it is approximately 17 kilometers south of Durban's Central Business District (CBD) and immediately west of the Durban International Airport and the Southern Industrial Basin (eThekwini Municipality, 2008). Umlazi comprises of 26 sections, while the one being studied (section H) is bounded by the J section on the west, G section on the east and N section on the south as indicated in figure 4.2. Umlazi is part of the eThekwini Metropolitan Municipality in KwaZulu-Natal and has a land area of 4 481,7 hectares (eThekwini Municipality, 2008). Umlazi Township is the second most populous African township in South Africa after Soweto (Ngubane, 2014). According to Demarcation Board statistics, the population is estimated to be 550,000 people, with an increase of 166 438 people from the census of 2001 (eThekwini Municipality, 2008).

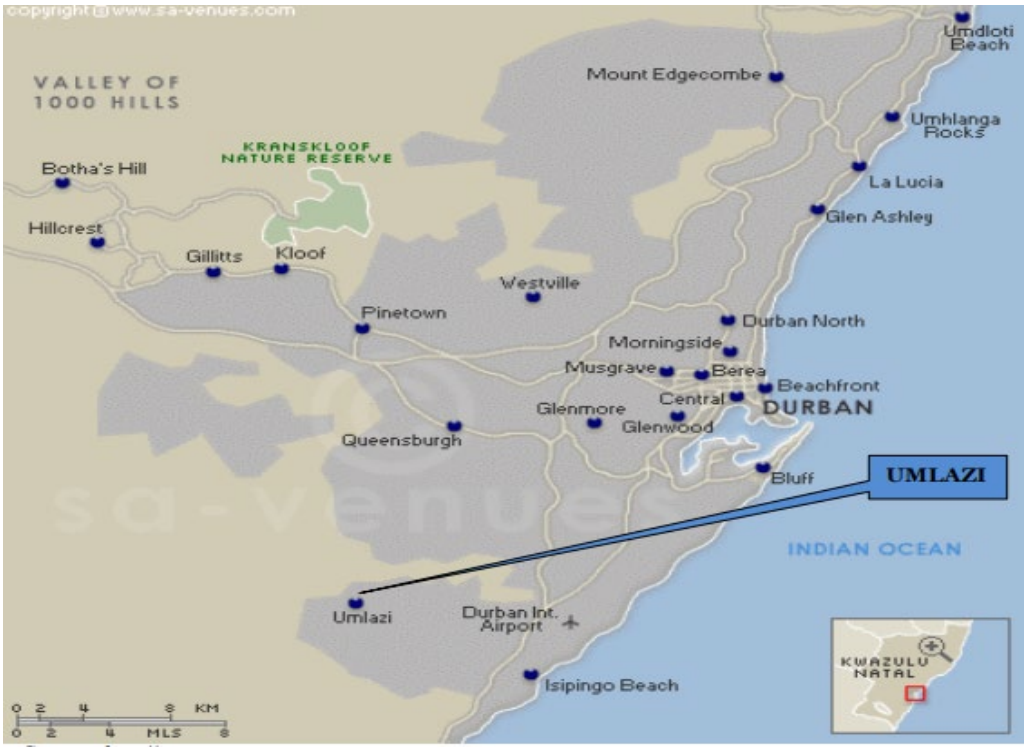


Figure 4.1: Map showing locality of Umlazi Township within eThekwini Municipality (Source: http://www.sa-venues.com)

Figure 4.2: Map showing locality of Umlazi H Section within Umlazi Township (Source: https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcTfJQ-

4.3 Brief Background of Townships

South Africa's apartheid system had a major influence in shaping the current spatial situation in townships (Zondi, 2011). According to Warrington (2001), apartheid racial segregation politics has left developmental and emotional scars in the current South African society, which over the years has slowly appeared (Ndaba, 2018). For instance, because of Umlazi being located outside of the urban core area, consequently, levels of infrastructure provision are lower than the urban core (eThekwini Municipality, 2011). This research study does not intend to discuss the historic origins of South African townships in depth, but it aims to highlight the historic origins which landed Umlazi Township where it is today.

In 1923, the Black Native Administration Act and the Group Areas Act in 1950 was enforced. These laws were created with the intent of controlling and excluding townships, so they were built on the outskirts of cities to serve as satellite settlements that supplied labor to the city (Pernegger and Godehart, 2007). Townships, according to Pernegger and Godehart (2007), are a distinctly South African 'invention,' but they were influenced by colonial town planning. Three groups of people were meant to be spatially separated by colonial planning: the white (colonial elite); the colonized (middle-class); and the colonized lower-class (comprising of Indians and some Africans working in the colonial bureaucracy and most Africans working for the elite) (Pernegger and Godehart, 2007). In short, white people were located closer to towns while Africans had to travel long distances to their residential areas (Ndaba, 2018). As a result of these policies, severe deprivation for most of the African population in an unregulated and under-serviced environment resulted.

4.4 History of Umlazi

Umlazi Township, which is divided into 26 parts, is the product of the British colonization of what was renamed Natal after land was confiscated from the indigenous population - Zulus - in 1845 (Mthembu, 2007). The Church of England founded the Umlazi location in 1862 to provide a progressive rural existence for "natives" pursuing pastoral and agricultural occupations (Mthembu, 2007). They then later relocated, and the land was left unoccupied, which was where the government saw the need to utilize the area as the relocation point for Cato Manor residents who resided in the area which was regarded as slum. In 1962, it was designated as a periphery township to house Cato Manor residents who had been relocated due to the slums rule (Mthembu, 2007).

However, Wiley et al., (1996) argue that the area of Umlazi was itself a noxious area to relocate people to. He observes that the housing development in Umlazi began in the early 1960s with both formal houses and large single-sex hostels which were predominantly located in Section T. Umlazi's Section T was used as the landfill site where most of the hazardous wastes from Durban builders and throughout the KwaZulu-Natal province were dumped (Wiley et al., 1996). This site was originally owned by Waste-tech and later by Enviroserv. Since this sites' inception, there were several complaints lodged by the neighboring residents about the harmful stink from the site, particularly from the educators and learners at Shumayela Secondary School in Umlazi and Isipingo Secondary School 300 meters southeast of the landfill site (Wiley et al., 1996). Further, the groundwater was also contaminated even beyond the boundaries of the landfill, receding toward the nearby Isipingo River. This being said, it makes no sense nor sustainable how they relocated people from one hazardous area to another.

With regards to storm water infrastructure, eThekwini Municipality (2011) states that severe storms highlighted serious problems in 2008. As a result of capacity of the storm water system which was not meant to accommodate a massive influx of people that moved to cities after the removal of Group Areas Act in 1994, issues such as blockages and broken storm water pipes were experienced (eThekwini Municipality, 2009). With that issue at hand and the fact that Durban is a predominantly a summer rainfall region with rain events of high intensity occurring over a short time, in consequence, flooding due to storm water blockage exist (eThekwini Municipality, 2009).

From a spatial planning and management point of view, eThekwini Municipality (2009) indicates that the Umlazi areas' utmost limitation around 2008 is that there was no existing Town planning Schemes in place. Therefore, this contributed to the unstructured change of land uses around the area as the property and public space was not managed. As a result, people ended up occupying spaces which are not meant for residential use.

4.5 Conclusion

This chapter discussed the study area location which covers it geographic location, magnitude and the population size. The chapter also provided a brief history of where exactly the townships in South Africa are coming, to be precise, how racial segregation occurred and the laws that shaped them. This chapter further provided a historical background of Umlazi Township, covering

particularly how it was established, when housing development begun, the background of landfill sites and storm water infrastructure, and the spatial expansion of the area.

5. Chapter 5: Research Findings, Data Analysis and Interpretation

5.1 Introduction

This chapter presents primary data gathered from the field, analyzes it, and interprets it according to the interviews undertaken with eThekwini municipal officials, ward councilors, and the residents of Umlazi section H. Further, this chapter also analyzes and interprets the site observations undertaken by the researcher in such a way that it achieves the research objectives. This section of the research is very critical and significant as it provides the practical aspect of the study and corroborates the essence of the study.

A thematic form of data analysis was employed to analyze data. Themes were associated with the questions of the research for the data to correspond with research objectives. Furthermore, the aim of this research was to look at the impact of climate change on the built environment, as well as the transformative role that planning can play in climate change adaptation and mitigation. The results of the collected data are used as pointers to investigate the extent of climate change's effect on the built environment, as well as the role that the planning profession plays now and in the future.

5.2 Data Analysis and Interpretation

To obtain a clear understanding of the area, direct observations of the study area and interviews were conducted. The researcher interviewed a total of twelve residents from Umlazi Section H, the ward councillor and two municipal officials from eThekwini Metropolitan Municipality. All the respondents were provided with a series of questions which were established in line with the research objectives (Zinn, 1979).

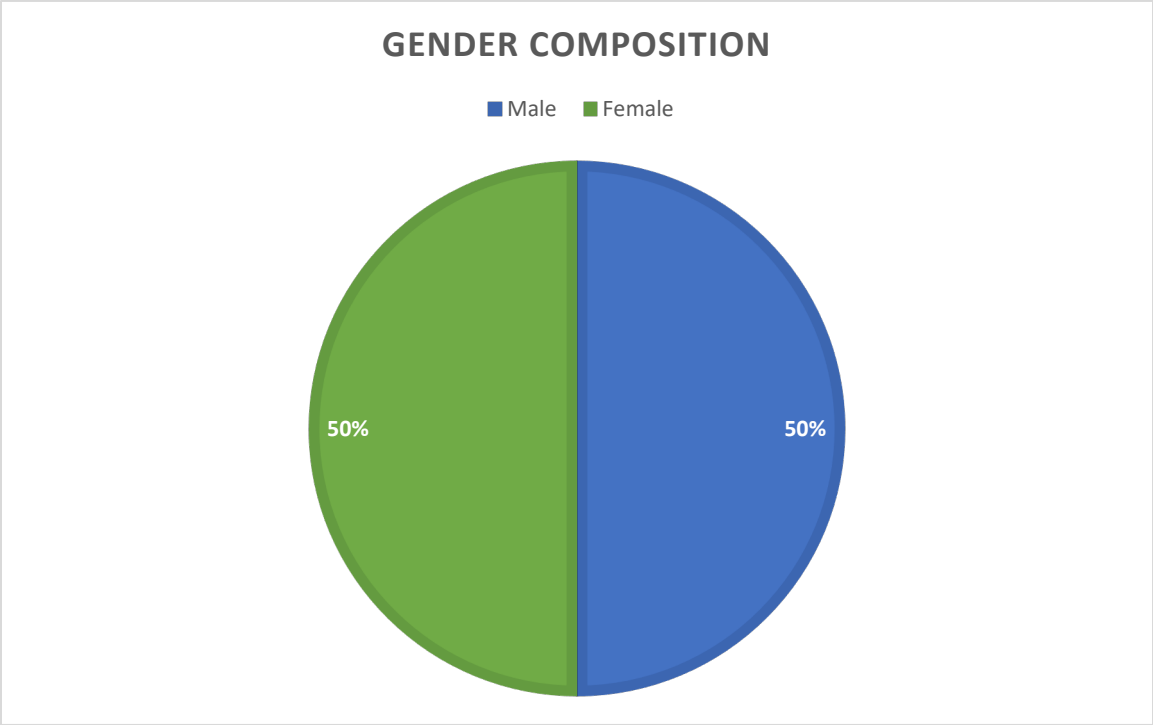
The focus groups interview between the researcher and the residents took place in one of the residents' homes in Umlazi Section H. The one-on-one interview with the ward councillor occurred at the office of Umlazi ward councillors located in Section H. Then the interview with the municipal officials took place electronically via zoom and Microsoft teams because of covid-19 lockdown restrictions, which though enabled the researcher to gather extensive information at a lower cost (Nagle, 2013). All interviews with the informants were recorded and written down at the same time.

Hard copies, such as interview recordings and the write ups from the discussion were securely kept in the lockable cabinet that can only be accessed by the researcher and the supervisor (Arifin, 2018). Documentation such as the signed informed consent form that contain highly confidential information, i.e., name and signature, were also kept in a safe place which can be accessed by the researcher. The data will be held for 5 years before being destroyed by removing soft copies and burning hard copies (Arifin, 2018).

5.3 Research Findings: Interview with the residents of Umlazi Section H

This section presents data collected from the residents of Umlazi section H.

5.3.1 Graph 5.1: Gender composition of the respondents



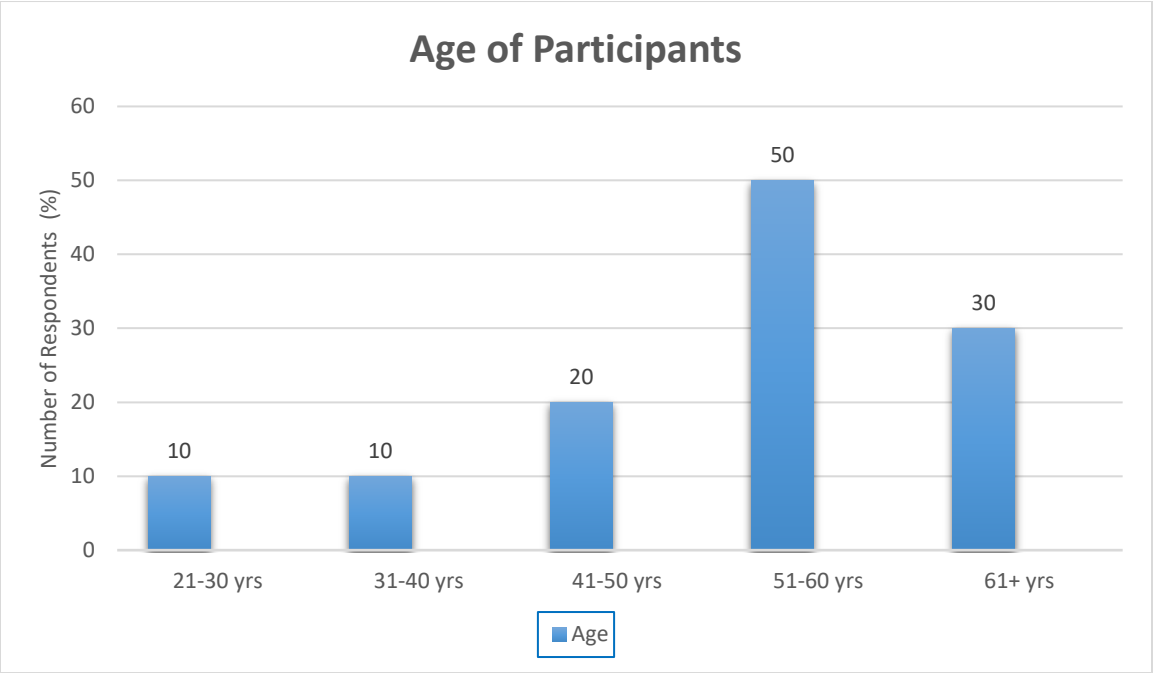
Source: Fieldwork Survey (2020)

Graph 5.1 above illustrates that out of the 12 respondents interviewed in Umlazi section H, 6 (50%) were males, and the other 6 (50%) of the respondents were females. This demonstrates that this area is occupied by equal gender composition, and 100% of these households said climate change does affect their livelihoods equally. In fear for her life, one of the residents complained that "things become extremely difficult for us when we encounter climate change disasters as we have no other option but to stay and keep on rebuilding other settlements in the same hazardous area".

Further, other households complained about how this even affects their ability to save money and send it back at home (in rural areas) as they only reside in this area to be close to their jobs in the city.

5.3.2 Graph 5.2: Age of the respondents

The graph below illustrates the ages of the respondents residing in Umlazi Section H. The graph demonstrates that majority of the inhabitants are between the ages of 51-60 years, and that the area is dominated by mostly elder persons.



Source: Fieldwork Survey (2020)

5.3.3 Table 5.1: Duration of stay in Umlazi Township

Duration	Interval	Percentage
1-10 years	2	17%
11-20 years	3	25%
21 years and more	7	58%
Total	**12**	**100%**

Source: Fieldwork (2020)

Table 5.1 above illustrates that most households have resided in Umlazi for over 10 years. According to the residents, 58% of the households are from the first group of people which were relocated from the Cato Manor informal settlements. The second group of people (25%) is the group that followed the Group Areas Act of 1950 had been enforced and called upon racial segregation. Then the third group (17%) are off springs of the first and second group which grew up in the area and later decided to form a youth ward committee after realizing that the area has no progress in terms of public infrastructure provision.

Many households have settled there since 1970, and about 83% of them have lived there long enough to observe everything that has been happening for the past years to date. Trying to locate the researcher in the picture of how long ago they have resided in the area, one elder lady mentioned that "we were here even way before the distribution of Reconstruction and Development Programme (RDP) houses that came just yesterday after years of sweat, we used to build our own houses with what we could afford, and that was predominantly mud" so she said. According to the households, the RDP houses are a very recent form of housing after years of fighting for such infrastructure, in fact, they had already accepted the situation as it is. By this information, the households were trying to express that they have been living under the influence of climate change ever since they arrived more than 50 years ago. As a result, this information redirects the investigation into what was done by the planning fraternity at that time to assist households in responding to climate change (Winkler, 2018).

5.3.4 The year in which disasters started taking place

In quest to find out the period in which climate change disasters transpired, the researcher directed this question to only the households who have resided in the area for over 21 years and above so that she can obtain the accurate timeframe. Considering that they did not all arrive at the same time, majority of the responses from the households pointed out that this started from their time of arrival. One man alludes that "we say this mainly because every time we experienced heavy rains; we always knew that a few houses will be closed as a result of its severity". Furthermore, "it was even severe during the times of mud self-built houses on the edges of hills because we were easily washed away by floods as houses were not established resilient enough to withstand the changes in climate".

5.3.5 Table 5.2: The Climate Change Disasters that have occurred in Umlazi Township

Disaster	Interval	Percentage
Floods	12	100%
Heavy Rainfall	12	100%
Heavy Windstorm	12	100%
Landslide	12	100%
Increased Heat	12	100%

Source: Fieldwork (2020)

Table 5.2 above depicts the type of climate change disasters that Umlazi come across to. The common disasters that are experienced are floods, heavy rainfall, heavy windstorm, landslide, and increased heat (eThekwini Municipality, 2014). 12 (100%) of the households that participated in the study agreed that these disasters arise frequently in the area and that it is their ability to adapt that has reduced their vulnerability to climate change. The households point out that they experience most of these disasters because of the unsuitable land that their homes are located at. In addition, "we don't even get refuse removal services from the municipality as a result of the horrible location that we reside at – an area that is more like a snake hole" so said one of the old ladies.

The information provided by the households therefore suggests that some of the sections at Umlazi Township has serious environmental health problems. According to Section 24 of the Constitution, everyone has the right to a healthy and safe environment, as well as the right to have the environment preserved for future generations by fair legislative and other steps that prevent pollution and ecological degradation; encourage conservation; and ensure ecologically sustainable production and use of natural resources while fostering justifiable economic and social growth (Hayward, 2005). With this right being taken into consideration, the households of Umlazi have every right to contest for the unjustifiable environment that they live in because it further affects their health. Furthermore, these households add that when these disasters occur, they destroy at

least a minimum of 5 homes as the houses slide from the homes located at the top of the area and down to the homes located at the bottom. The households complain that they live in fear because every time the weather changes, they wonder “whose home is next?”.

5.3.6 The frequency that these disasters occur

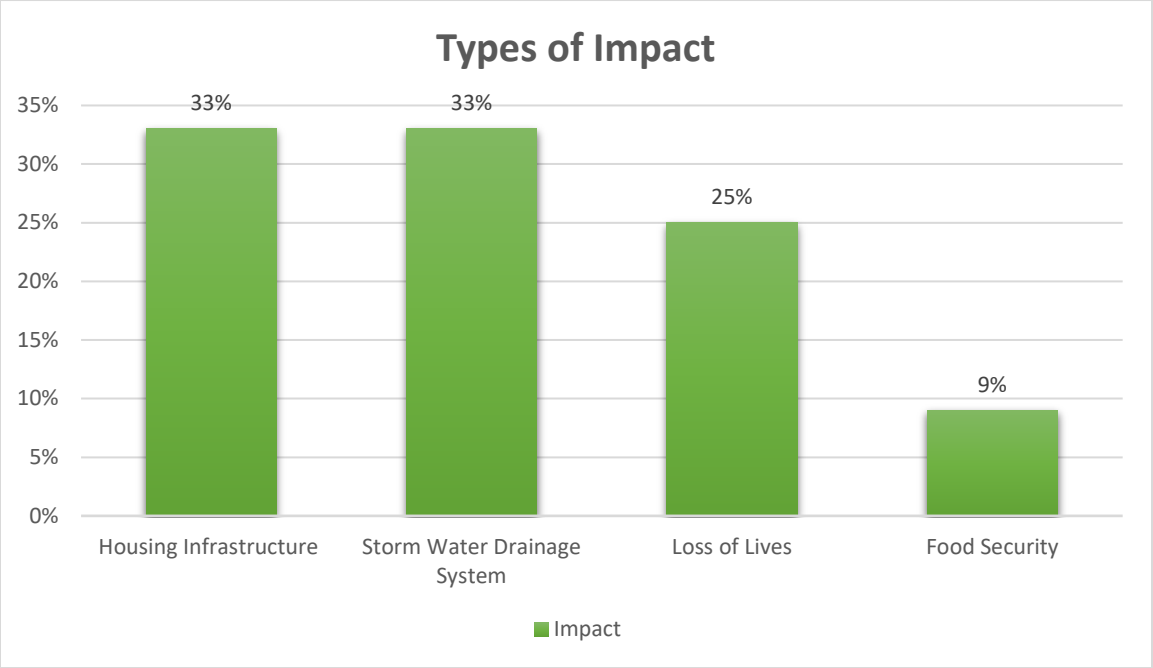
In quest to find out the frequency that the above-mentioned disasters have occurred with an aim of investigating whether the environment is suitable for living, the researcher asked how often these disasters occur annually. The households responded that they don’t happen more than five times a year, but once they occur, they hit hard. For instance, one of them mention that the last flood catastrophes which occurred on 28 April 2019, destroyed at least 124 houses, and claimed 14 lives (Dludla, 2019).

Given the details above and the researcher's observation findings in the study area as shown in figures 5.1 and 5.2, indicates that the environment that these households are situated at is badly degraded and unsuitable for any infrastructure development. The households even pointed out that their RDP houses don’t even have a foundation, hence once it rains heavily, their houses easily get washed away by floods. This may be due to that the builders themselves realized that the physical infrastructure won’t be sustainable in this environment because of the inappropriate soil type and slope. Moreover, the households complained “we even have many snakes in this area young lady, and they get inside our houses, so we are not even sure if this is a wild or domestic area”. This therefore further indicates that their area is not meant for residential use but rather conservation for biodiversity.

Figure 5.1: Unsuitability of the area for infrastructure development (Fieldwork, 2020)

Figure 5.2: Retaining walls indicating that the soil is eroding (Fieldwork, 2020)

5.3.7 Graph 5.3: The types of impacts that the disasters have caused



Source: Fieldwork (2020)

The graph above shows the different types of effects that the climate change disasters have caused to the households and the built environment. Majority of the respondents identified housing infrastructure and storm water drainage system to be affected by climate change the most. According to the households, the floods and soil erosion that occurred on 28 April 2019 destroyed about 124 houses in Umlazi, and one of these houses which was already on the edge of the hill as a result of previous disasters that occurred washed away on that day and claimed a life of a young boy (refer to figure 5.3 below) and 14 other lives on the other parts of Umlazi (Dludla, 2019). The households said that this was one of the most traumatic experiences as they realized how unsafe their homes are, “death as a result of floods has basically become a norm to us” so added a teary old lady. The heavy rainfall events are identified to be resulting in the overflow of water from the storm water pipes which further adds up to flooding. Moreover, some households perform subsistence farming as a livelihood strategy and 9% of the respondents complained about how much the floods tend to damage their crops even permanently in the gardens for them to ever grow anything again – and these are same gardens which are their source of income and brings food to the table (Morton, 2007).

This information suggests that climate change disasters have a major negative impact in the livelihood of the vulnerable households as emphasized by Kim and Lim (2016). According to the households, the most common forms of effects are housing facilities, storm water drainage systems, and loss of life. This is mainly triggered by negligence of developing houses in an unsuitable/unhealthy environment and not building according to NHBRC specifications which requires single storey buildings to be in a stable soil condition with a strip foundation of a minimum width of 500mm for external walls and 400mm for internal walls (Van Rooy, 2006). Therefore, the houses were eventually expected to collapse as the households pointed out earlier that the houses are foundationless. The storm water drainage system fails because of water capacity that the pipes can withstand is exceeded due to heavy rainfall and this area is also a passageway to the existing river. Consequently, loss of lives is expected on such areas.

5.3.8 The support they need in Umlazi during these times

When the researcher asked what kind of assistance the households primarily require during the times of disasters, the households collectively said they now need a permanent solution rather than

a temporary one, and that being a comprehensive development which will cater for all their needs. They indicate that this development will include the following aspects: housing in a better location, roads, proper sewer and water drainage pipes, toilets, and refuse removal services. They indicate that getting this kind of assistance from the municipality will be all-inclusive, leaving no family behind to ever suffer again.

Willing to relocate, one of the households added that receiving this kind of support from the municipality, will mean that there will be no more houses collapsing as wherever they will be relocated to the houses will be built according to the National Building Standards (SA Government Notice, 2008). The households mentioned that they struggle a lot during emergencies such as illness or when a woman is in labor since the ambulances or cars can't access the area – they would have to carry that person themselves to the main road, which is extremely problematic. Hence, he further states that they will have access to road infrastructure and services such as refuse removal, public transportation, and health emergency. Moreover, having proper sewer and water drainage system pipes will eliminate the issue of flooding. The households agree that they have received physical infrastructure assistance in a form of RDP houses and retaining walls were installed, however, the retaining walls are not suitable for that area since they fall on top of the houses when there is heavy wind and rain.

5.3.9 Table 5.3: The provision of support by eThekwini Municipality during climate change disasters

Contributes	Interval	Percentage
Yes	0	0%
No	12	100%

Source: Fieldwork (2020)

Table 5.3 above shows whether the eThekwini Municipality supports the community during disaster times or not. Unfortunately, none of the respondents (0%) agreed that the municipality supports the community. All the respondents collectively agreed that the municipality does not provide any support during these times. One of the households angrily expresses that “the only thing that the municipality does is to assess and take pictures of the amount of damage which occurred”. Instead, they, as a community, support one another wherever they can. The kind of support they give to each other include amongst other things temporary accommodation in one’s

home, food, and clothing. When Mrs. Fikelephi Mungwe's (62) house washed away and disappeared into a muddy cavity in 2019, the households mentioned that only her relatives and neighbors reached out for help as she was left with nothing but only the clothes she was wearing, a handbag and a mere R10 in her wallet.

Based on the observation that the researcher made on site, it is evident that there was indeed no sign of another structure being built on Mrs. Mungwe's stand after her house collapsed in April 2019 (refer to figure 5.3 above). Therefore, this information could either suggest one of the two points. First, it could suggest that there is rather negligence of the disasters, or it could also suggest that they are still coming up with an alternative permanent solution of rather relocating the whole community rather than wasting more resources of building another house which will eventually collapse.

5.3.9 Other ways that the Municipality can provide support

According to the respondents that participated in the study, other ways that they suggest the municipality do is to immediately reach out to the affected families by providing them with emergency shelter and compensation of the valuables they lost in their homes such as important documents like Identity Documents, certificates, and driver's license.

5.4 Interviews with the Municipal Officials

Two of the municipal officials were interviewed electronically, and this section aims to present their responses to the questions. The interviews with eThekwini Municipality officials were crucial in this study because they assisted the researcher in revealing how exactly does the town planning fraternity helps towards adaptation to and mitigation against climate change.

The first municipal official that was interviewed is an Environmental Planning and Climate Protection Practitioner (EPCPD) focusing on climate change under eThekwini Metropolitan Municipality in Durban. His role is to plan for mitigation of and adaptation to the impacts of climate change and conserve biodiversity and the ecosystem goods and services it provides for the benefit of present and future generations (Naicker, 2017). The second municipal official is a Town and Regional Planner working for eThekwini Metropolitan Municipality under the Strategic Spatial Planning division. His role is to ensure public infrastructure provision and refurbishment within the local communities (eThekwini Municipality, 2011). He is also well knowledgeable of

the climate change phenomenon as his work is interlinked with that of environmental planning and climate protection experts.

5.4.2 The Role that the Planning Profession plays in Climate Change

According to one of the municipal officials, climate change action and reduction of the scale and the ability to respond to disasters begins with planning. He states that the planners are the ones that lay out the urban form that allow different land use types and changes to occur, and can build into their plans for the cities, especially city marked change projected impacts for the future. He said planners have done their work well in such a way that when a particular event happens that could cause a disaster, the scale of a disaster would be much smaller than expected as a results of the proper planning present in a city. He further adds that this is evident in cities around the world with very high levels of informality, where you find that large-scale climate events have a bigger impact in those places than in cities that are well-planned.

Hence, this official indicates that planners organize the space through planning in such a way that it avoids severe impact of climate change disasters. For example, Durban has the Durban Metropolitan Open Space Systems (DMOSS) which are about 1000 hectares (almost 1/3 of Durban), and all these ecosystems are able to absorb a lot of the weather that we get, so if we think of some of the series rainfall events i.e., 1/10 or 1/20 year rainfall event, and you have got just hardened surfaces everywhere, that is going to create a lot more runoff and flooding especially with the steeps out of valleys in Durban (eThekwini Municipality, 2014). Whereas, if planners have made provision for the keeping or sort of ecosystems in the surfaces they provide, then it helps to buffer the infrastructure. The planners make the plans which the enforcers must enforce, it's a chain of events, they do their work well but then if the enforcers don't do anything then you will still lose in the end, so every official or stakeholder in that chain must follow the plan to be successful, so he said.

Whereas the other official's perspective lies on ensuring that the work done by planners lives a footprint. He indicates that planners can coordinate multi-disciplinary teams of professionals who are involved in the development planning profession. He said the specific role that planners play would be to ensure that the work that they produce as planners has input from professions such as environmental planning and climate protection work as well as climate scientist work because they feed into the science behind decisions that dictate whether they are doing well as professionals in

either mitigating or adapting to climate change. So, the role that planning profession plays is more of ensuring that they coordinate all actors that are involved in climate change space and begin to develop plans that will consider input from all those professions. In short, planners play a role of mainstreaming climate change output in the work that they do as planners.

5.4.3 The Role that Planners play towards adaptation to and mitigation against Climate Change Disasters

According to the first official, the planners are in the pre-emptive role, meaning that they are not dealing directly with disaster response - they come much earlier in the whole piece. In Durban, there is a Durban Climate Change Strategy (DCCS), and that strategy has several enabling themes, in other words, actions that the city needs to take to be able to even implement its strategy (eThekwini Municipality, 2011). One of those actions is around planning for climate change or mitigation and adaptation, setting aside land or places where industry can build a renewable energy, the city would support that with developing policy around establishing a renewable energy-manufacturing hub for example, and that would then get implemented through the economic development. Similarly, for adaptation, the planners would set aside land uses using spatial layers in their strategic spatial planning branch, to consider the future impact of climate change. An example here could be a revision of the 100yr flood plain and then widening this area where development would not be allowed because it would be in a future flood plain even though it might not be in now, perhaps changing the land use type from heavy industry development to very light such as parks and gardens (eThekwini Municipality, 2011). Hence, although under-appreciated, the above information suggests that they have a very much pre-emptive role of avoiding dangerous developments.

In terms of adaptation, the second official says that planners collaborate with the agricultural municipal department to examine food security and how they can ensure that local food production networks can recognize risks and meet the needs of the poor. He explains that they typically ensure that the plans consider proposals that would ensure that we begin to change spaces for example where people used to have parks or public open spaces that are not in use, hence, they begin to influence them to have uses like food gardens as an alternative to a flower garden. Therefore, from the agricultural perspective it is largely ensuring that they identify land that has high or medium agricultural potential and preserve it for such uses to ensure that they are not lost.

Moreover, on the health aspect under adaptation, he states that there is work that planners are doing which is focusing on reducing the carbon dioxide emissions. They work closely with the eThekwini Transport Authority because they assist them with transport plans as well as road network planning. He explains that they have strategies like the one called low emission zones, and it basically means that they identify a wide variety of vehicles i.e., buses, trucks, and private vehicles, and there is technology that is used to measure the emissions from those vehicles. For instance, he mentions that before a car is made available to the market, they do emission level testing at a factory where the car is manufactured, those emissions level testing need to comply with the industry standards. However, once a car is sold to an end user, the vehicle would then begin to emit carbon dioxide in a real-world scenario, not from the laboratory where the testing is done. Therefore, they would measure those emissions using emission monitoring stations which have technology inbuilt in them to be able to distinguish which vehicle, truck or bus type is the worst polluter (Naicker, 2017).

Furthermore, according to this official, the low emission zones would be the precincts such as the inner city where cameras will be installed, those cameras have in-built technology to pick up the make of the car, the engine type and the emission levels as vehicles are passing a particular point. Then the emission levels are analyzed to determine which vehicles are the worst polluters or the least polluters, typically the worst polluter would be older vehicles that were manufactured at a time when climate change was not such tropical, so those results will begin to point the traffic authorities as well as planners to the evaluation of the low emission zones, whether is there any reduction in emission levels or there is an increase (Roberts and O'Donoghue, 2013). Those emission levels typically will also have health impact, meaning if you introduce a low emission zone and alongside this concept promote public transport usage that is running on clean energy, the theory detects that you would achieve lower emission levels and with lower emission levels it means better air quality which then means the populace would then be inhaling a much cleaner air, thus reducing the likelihood of respiratory diseases. According to him, this positively impact in health in such a way that if air quality is better, then typically the population will be spending less money on health-related issues and further improving their life span (eThekwini Municipality, 2011). This suggests that there is a relationship between clean air and better health.

On the mitigation aspect, the second official focuses on energy supply and waste. This official indicates that largely our energy in South Africa is coal-based and there are large electricity generation installations in Mpumalanga which is then distributed throughout the country. However, since South Africa is attempting to transition away from coal-fired electricity production and toward renewable energy, planners have been working with the relevant authority (the electricity department at the national and provincial levels) to begin to influence them to think differently about energy provision and to consider getting onboard independent power producers who are producing electricity either through wind solar or any other renewable source of energy (Roberts and O'Donoghue, 2013). Hence, on the mitigation aspect those are the issues that needs to be managed carefully so that we can be able to achieve reduction of emissions that are related to coal.

The second aspect he points out under mitigation is waste. He states that we get a lot of greenhouse gas emission from landfill sites and thus there needs to be a strategy to divert waste from landfill, in doing that, he further indicates that there will be employment opportunities created by harnessing energy from methane gas or any other form of energy that can be sourced from landfill site waste.

5.4.4 The common Climate Change disasters experienced by eThekwini Municipality at large

In the last few years, the common climate change disasters that the municipal officials noted to be occurring the most in eThekwini Municipality are extreme rainfall events, with the most recent event occurring on the 22nd of April 2019 which further led to serious floods disaster (eThekwini Municipality, 2011). The officials state that it is not just about how much rain falls, however, it is also about the type of area that the rain falls and how saturated the ground is, and the one factor why the last floods were so serious was because a few days before that event there had been real steady rain, hence, the whole ground was filled with water from that steady rain, so when this heavy rain fell the only place that it could go was of the top and become run-off. The amount of flooding is influenced by how much hardened the surface area is, and so planners would have a role to play there. One of the municipality officials provided that Durban has storm water policy which states that any development needs to attenuate the flow from the property that is equivalent to the hardened surface of that property, so if ¾ of your property is now concrete, you have to

capture and release slowly the certain amount of rain that you receive (eThekwini Municipality, 2014).

Further, the municipality being the coastal city, the officials also mention extreme storm surge event such as lightning as another form of disaster that happens quite often in Durban and has been considered as very dangerous (Mather and Stretch, 2012). According to these officials, in the recent past there has been several storms that destroyed infrastructure and that flooded certain parts of the city. They say that it comes with added risks, there are compounding factors that people that are living in nice brick houses with lighting conductors are in much lower risk than other people with less means, so there is always a compounding factor, and it is usually related to how much money a person has (economic status).

Furthermore, one of the officials also highlighted that around 2015, Durban experienced another form of disaster event called El-Niño, which is the changing of the ocean currency in the pacific, when you have a severe reversal of this currency, it is said to have global impact for the weather being experienced (Nxumalo, 2014). During the same time as El-Niño, these official further states that drought is another common disaster that is associated with climate change that Durban has been experiencing. They had a serious issue of drought more especially in 2015. This is due to the frequency of rainfall being minimized and the increase in temperature which leads to a lot of water sources drying out, therefore, there are still challenges pertaining to drought. However, it is fortunate that the climate prediction for the moment is said to be Lamina, which is the alternate state where you expect more rainfall (eThekwini Municipality, 2019).

Nevertheless, according to these officials that is not all for Durban. The above-mentioned disasters are just sudden onset tragedies. There are also slow onset disasters that creep up slowly like gradually increasing heat, and they have noticed that particularly during heat, the number of sequential days where the temperature is above 30 Degrees Celsius are increasing and are expected to get more intense during summer months. Further, they mention that Durban is said to be also dealing with sea level rise which is another form of slow onset disaster. They noticed that sea level rise occurs the most during intense storms when a lot of water is being pushed up onto the coastline by the winds (called storm surge), and that is what causes a lot of damage – the last time that Durban had storm surges was in March 2007 which caused a huge damage along the coastline. They further add that storm surges are compounded by changes to the sand flow along the

coastline, Durban only gets a 1/3 of the normal sand into the beaches that it gets from the rivers annually, therefore, there is less sand that is required to form the sand banks along the breaking waves which helps erode the power of waves so that they don't eat the shoreline. Hence, when you lose that sand from the sand mining and from the dams that trap sand, then it means you will not have the protected barrier anymore (eThekwini Municipality, 2011).

5.4.5 The commonly affected communities

Both the municipal officials believe that all communities can be affected one way or the other, for instance, during the April 2019 storm, they mention that there was a very big and expensive house on the coastline that washed away down near Amanzimtoti – which illustrates that anyone can be affected. However, fortunately for them, they insinuate that they probably had an insurance and a job to sustain themselves and afford another accommodation while their house was being repaired. Whereas, when it is compared to the Umlazi RDP house case that also washed away in 28 April 2019 or to people living in informal settlements in very vulnerable places on flood plains, it appears that the climate change does not affect everyone equally.

The point that they were trying to raise here was that while everyone can be affected, the person who doesn't have a job has very limited financial means and is living in a highly vulnerable place on the river flood plain because that is the only place that they can build a shack in the area which is much more vulnerable to climate change and is much worse impacted (eThekwini Municipality, 2014). Nonetheless, one of the officials mentioned that in other work that they do they try to target their actions at the people that are most vulnerable and in need. Amongst others, they listed Quarry Road informal settlements, Isipingo, KwaMashu, and Umlazi as the communities which they know of and have worked with during the times disasters. This therefore suggests that the poor and vulnerable communities are commonly affected by climate change disasters, however, it does not mean that people that are affluent are not affected as well because they do get coastal erosion that affect properties along the coast. It all depends on where the intensity of storms is at its highest, and if the area doesn't have infrastructure to cope with the volume of water, then it becomes a problem, but if it does, then it mitigates the impact a little bit.

5.4.6 The Methods used by Planners towards Climate Change Adaptation and Mitigation

One of municipal official indicated that the Strategic Spatial Planning Branch for the municipality has developed a climate change resilience implementation plan for spatial planning. As it was

indicated earlier on that the planners work with a multi-disciplinary team, he explains that this mechanism has 10 themes that emerged out of the Durban Climate Change Strategy and a strategic spatial planning department took a view to say how they can begin to use planning as a tool to address impact of climate change (Roberts, 2010). Looking at the policies that regulate the work that they do inside the city planning space, he claims that they began to implement climate-sensitive policy positions so that while projects are taking place out in space, majors that minimize the effects of climate change in the urban sphere are considered. This is one way that planners are attempting to mitigate climate change through policies and ensuring that planning applications as well as on-the-ground projects consider majors that reduce climate change's effects.

Further, he makes an instance that there are green building designs that planners advocate that will look at recycling water, saving energy, ensuring that the waste generated by developments is kept to a minimum or if possible, is recycled within the same building (Roberts, 2010). All these methods are used in climate change adaptation and mitigation to ensure that future projects are more environmentally friendly. In addition, he states that they also work closely with environmental planning and climate protection department in ensuring that they conserve areas that have been cleared for conservation purposes or that have environmental sensitivities, so typically they wouldn't propose or support development in those spaces because they do serve as mitigation spaces for example flooding impacts.

5.4.7 The Effectiveness of these Methods

These methods according to both the officials have changed the way development was viewed long ago as opposed to now. There is much more appreciation of preserving natural places and developing in areas that are suitable for development. He also mentions that work is being conducted on an international level by the Intergovernmental Panel on Climate Change, which is starting to put forward policy positions that suggest global temperatures must be kept below 1.5 degrees Celsius, since doing so would begin to alleviate the effects of climate change on the entire world, but also you are prolonging the likelihood of this climate change impact hitting the communities within a short space of time (IPCC, 2001). Therefore, we are in a space where we are buying time but in the main lessening or mitigating against the temperature increase because that leads to storm events, urban heat causes an impact on communities and health of the people. Therefore, this both the officials agree that the methods that they have used are effective because

they are beginning to change the way the city operates, for instance, if you introduce vehicles that are running on clean air, the immediate outcome would be much improved air quality leading to improved health and community spaces.

5.4.8 The Future Projections of the Impacts of Climate Change

According to both the municipal officials, various types of impacts will be dealt with in the future, and if we sit and do nothing, the problem will worsen; but, if we act, we will be able to begin to enroll in lessening the impacts of climate change and thus will the average rise in temperature. These impacts include increased heat (more heat waves), higher average minimum temperatures (more extreme temperatures), increased rainfall and drought (Greenstone, 2009). The above-mentioned impacts have several effects in health of vulnerable communities or vulnerable demographics. The officials state that these will have severe impact on the rate at which food can spoil, so for people who don't have fridges they could find food coming off quicker. Whereas under health, we might see an increase in factor on diseases such as Malaria (passed on by mosquitos) during increased heat period.

They further project that the total rainfall will likely increase, but this rainfall is likely to fall increasingly in extreme rainfall events, meaning hard rainfall over shorter time periods with longer periods of drought in-between (eThekwini Municipality, 2014). This suggests that while we might have more rainfall, we might also have more drought because the total rainfall will be falling in much shorter periods. These hard rainfall events will further lead to more erosion because there will be more runoff down the steep banks, flash flooding (much quicker flooding) and risks associated with hardened surfaces in the catchment. Furthermore, they note that the other predicted catastrophe in the future is sea level rise along the beachfront, and that there will be periods when people must decide whether to transfer infrastructure to accommodate sea level rise the shoreline or defend it. In addition, the officials even indicated that the city is trying to stop all new development that will begin in an area under threat to future sea level rise.

Nonetheless being an optimist, one of the officials makes an example with global phenomena of covid-19 pandemic. He states that everybody in the world is currently impacted by covid-19 and that is something that last year or the year before never imagined that we will all be experiencing, but how people responded amid this pandemic have shown how resilient people can be in the face of disasters. He then indicates that if you take the same logic and apply it to climate change, you

will begin to realize that there is quite a lot of work that is being done to ensure that the future is not as blink as many may see it to be. As a result, he argues that the implementation of climate-sensitive urban planning methods begins to instill confidence in future generations that the world will be left in a better shape. The acceptance of energy industries of renewable solar wind energy is a positive scenario looking at the future. Therefore, if more and more actors come into this space and begin to play their part in either mitigation or adaptation of climate-related impacts, then he believes we can at some stage in the future begin to look back and realize that the world is in a better state than it is today. He then recommends that planners should be at the forefront of that struggle because where people live, work and where people go for opportunities those spaces are planned by planners. This suggests that if all the actors (particularly the corporate world government and all spheres of government) are doing their part then the world will be in a better state in the future.

5.4.9 The incorporation of climate change into planning from the official's perspective

One of the municipal officials believes that the environment was incorporated into planning mainly because planning typically looks at the urban form. According to this official, over the last 15 to 20 years there has been a growing understanding that all our development is underpinned by a healthy environment, where we don't look after the environment, we find that impact occur (eThekwini Municipality, 2011). He makes an instance that where you just take away all the wetlands, the rivers will no longer have a sponge to absorb high rainfall events and all that just comes down the catchment and then down the stream developments get flooded. So, he strongly believes that planners have understood this better and the value that ecosystems bring in terms of the services they provide for free, hence, the role of the environment in planning has grown essentially.

Another good example he makes is that the Durban Metropolitan Open Space System and the value of it was realized many years ago and this was created through the effort of a small champion apartment where a formal town planning layer was created for DMOSS and it is protected in terms of any development application that are submitted on DMOSS land (eThekwini Municipality, 2011). Therefore, that is one good example of how Durban was at the forefront of the whole movement to acknowledge the value of natural spaces and open spaces in terms of the service they provide and how they underpin the sustainability of developments.

On the other hand, the other official believes that it was incorporated mainly because development happens in space and typically before any development happens, you get a natural environment. The environment aspect of planning ensure that we can begin to live in harmony as opposed to destroying everything that exists in the name of development. In short, he indicates that it was incorporated for consciousness of the practitioners that we need to strike a balance between development and nature because there is a typical debate that where there is major developments, we normally put forward economic aspect than environmental aspect of sustainability.

5.4.10 The laws put in place to facilitate adaptation and mitigation against climate change

According to both the first officials, internationally there is Paris Agreement policy which the South African national government of South Africa signed up to with a set of Nationally Determined Contributions (NDCs). They define it as a binding global agreement that begins to ensure that all actors begin to work towards reducing pollutions in their own countries. They argue that this is the South African government's strategy for contributing to the global effort to tackle climate change. This is a top-level law and as a signatory, South Africa must implement its Nationally Determined Contributions (NDCs), and to do that, there is a climate change law which is in the last stages before it becomes a legislation.

Officials say that there are NDCs at the national level, which feed into what South Africa as a country needs to do to at least stabilize the rising temperature at 1.5 degrees Celsius or below. Further, there are Sustainable Development Goals (SDGs) that outlines policy context that also informs planners' work. They mention a national Climate Change Response White Paper that was published in 2011 and the Climate Change Bill that was developed in 2018 and is scheduled to be promulgated as an Act in 2020 (Ziervogel et al., 2014). They also mention the Disaster Management Act of 2015, which requires all actors to play a role in disaster mitigation within their areas of responsibility and gives cities the responsibility to prepare for and enforce climate change adaptation, as well as the Draft National Climate Change Adaptation Strategy, which was produced in 2019. Hence, all these pieces of legislations and or Policies inform the work that the spatial planning department do as well as the work that is being done by either the energy office or environmental planning and climate protection department (eThekwini Municipality, 2014). Furthermore, they indicate that there will be a climate change strategy that will require the three

levels of government, namely national, regional, and local, to respond against climate change, with the carbon tax as one of the instruments (a separate piece of legislation).

At the local level, the municipal officials indicated that they enforce bylaws which are all developed on the back of local level policy. In the city of Durban, they have a Durban Climate Change Strategy, and when they have a climate change act being promulgated, then they all must strengthen their policy so that they can develop their laws to implement the act.

5.4.11 The effectiveness of these laws

According to one of the officials, mitigation is a lot easier to achieve because it is easier to measure the actions you take for mitigation, they are not too complex such as the renewable energy, electric vehicles, energy efficiency etc. Hence, he states that have you something that is a lot easier to plan for, implement, measure and report. However, what is difficult with it is to have a complete agreement by everyone on whether to do it or not. He makes an instance with the US president where he said climate change doesn't exist and therefore that kind of thinking by the world leader tends to erode the thinking of people to taking climate change action. The point being, it would be difficult to convince people otherwise when there is such high messaging discrediting climate change. Therefore, there has been slow progress around mitigation of climate change mainly because there is a very strong alternative lobbing in the fossil fuel industry that are undermining the message. Nonetheless, the reason why it is so easy to support mitigation is because the renewable energy costs have dropped, and so it is economic imperative to change, and fortunately more people believe that there is climate change than the denialists. Even the big oil companies know the reality, so they are trying to maximize profit as much as possible it all ends.

In terms of adaptation, the first official states that it is much more complicated as, as stated earlier on during this interview, to determine what happens to the rainfall, it all depends on what the land use types are and on the type of communities imposed whether it is disadvantaged communities with very little resources to do anything, and so there is a wide variety of effects of the rainfall, which means that there is much more different responses required by an organization like eThekwini Municipality to plan for it and to reduce the scale of these impacts. Hence, with climate change adaptation it is very hard to make the business case or looking after the river because there is no profit to be made of it (eThekwini Municipality, 2014).

5.5 Research Findings through Observations

The researcher made on site observations to explore the physical form of the area and investigate how much negative impact has climate change caused to the environment and infrastructure. The researcher focused on the following aspects during observations:

- If the spatial location of Umlazi Section H is suitable for development and resilient towards climate change.
- If the development in Umlazi Section H is in line with Sustainable Development Goals (SDGs); and
- If there were any impacts associated with climate change, what are those impacts and what they cause to the environment and infrastructure of Umlazi Section H.

After observing the area of Umlazi Section H, the researcher noted that in terms of suitability, the land they are located at is not suitable for development because of how steep it is. The houses are located right at the bottom of the local/access road that you can barely even see other houses as shown in figure 5.4 below, mind you, the river is just approximately an inch away from the houses. Even one of the respondents from Umlazi pointed out that they forcefully built their shacks there because of unemployment, but initially they were denied access by the local government seeing that the land cannot sustain structures because of its gradient. In terms of resilience, their houses are not resilient towards climate change considering that they don't have even a foundation because of unstable soil, the instability of this land is further indicated by the incorporation of the retaining walls to block the soil from eroding. Therefore, this indicates that this section of Umlazi was not meant for infrastructural development, but rather environmental conservation (Tisdell, 2005).

Figure 5.4: Poor location of Umlazi H Section housing infrastructure (Fieldwork, 2020)

In terms of the compliance with the Sustainable Development Goals, it was noted that this development does not comply with SDGs as the environment does not support this land use type. The Sustainable Development Goals (SDGs) advocate for a balance of the three pillars of economic development, social development, and environmental protection. It also emphasizes the growth that addresses the needs of the present generation while not jeopardizing the needs of the future (WCED. 1987).

However, the researcher noted that only the social and economic pillar was prioritized in the development of this Section, while the environmental pillar was being threatened. The social pillar was prioritized in that they focused on satisfying the housing and infrastructural needs of the underprivileged people, while putting aside the importance of preserving the environment from being further degraded as one of the respondents mentioned that deforestation took place before the establishment of these settlements. Further, according to Mebratu (1998) this area was meant to be saved from degradation to ensure the protection of biodiversity and to restore ecological balance (Mebratu, 1998). While the economic pillar was prioritized in a way that some residents only reside in this area just so that they are near their jobs but have proper homes back in the village. Therefore, this suggests that sustainable development was not implemented or recognized.

Regarding the effects associated with climate change, it was observed that Umlazi experiences the issues of soil erosion, high temperature and flooding. Soil erosion occurred as a result of

deforestation and removal of crucial vegetation as they made space for housing development. This vegetation and trees prevented soil from eroding. While the absence of proper drainage system which prevent water from running off the surface (as depicted in figure 5.5) and the settlements established on an unsuitable land (refer to figure 5.6), are the main causes of increased flood events.

Figure 5.5: Poor water drainage system that runs water off the surface (Source: Fieldwork, 2020)

Figure 5.6: Houses located in a hilly area (Source: fieldwork, 2020)

5.6 Conclusion

This chapter summarized the research findings, interpreted, and analyzed data collected from the study area (Umlazi Section H). This data was gathered through electronic interviews with municipal officials, focus group interviews with the households of Umlazi Section H, as well as direct observations by the researcher. The methodology used was essential because it enabled the researcher to reveal how the planning fraternity tends to play a crucial role towards adaptation to and mitigation against climate change, and it was efficient to collect enough data from the participants.

6. Chapter Six: Conclusion and Recommendations

6.1 Introduction

This chapter seeks to discuss research results in light of the literature and theoretical framework of this study. To be precise, it seeks to analyze if the research findings link to the main themes used in literature, and what the theoretical framework dictates. Further, it will conclude with a review of the entire research study and provide recommendations as to how planners, collaborating with other disciplines, can improve their methods of adaptation and mitigation against climate change.

6.2 Linking findings with Literature

6.2.1 Growth of Climate Change

The growth of climate change is associated with desire for profits by major companies, unemployment levels, ignorance, lack of awareness towards consciousness to climate change effects, and lack of information by the society of the number of effects that climate change brings about. This is further manifested by the relevant disciplines not playing their part towards achieving adaptation and mitigation against climate change. The less work invested towards accomplishing these mechanisms, the more the impacts caused by climate change.

6.2.2 Impacts of Climate Change

The problem of climate change is not a new concept; it is an urgent concern that has only recently become widely understood because of the 4th Industrial Revolution, which brought about industrialization and a rise in the use of transportation, all of which release additional carbon dioxide into the atmosphere. Adaptation and mitigation strategic measures have largely been implemented by various fields, including planning, as a response mechanism to climate change. Although the increase in the emissions was drastic, it is evident that the combined efforts have been making a vast positive impact towards fighting this phenomenon for future generations to inherit a better space. As much as the impact varies with the financial state, it is evident that the impacts are widely recognized in developing countries like South Africa, as they are already faced with much more deeper issues of scarce resources and poverty alleviation.

In terms of climate change's consequences, both the literature and research findings indicate that climate change is a global phenomenon that affects all facets of life. Amongst other things, it

causes major impacts on health, food security (agriculture), water resources, infrastructure, and more especially human settlement. In South African, the settlements of advantaged and disadvantaged people were both identified as equally affected although in unique ways, the only difference is that the advantaged people would at least have a Plan B, whereas the disadvantaged people would be left with nothing but devastations of homelessness. For townships settlements (predominantly RDP houses), the direct impacts include soil erosion, flooding, landslide, and increased heat, while the indirect effects are droughts and food security. It is evident that Umlazi Township, dominated by RDP settlements, has been frequently exposed to hazards such as high rainfall over a shorter period, extreme floods, soil erosion and drought after. The indirect impacts that were observed by Umlazi residents and municipality officials are issues of food security and droughts because of soil erosion due to high rainfall occurring over a shorter period.

6.2.3 The link between Planning and Climate Change

Although indirect, it is evident that planning collaborates closely with the climate change discipline for climate change adaptation and mitigation. Planning, according to the report, goes hand in hand with the climate change division because it encourages cooperation among multi-disciplinary teams and ensures that everyone contributes to adaptation and mitigation. These disciplines include transport, energy, environment, coastal storm water and engineering offices, which essentially play different parts. Furthermore, planning is linked to climate change because they work on spatial strategies that are resilient to the effects of climate change; as a result, the study revealed that they meet with the climate change office to see if their plans are compliant with their policies before they are approved.

6.2.4 The Role played by Planners towards Adaptation and Mitigation against Climate Change

The study showed that the planning fraternity plays a significant role through land use planning whereby they prevent future climate change disasters by planning for expected changes so that when they occur, they don't cause severe impacts. During apartheid times, they couldn't control this as some processes such as land use planning were not enforced, hence, people (particularly Africans) used to relocate according to how they were directed to. Nonetheless, the planners successfully achieve adaptation and mitigation of climate change by not necessary working

independently, however, they work closely with the environmental planning and climate protect department towards promoting low carbon emissions to reduce global warming.

Physical land use planning is a significant response to climate change by planners in managing different land use types, i.e., residential, industrial, agricultural, and commercial, to allow sustainable use of land and to avoid the harmful land uses from affecting the unharmful ones. For instance, they ensure that the land use type for industries is placed far away from the residential land use as the industries emit toxic gases such as methane. In addition, planners alter land uses in response to climate change threats and variability. The study discovered, for example, that planners define areas that can be modified from parks and open space to useful vegetation zones for food protection and weather adaptation. This shows that planning can achieve economic results while conserving the environment (Shezi, 2016). Sustainable use and management of natural resources, according to Shezi (2016), are vital strategies for adjusting to changing climatic conditions. Vegetation such as trees, helps protect houses from collapsing while avoiding flooding as well. As a result, land use planning is important for mitigating the detrimental consequences of climate change.

With regards to spatial planning, the study found that planners (under the strategic spatial planning branch), have developed Climate Change Response mechanism called Climate Resilience Implementation Plan for spatial planning which incorporate climate sensitive policy positions so that when developments are occurring in space, they consider majors that decreases the impact of changes in the urban environment. Another way that planners are trying to mitigate climate change is by incorporating these types of policies and ensuring that development applications on the ground are aware of the impacts of climate change. The spatial planning aspect of planning tends to play such a crucial as it prevents the problem before it even occurs, and it is much easier to prevent a problem from occurring than to treat it.

Green building designs is said to be another measure taken by planners which plays a significant role towards climate change. They advocate recycling of water, saving energy and ensuring that the waste generated from waste areas is kept to a minimum or reused within the same building it was produced. Lastly, the study also discovered that planners work closely with the transport department to achieve low carbon emissions from the vehicles, trucks, and buses. Vehicles, predominantly in urban areas, are considered as a second worst polluters in the globe, and thus

pose a major threat to perpetuating climate conditions. The planning fraternity, together with the transport department, takes charge in ensuring that the manufacturers create vehicle models that have low carbon emissions, while encouraging the use of public transport. In short, the planners are ensuring that all departments are aware of the environmental effects of climate change, because lack of awareness about climate change is one of the factors contributing to its worsening.

6.3 Linking findings with Theoretical Framework

The theories of Sustainable Development, Resilience Collaborative Planning and were further distinguished and discussed in depth. During data analysis, it was recognized that the relationship exists between the research findings and the theories used in this study. In terms of sustainable development theory/approach, which advocates for a combination of the three pillars, namely the social, economic, and environmental pillars (Emas, 2015), and sustainable development that meets the needs of both current and future generations (WCED, 1987). The connection exists in a manner that the development in Umlazi Section H is unstable, had it obeyed the principles of sustainable development, then the settlements wouldn't be collapsing as frequent as they are collapsing, and the infrastructure would not be destructed as much as it is destructed.

This development only accommodates the social needs by the community of getting shelter, and economic needs by the community officials of gaining construction tenders even though the land is not suitable for this type of use, while disregarding the environmental aspect of land degradation through deforestation. The sustainable development theory implicates this land as conservation area, which is why municipal officials (particularly planners) refused for the housing development to take place in such environment from the first place as the residents pointed out. Further, it only prioritizes the immediate needs of the present (closer shelter to job opportunities) and disregards the needs of the generations to come (stable shelter) as they are already collapsing because of poor land vulnerable to climate change impacts.

Similarly, resilience theory asserts that social, economic, and environmental structures should be able to cope with a hazardous event or disruption by reacting in ways that retain their basic role, identity, and structure while also allowing for adaptation, learning, and transformation (Kim & Lim, 2016). The foundation-less settlements that were built for the residents after their mud settlements had collapsed several times indicates the significance of the theory of resilience which could have avoided the development from taking place in such an environment that cannot

withstand robust disaster events. This is pointed out by the frequency of housing and infrastructure destruction which occurs every time the disasters happen. According to the theory, the areas resilient to climate change includes adaptation strategies aimed at preparing the built environment for climate emergencies (European Environmental Agency, 2016), but this area is far from being considered a development-friendly environment, which is why they experience such many disasters.

The goal of collaborative planning theory is to enable people to participate in dialogue in an environment of equal empowerment and shared knowledge, to learn new ideas through mutual understanding, to produce innovative results, and to develop institutional capacity (Innes and Booher (2004); Healey, (2006). The linkage in this theory with the research findings is that it was indeed noted that planners eliminate conflicts by integrating diverse multi-disciplinary departments such as climate protection, transport engineering and agriculture, and bring them to work towards achieving one goal of climate change adaptation and mitigation. The planners bring together different views and put it into one solid view through planning. They also make use of climate change policies by incorporating them into their strategies and modifying their policies to prepare for the effects of climate change.

6.4 Conclusion

The research study's main aim was to look at how the planning community would play a transformative role in climate change adaptation and mitigation. The first envisioned objective was to assess if climate change has an impact on the built environment. If it did, the second key goal was to then find out ways in which the planning profession contributes towards adaptation to and mitigation against climate change. In essence, the study aimed at revealing the measures taken by planners towards eliminating or reducing the impacts caused by climate change.

This study has managed to reveal that climate change indeed has major negative influences on not only the built environment, but also on the livelihood of diverse people including the privileged people. On the one hand, it has been discovered that the cause of climate change in the natural and built environment is largely due to anthropogenic activities (human activities), such as industrialization, which causes global warming and simply disobey the requisite laws placed to ensure their protection. Humans seem to be disobeying the guiding laws in the name of exercising their right to shelter and benefit, which is enshrined in the South African Constitution of 1996. Climate change, on the other hand, is an overwhelming phenomenon that poses a major threat to

both the natural and built environment. The changes in the climate tend to also destruct the developments which were established in a sustainable manner because of how extreme weather conditions can be at times. It is therefore important to work in collaboration with one another towards taking responsibility and necessary precautions to protect and conserve our climate.

The study has also critically examined the various adaptation and mitigation strategies employed by the planners towards fighting the ever-changing climate. It has found that the planning profession plays such a significant role in, first, collaborating different government departments towards working together to bringing about different systems and strategies of reducing and addressing the climate change impacts. In other words, the planning profession acts a mediator between diverse branches.

Second, planners' actions do play a transformative role in assisting communities in responding to and mitigating climate change. The study discovered that developers tend to avoid unsustainable projects by ensuring that construction policies include environmental aspects of sustainability. This is quite a significant strategy considering that the destruction of the built environment begins with the developments, i.e., where, and how it was established, if it responds to the human needs and if it is resilient towards climate change impacts. Green building designs, which ensure a minimum usage of energy, water, and other resources, are advocating for the use of renewable energy, and ensuring minimum greenhouse gas emissions, are another essential planning strategy for reducing climate change negative impacts.

The study also found that the planning profession's actions are successful and go a long way towards reducing and addressing the issue of climate change. The planners do not cover everything on their own, however, like other departments, they play an independent and pivotal role in maintaining synergies between involved departments. In collaboration with other relevant departments, change is accomplished. Moreover, although there are certain barriers towards addressing climate change such as those misleading information by the leaders about the reality of climate change and lack of understanding by communities of how serious it is, the study revealed that if something is being done in the process by relevant sectors and as long as each sector plays its role, the changing climate conditions could be efficiently reduced or even eliminated at some point.

This research study was successful in achieving its primary goal of determining whether the planning fraternity plays a significant role in climate change adaptation and mitigation. The conclusion to the key research questions is that the planning profession does play a transformative role in reducing the drastically rising impacts of climate change. The planning profession has also played a major role in integrating diverse departments to work together towards achieving a common goal.

In conclusion, this study stresses the importance of consciousness of the environment as well as the importance of conforming to the laws put in place since they were established to protect us rather than harming us. One should understand that the positive and negative change we are posing to the environment could either be a benefit or a consequence to us in a few or many years to come. Therefore, it is important to preserve the environment so it can be benefited by both the present and future generations. Also, it is important that the government emphasizes on the sustainable development approaches to all its departments responsible for manufacturing of products.

6.5 Recommendations

The following recommendations are based on research findings.

6.5.1 Policy Recommendations

The climate change impacts experienced in Umlazi, and eThekwini Municipality at large include increased heat, extreme rainfall events, extreme storm, sea-level rise, soil erosion and flooding. Hence, it is recommended that these catastrophes should be reduced and eventually eliminated before claiming more lives. This could be accomplished by enforcing green policy and system directed to all corporate companies that manufacture products (other than just one) which conscience them in considering the environmental threats or dangers. These systems and policies should guide all products manufactured in such a way that they produce limited or no greenhouse gases. If not, then the company should be held accountable for contravention of this policy or system. This policy could be more effective and feasible since every manufacturer will be conscious when it comes to production and have a sense of responsibility towards their product.

This solution was raised mainly because it will radically bring about the required solutions to this worldwide dilemma. It will further enable the shaping of new developments and proposed developments for sustainability development goals (SDGs) to be realized. Policies have a capacity to shape and control everything on the built environment. Apart from that, this solution will permit

the government to contribute towards the Paris Agreement which requires all countries (developed and developing) to make significant commitments to addressing climate change through deeper emissions reduction (National Defense Resources Council (NRDC), 2017).

6.5.2 Recommendations on improving collaboration between stakeholders

It was noted that the eThekwini Municipality development planning department is already working with the climate change, transport, and engineering departments towards curbing climate change, however, there is still more efforts to be made. The continuous climate change impacts are evidence of this. In this regard, collaboration of these departments with the housing departments which deals directly with settlements and infrastructure is recommended. The climate change and planning departments could be of a greater assistance to the housing department in identifying areas or settlements which needs relocation process as they work directly with such areas, rather than upgrading settlements on unsuitable environments. This is evidence in Umlazi Section H, where mud self-help houses were upgraded to RDP houses in the same area, and one could say that this issue was handled the wrong way since till date they are still experiencing floods and soil erosion disasters. This, therefore, indicates that the upgrading process was not a suitable project for Umlazi Section H, what was required is upgrading in a form of relocation. According to the United Nations High Commissioner Refugees (UNHRC) (2014), relocation from a spatial point view is whereby a community is physically moved from an unhabitable location to a suitable stable location. The collaborative planning amongst relevant stakeholders could therefore be another efficient and resilient solution towards curbing the changing climate.

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ANNEXURES

Annexure 1: Informed Consent

CONSENT

I……. have been informed about the study entitled "The Transformative Role of the Planning Profession in Adaptation and Mitigation Against Climate Change: A Case Study of Umlazi Township" by **Londeka Amanda Khanyile (215025726)**.

I understand the purpose and procedures of the study.

I have been given an opportunity to answer questions about the study and have had answers to my satisfaction.

I declare that my participation in this study is entirely voluntary and that I may withdraw at any time without affecting any of the benefits that I usually am entitled to.

If I have any further questions/concerns or queries related to the study, I understand that I may contact the researcher at:

Full address: 3 Monty Road, Howick, 3290
Tel: 0731356098
E-mail: Ngwanelihle96@gmail.com

I understand that even if I agree to participate now, I can withdraw at any time or refuse to answer any question without any consequences of any kind.

I understand that I can withdraw permission to use data from my interview within two weeks after the interview, in which case the material will be deleted.

I understand that participation involves answering the questions asked by the researcher truthfully and without being biased, using explicit language or discriminating anyone

I understand that I will not benefit directly from participating in this research.

I understand that all information I provide for this study will be treated confidentially. I understand that in any report on the results of this research my identity will remain
anonymous. This will be done by not mentioning my name and disguising any details of my interview which may reveal my identity or the identity of people I speak about.

I understand that disguised extracts from my interview may be quoted in the dissertation of the researcher

I understand that if I inform the researcher that I or someone else is at risk of harm they may have to report this to the relevant authorities - they will discuss this with me first but may be required to report with or without my permission.

I understand that signed consent forms and original audio recordings will be retained in the University of KwaZulu-Natal within the period of five years' period

I understand that a transcript of my interview in which all identifying information has been removed will be retained for a minimum of two years

I understand that under freedom of information legalization I am entitled to access the information I have provided at any time while it is in storage as specified above.

I understand that I am free to contact any of the people involved in the research to seek further clarification and information.

If I have any questions or concerns about my rights as a study participant, or if I am concerned about an aspect of the study or the researchers then I may contact:

HUMANITIES & SOCIAL SCIENCES RESEARCH ETHICS ADMINISTRATION
Research Office, Westville Campus
Govan Mbeki Building
Private Bag X 54001
Durban
4000
KwaZulu-Natal, SOUTH AFRICA
Tel: 27 31 2604557 - Fax: 27 31 2604609
Email: HSSREC@ukzn.ac.za

I hereby provide consent to:

Audio-record my interview YES / NO

_____ _____
Signature of Participant **Date**

_____ _____
Signature of Witness (Where applicable) **Date**

_____ _____
Signature of Translator (Where applicable) **Date**

Signature of researcher **Date**

I believe the participant is giving informed consent to participate in this study

Annexure 2: Interview with the eThekwini Municipality Development Planning Officials

1. What role does the planning profession play in climate change?

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2. What specific role does the planning profession play towards adaptation to and mitigation against climate change disasters?

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3. Which common climate change disasters are experienced by eThekwini Municipality at large?

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4. Which communities are commonly affected?

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5. Which methods are used by the planning profession towards climate change adaptation and mitigation?

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6. How effective are these methods?

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7. What are the future prospects?

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……

8. From your experience, why was the environment incorporated into planning?

……..……

……..……

9. Which laws are put in place to facilitate adaptation to and mitigation against climate change disasters?

……..……

……..……

10. How effective are these laws when it comes to adaptation to and mitigation against climate change?

……..……

……..……

Annexure 3: Interview with the Residents of Umlazi Section H

1. How long have each of you lived in Umlazi Section H?

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2. Which year did you start experiencing climate change disasters?

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3. Ever since you started living in Umlazi, what kind of climate change disasters have you experienced?

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4. How often do these disasters happen?

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5. What impact have they caused to you and your families?

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6. What kind of support do you need during these hard times?

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7. What kind support does the municipality offer?

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8. How effective is this assistance?

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9. If not effective, what other ways could you possibly suggest?

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