Investigating the socio-economic impacts of and community perceptions towards lightning storms and lightning fatalities in uMkhanyakude District Municipality.

By

Nokuphila Mthethwa

Student Number 201623053

Masters in Arts

In the field of

Geography and Environmental Studies

Department of Geography and Environmental Studies

Faculty of Science and Agriculture

KwaDlangezwa

Supervisor: Prof I. Moyo

ORIGINALITY DECLARATION

Full Names and Surname	Nokuphila Pearl Mthethwa
Student Number	201623053
Title of dissertation/thesis	Investigating the socio-economic impacts of and community perceptions towards lightning storms and lightning fatalities in uMkhanyakude District Municipality.

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DEDICATION

I dedicate this thesis to my mother Gloria Thoko Mthembu (umamMvelase owavel' eNyandeni yemikhonto yakwaMabaso, Jama) all of this was made possible by your support and guidance. Thank you for being there for me every step of the way, bringing me back up to my feet, when I fell. Thank you for encouraging me when I lacked the courage to continue. Your dedication to my education is one of the reasons I was inspired to complete this study.

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LIST OF ACRONYMS AND ABBREVIATIONS

UKDM: Umkhanyakude District Municipality

NLSI: National Lightning Safety Institute

PMT: Protection Motivation Theory

NASA: The National Aeronautics and Space Administration

ABSTRACT

Over the years there have been more and more reports of lightning fatalities in South Africa, with the uMkhanyakude District Municipality being affected the most. Therefore, this study investigates the socio-economic impacts of lightning in selected areas in the uMkhanyakude District Municipality. The specific objectives of the study are to; (a) map the fatal lightning strike hot spots in the study area; (b) assess the socio-economic and cultural impacts of lightning strikes in the uMkhanyakude District Municipality; (c) explore the perceptions of the community in the uMkhanyakude District Municipality towards lightning strikes; (d) analyse the community's response to the lightning strikes in the study area and (e) evaluate the response of the government towards the fatal lightning strikes in the uMkhanyakude District Municipality. To achieve these objectives, this study followed a qualitative research methodology in the form of qualitative interviews with municipal officials and the rural communities' members in 5 local municipalities in the uMkhanyakude District Municipality. The data was analysed by following strategies of qualitative data analysis. The findings show that lightning has several socio-economic impacts and that people lack adequate and accurate information regarding lightning. The study recommends sustained knowledge dissemination to rural communities about lightning and how it can be prevented.

Keywords: Lightning, socio-economic impacts; uMkhanyakude District Municipality

CHAPTER 1: ORIENTATION OF THE STUDY

1.1 Introduction

This chapter provides an overview of the study. It does so by outlining the background of the study, problem statement, aims, and objectives of the study as well as the research questions. The chapter also discusses the significance of this research and the last part of the chapter describes the chapter format or outline of the study.

1.2 Definition of concepts

1.2.1 Lightning

Lightning can be defined as when the voltage between the clouds and the earth becomes so high that stray electrons in the air are accelerated to kinetic energy large enough to knock electrons out of the air (Giancoli 2005). In this study, the focus on lightning is on how community members perceive it and what socio-economic and cultural impacts are suffered as a result of lightning incidents.

1.2.2 Fatality

This is an occurrence of death by accident, in war, or by disease (English Oxford Dictionary, 2015). In this study, this term will be used when referring to the people that have been killed by lightning in uMkhanyakude District Municipality.

1.2.3 Perception

Perception has been defined in a variety of ways since its first usage, but more or less, perception is an act of being aware of “one’s environment through physical sensation, which denotes an individual’s ability to understand” (Ogheneochuko, 2009, p. 18). In this study, the term perception will be focused on people`s opinions on lightning, lightning fatalities, and impacts in uMkhanyakude District.

1.2.4 Impact

The meaning of this term is to have an effect on something (Oxford English Dictionary). This study uses it to refer to the socio-economic impacts of lightning on the community in the study area.

1.3 Background of the study

Lightning is a climate-related, highly localised natural phenomenon, where electrical charges generated due to cloud/air movement, dust storms, volcanic eruptions, or other turbulent atmospheric conditions get discharged to the earth through a

conductive path with disastrous direct and indirect effects (Illiyas et al, 2014). Lightning is still one of the most lethal natural phenomena and claims the lives of several hundreds of people globally each year (Holle et al, 2005). Holle and Lopez (1996) concluded that 24,000 deaths and 240,000 injuries occur per year worldwide. For several years now, the US had been ranked as number one in the world in terms of the high numbers of lightning strikes, followed by India and South Africa at number three (The Atlantic, 14 January 2014). Whereas the first two countries have somewhat shifted their position, South Africa maintains its spot in worldwide ranking on lightning fatalities[1]. According to the NLSI (2019), Thailand currently has the highest record of deaths by lightning followed by Mexico and in its constant position is South Africa.

However, although the US has been ranked number one, the number of people who die from lightning strikes is very low. The subject of death by lightning has been making headlines in South Africa over recent years. Numerous broadcasts have publicized incidents and fatalities caused by lightning around the country such as the South African Broadcasting Corporation (SABC) News. Reports by newspapers such as the Sowetan, The Guardian as well as The Citizen have also largely contributed to bringing insight on the matter. On the 15th of January 2019, the Sowetan released a report titled “Lightning conductors to be installed in KZN’s high-risk areas”. In this report, the writer highlighted that there are frequent lightning strikes in parts of the rural northern KZN and that the uMkhanyakude district was being affected the most (Sowetan, 15 February 2019). According to the British Broadcasting Corporation (BBC) News report, lightning appears to be killing and injuring an increasing number of people in developing countries.

In addition, casualties of lightning strikes could be even higher than other weather-related disasters such as floods, landslides, and droughts. Although there is insufficient research to corroborate it, there is a belief that lightning strikes are increasing every year. This has been linked to climate change and in fact, some scientists go as far as to predict that with the increase in global temperature, the frequency of thunderstorms and lightning will rise (BBC News, 14 March 2014). Further, although the number of thunderstorms in the world seems to be relatively stable, the number of lightning strikes detected is on the rise (BBC News Report, 14

[1] http:/lightningsafety.com>nlsi_pls

March 2014). This rise can mean that more and more individuals are or will experience lightning incidents, some resulting in fatalities. This is the context within which this study investigates the socio-economic impacts of, and perceptions of community around uMkhanyakude district towards lightning and lightning fatalities.

1.4 Problem statement

Death by lightning is becoming more and more common. Most people agree that this is a result of climate change and global warming being experienced recently. Nonetheless, the documentation of fatalities remains poor, prevention measures or mitigation strategies are unheard of, at least in the rural parts of South Africa which is where such incidents occur the most. Research on lightning is usually focused on the scientific aspects of the phenomenon and its meteorological features. Examples of such research include that by (Chunshan & Bihua 2003; Rachidi (2011). The first analysed the methods to generalize engineering return stroke models and the second focused on recent progress in lightning return stroke modelling and electromagnetic field computation. Other studies (see e.g. Seidl, 2012) have focused on the medical aspects of lightning such as the effects of lightning on the human body. Within South Africa, uMkhanyakude District Municipality (MDM) is the most affected by fatal lightning strikes (Sowetan Live, 15 February 2019). Despite this, research on lightning has focused on climatology and the physics of lightning. The perceptions of people towards lightning fatalities and the socio-economic and cultural impacts have seldom been studied. This study occupies this gap and therefore explores the perceptions of the people who have been affected by fatal lightning strikes in uMkhanyakude District Municipality (UKDM).

1.5 Aim and objectives of the study

1.5.1 Aim

The study aims to investigate the socio-economic impacts of and community perceptions towards lightning storms and lightning fatalities in the uMkhanyakude District Municipality.

1.5.2 Objectives

The objectives of this study are to:

a) Map the fatal lightning strike hot spots in the study area.

b) Assess the socio-economic and cultural impacts of lightning strikes in the uMkhanyakude District Municipality.

c) Explore the perceptions of the community in the uMkhanyakude District Municipality towards lightning strikes.

d) Analyse the community response to the lightning strikes in the study area.

e) Evaluate the response of the government towards the fatal lightning strikes in the uMkhanyakude District Municipality.

1.6 Research questions

Where are the fatal lightning hot spots in the study area?

What are the socio-economic and cultural impacts of lightning strikes in the uMkhanyakude District?

What are the perceptions of communities in the uMkhanyakude District towards lightning strikes?

How does the community respond to lightning strikes in the study area?

How is the government responding to the fatal lightning strikes in the uMkhanyakude District Municipality?

1.7 Significance of the study

There is significant research on fatal lightning strikes relating to the scientific as well as the medical aspects of lightning, in terms of how lightning strikes affect people and animals (Poelman 2010; Mohyedin 2015). There is however limited research on the perceptions of lightning by the affected people as well as the socio-economic impacts that lightning calamities impose in the affected areas. The researcher did not find any research on the perceptions of the people regarding lightning and the fatalities caused in South Africa and especially in the study area which is in one of the provinces reported to have high occurrences of lightning flashes (KwaZulu-Natal). Therefore, it is anticipated that this study will provide information such as how people perceive lightning and how they react to it, which can help in developing disaster management strategies that can assist in reducing the fatality rates in South Africa.

1.8 Outline of the study

This study is composed of seven chapters as follows;

Chapter 1: Introduces the whole thesis by discussing the background of the study, outlining the aim, objectives, research questions, problem statement as well as the significance of the study.

Chapter 2: Discusses the theoretical framework on which this study is grounded, namely the Protection Motivation Theory and the Emergency Management Theory.

Chapter 3: Focuses on the literature review. It does so by reviewing authentic literature sources on themes that respond to the objectives of the study.

Chapter 4: Describes the setting of the study area. This includes a description of among others, the physical, climatic and socio-economic, and historical characteristics of the study area.

Chapter 5: Discusses the methodology that the researcher followed in the collection and analysis of data.

Chapter 6: Focuses on the analysis and presentation of findings. The analysis of data follows the sequence of the objectives.

Chapter 7: This is the final chapter in which the summary of the whole study and recommendations are made.

1.9 Chapter summary

This chapter has introduced the whole research by explaining the background of the research as well as describing the aim, objectives, problem statement, research questions, and the significance of the study. The next chapter focuses on the theoretical frameworks.

CHAPTER 2: THEORETICAL FRAMEWORKS

2.1 Introduction

This chapter focuses on the theoretical frameworks used in the study. It does so by discussing the three theories this study utilised, these being the Protection Motivation Theory and the Disaster Risk Management Theory.

2.2 Theoretical Frameworks

Theoretical frameworks offer a specific perceptive, or lens, which a person can use to understand a given topic. In this study, two theories (lenses) have been used, namely the Protection Motivation Theory (PMT) and the Disaster Risk Management Theory (DRM) (Figure 2.1 below). This chapter begins by explaining the protection motivation theory which is the lens that was used to understand the responses of communities and government towards lightning.

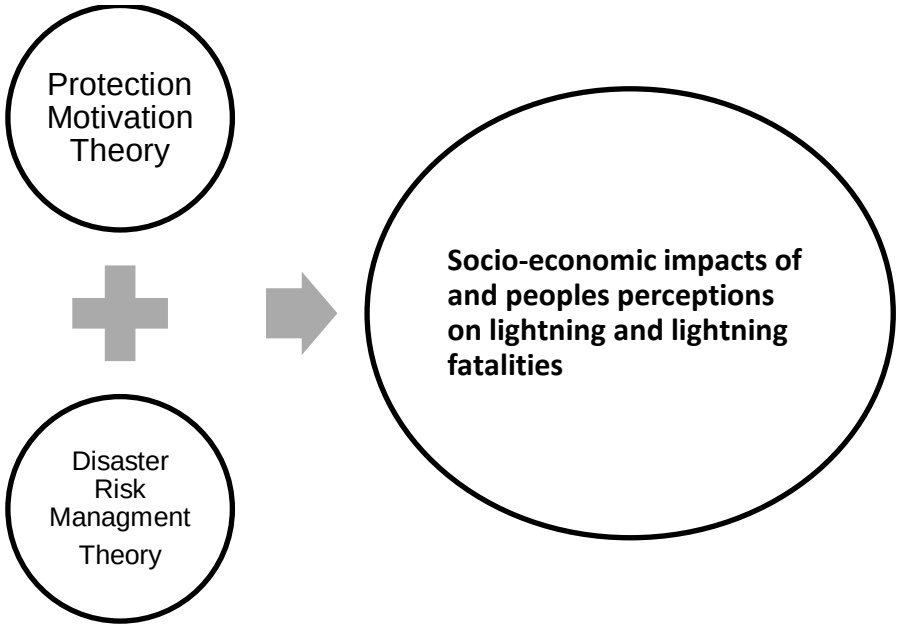

Figure 1: Theories underpinning the study

2.2.1 The Protection Motivation Theory.

Developed by Ronald Rogers in 1983, the PMT has been used vastly to theorize how people respond to potential threats to their health and safety. According to this theory, both individual and environmental factors can bring about encouragement or discouragement for engaging in safety precautionary measures (Clubb et al, 2015). This theory was used to understand how community members in the lightning hot spot regions of the study area are motivated to protect themselves against lightning. The PMT explains motivation by fear, risk appraisal (severity and vulnerability), and coping

appraisal (response efficacy/response costs/self-efficacy) (Lippke et al, 2009). Figure 2.2 below is an illustrative demonstration of the protection motivation theory.

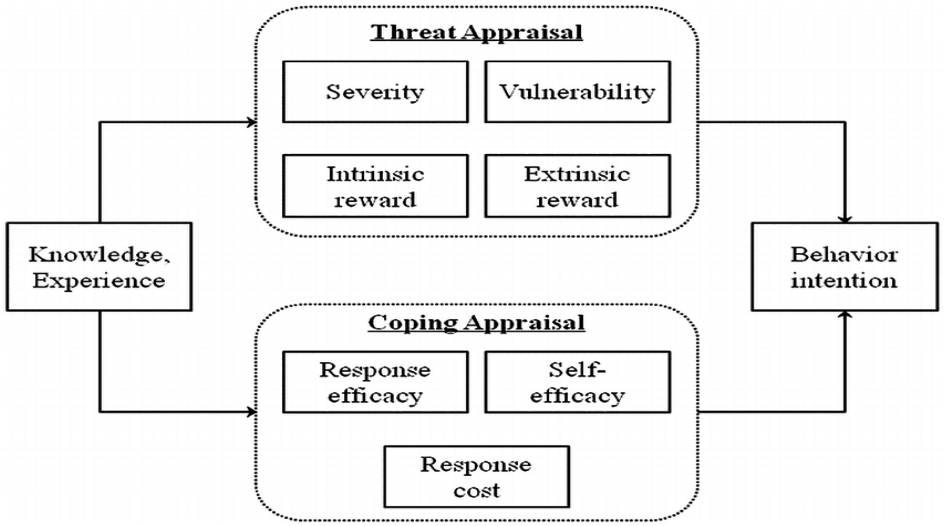

Figure 2: *The Protection Motivation Theory Rogers R.W (1983)*

This model is commonly used in health studies as a method of determining how an individual will respond to a recommendation such as quitting smoking as a cancer patient Rogers (1983). However, when applied to this study it can evoke knowledge that is useful in the extraction of real perceptions of people. According to PMT, two cognitive processes preside over the decision of whether we should engage in health-related behaviour or not. These two are the threat appraisal and the coping appraisal, and they both deal with the consequences that can be expected as a result of engaging or not engaging in specific health behaviour[2].

2.2.1.1 Threat Appraisal

This aspect of the process focuses on how threatened one feels, for example how scared someone is that she/he might be struck by lightning. In threat appraisal, the mind assesses a variety of aspects that are probably involved in potentially risky behaviour like standing under a tree when there is lightning[3]. The threat appraisal is comprised of what is known as perceived vulnerability and severity. According to Rogers (1983), perceived vulnerability addresses the belief that a person is susceptible to an illness, or in the case of this study, lightning. For example, a person can rate their chances of being struck. The feeling that the health threat will have

[2] www.communicationtheory.org (accessed 04/07/2020)
[3] www.communicationtheory.org (accessed 04/07/2020)

severe consequences in one's life is known as perceived severity Rogers (1983). As a result of perceived vulnerability and severity, fear is born and the outcome is known as fear arousal.

2.2.1.2 Coping appraisal

Coping appraisal is about the various measures that one can take to cope with a threat Rogers (1983). For example, to reduce the risks of being struck by lightning, people avoid behaviours that can increase their chances of being struck, like being outdoors. There are three sets of beliefs involved with this aspect of the process. First, there is response efficacy; this is the belief that if a person behaves in certain ways the threat can be reduced (Rogers 1983). A typical example would be avoiding using water during a thunderstorm as it is known that a building's plumbing system can conduct lightning. The second, self-efficacy deals with the belief that one has the necessary potential to engage in healthy behaviour. Lastly, there is the perceived response cost; here we consider the monetary factors that go into performing the health behaviours.

In summary, the PMT argues that people protect themselves based on two factors, the severity of the situation and how they can cope with that situation. Based on this notion this study assessed how community members perceived lightning in terms of how much of a threat they thought it was and, therefore, how they planned to cope with or protect themselves from lightning. The same notion was used to acquire knowledge of how other stakeholders such as the municipalities and COGTA were addressing the issue of increased lightning fatalities in the study area, which addressed objectives three, four, and five of this study. So in essence this research was based on the fear-drive model, which proposed that fear acts as a driving force that motivates trial and error behaviour and that if community members in the study area felt at all that they were threatened by lightning, they would by all means try to alleviate the feeling of fear and discomfort caused by lightning and they would most likely do that by the methods they used to protect themselves and as part of the objectives of this study the researcher also observed some of these "methods". The researcher was able to observe the various strategies and tactics that were used by locals of uMkhanyakude district municipality to protect themselves from lightning, which also brought insight to the perceptions that they had based on what they chose as a precaution method from the deadly phenomenon lightning, more details are discussed in chapter 6.

2.2.2 The Disaster Risk Management theory.

Disaster management as defined by the UNDP (1992) is “the body of policy and administrative decisions and operational activities which pertain to the various stages of a disaster at all levels. The Institute for Disaster Risk Management (IDRM, 2004, p. 2) believes that disaster risk management is a development approach to disaster management. The underlying focus of disaster management is on the risks that lead to the occurrence of disasters. Its objective is to increase capacities to effectively manage and reduce risks, thereby reducing the occurrence and magnitude of disaster (Niekerk, 2006).

As a theory, the disaster management theory encompasses various concepts which serve as building blocks for the development of higher-order theoretical components, originated from, and, are still used by other disciplines (Jensen, 2009). The concept of vulnerability illustrates the qualities or characteristics that make human beings, property, and/or the environment as being prone to the impact of a given hazard. Risk is the likelihood or probability that an event related to a given hazard will occur (Jensen, 2009). The application of both these concepts enables assessments of the factors related to the impact of a disaster in a given area and allows the spectrum of all possible hazards to be narrowed down to only those hazards most likely for that given area. This ultimately makes it possible to study what humans can do to reduce the impact of, prepare for and respond to hazards (Jensen, 2009).

According to Gratwa and Bollin (2002), disaster risk management is a series of actions and instruments expressly aimed at reducing disaster risks in endangered regions and mitigating the extent of disasters. The disaster risk management theory has been utilised in attempts to solve various disaster problems around the world. It was used as a guide in responding to disasters in Ethiopia as the country suffered from famine which claimed 900,000 lives (Ginsberg, 2013). The utilisation of this theory led to the establishment of many agricultural projects to reduce the impacts caused by the famine (Ginsberg, 2013). In South Africa, this theory was incorporated as a framework specified by the Disaster Management Act No. 57 of 2002, to address needs such as consistency across multiple interest groups, by providing a coherent, transparent, and inclusive policy on disaster management appropriate for the Republic of South Africa (Government Gazette, 2006). Consisting of four stages, this theory outlines how to

manage disasters before and after they have occurred and these are in stages; starting with prevention, followed by preparedness, response, and lastly recovery (Figure 2.3 below demonstrates the cycle for disaster risk management).

Figure 3: The Disaster risk management cycle

The prevention phase includes actions taken to prevent, reduce the cause, impact, and consequences of disasters. In the case of this study examples of mitigation methods include the installation of lightning protective equipment such as surge arresters and lightning rods to prevent or reduce the impacts of lightning. Preparedness is the next phase and it entails planning, training, and educational activities for events that cannot be mitigated. In areas prone to cyclones like Florida, USA, they have altered the equipment they use to build their homes substituting it for concreated houses because of its ability to withstand strong wind and rain than those built by wood and brick or panelling. All this is done in an attempt to prepare for what they know is inevitable. In the USA cyclones or hurricanes as they are popularly known, occur so frequently that these measures had to be taken to reduce the high economic impacts (Ginsberg, 2013). In this study, the researcher looked for similar strategies that were used by the people to reduce the loss when lightning struck.

There is the response phase that comes into effect in the immediate aftermath of a disaster. During the response phase business and other operations do not function

normally, personal safety and well-being is an emergency and the duration of the response phase depends on the level of preparedness. In this study, if a community member has been struck by lightning for instance, as a response they can be rescued from that place and given temporary shelter until they can take care of the damages to their homes. Lastly, there is the recovery phase involving the restoration of whatever was damaged during the calamity (Jefferson, 2017). A suitable example would be rebuilding damaged structures. In this study, the DRM was used to assess the means through which government and other stakeholders prepared for and responded to the impacts of lightning incidents in the study area which is the 5th objective of the study.

This theory is similar to the protection motivation in that it also covers ways that if threatened a person would respond to the threat, different to the protection motivation theory however is that the DRM it also looks at preparedness where the focus is on are people even aware that there is a threat and how informed are they about the threat to their lives. For this particular study it was used to study whether the people were aware that there in fact was a rise in the number of lightning fatalities around them and just how much did they know about lightning. The theory also focused on recovery and prevention measures. That is, what was done to assist people who had in fact been affected by lightning and what was then done to ensure that those effects are not felt again. These aspects of this theory contributed very much with the 4th and 5th objectives of the study.

2.3 Chapter summary

This chapter began by giving descriptions of some of the key concepts and went on to provide a detailed analysis of the theories used in the study. It has also shown how the study will be structured using the perspectives of the Protection Motivation Theory and the Disaster Risk Management Theory, particularly how these two theories lead to addressing the objectives of the study. The next chapter reviews the literature on lightning fatalities, perceptions, and the impacts of lightning in communities.

CHAPTER 3: LITERATURE REVIEW

3.1 Introduction

This chapter reviews the literature on lightning. It does so by first outlining the background to the phenomenon of lightning. This is followed by an overview of the spatial distribution of lightning worldwide. The chapter also discusses the socio-economic impacts of lightning and outlines the general perceptions of people towards lightning.

3.2 Overview of studies on lightning.

Uman (1984) defines lightning as a transit, high-current electric discharge whose path length is generally measured in kilometers. (According to Shivalli (2016) lightning is responsible for two major types of accidents. First, accidents are caused by a direct strike when lightning strikes a building or a specific zone, which can cause considerable damage, usually by fire. Second, indirect accidents like the economic impacts incurred through repairs and recovery measures after lightning has struck (Shivalli, 2016). Although not considered a big threat like other natural disasters such as floods, droughts, and earthquakes, lightning is responsible for many deaths around the world.

Several scholars (see e.g. Christian and Coauthors 2003; Seidl 2006; Holle 2009, Trangove 2012; Gomes 2014; Ronald 2016, Holle 2019) have documented some of the most fascinating information on lightning based on their research on the phenomenon. Christian and Coauthors` (2003) study was based on an examination of the vertical correlation between lightning activities and storm development. Their findings were that at least 10% of the 1060-h period analyzed showed a feature of ascending concentration of lightning activity which they referred to as lightning bubbles. The bubbles they found were mostly recorded in summer and only a few were recorded in winter in Florida. Trongove's (2012) study focused more on the myths associated with lightning and how those myths affected people's thoughts. He concluded his study by categorizing the myths and the risks associated with them into four main groups, firstly there were the myths that were harmless and did not affect people's safety like those of the mobile telephone and mirrors attracting lightning. The second category were the myths that could lull people into a false sense that they were protected against lightning when in fact they were not and those are the traditional medicine (*umuthi*) and tyres on roofs myths. The third category are myths associated

with high risks namely the myths about witchcraft. It was believed that a person could be responsible for controlling the lightning and ordering it to kill certain people and their cattle and destroying their wealth. According to Trenvago (2012) this could result in social unrests in communities and the false allegations can erupt wars. Lastly according to Trengove (2012) there was the myth about different trees that could be planted to protect people from lightning. All these researchers have presented different aspects of lightning ranging from studies based on the distribution patterns to those documenting the pathological effects of lightning. But there are no studies that have been done focusing on the perceptions of and the socio-economic impacts of lightning in communities in and around the study area. This is why this research study focuses on the perceptions of and socio-economic impacts of lightning in the uMkhanyakude District Municipality.

3.3 Spatial distribution of lightning strikes

According to King (2005), the distribution of lightning is far from uniform. Typical conditions for lightning to occur are specific to places where warm, moist air rises and mixes with cold air above (King, 2005). While these conditions happen almost every day in some parts of the earth, they rarely do in other areas. The national aeronautics and space administration (NASA) has satellites orbiting the earth with sensors designed to detect lightning. Data from these satellites is transmitted to earth and used to construct a geographic record of lightning over time (King, 2005). Once available the maps are studied and interpreted. Figure 3.1 below is a map showing the lightning distribution of the world.

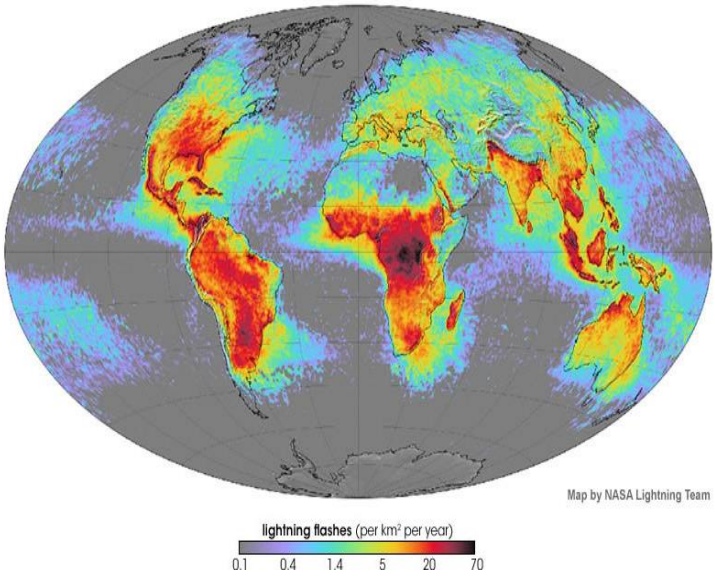

Figure 4: Map showing the lightning distribution in the world.

Source: NASA lightning team

According to NASA (2015) more lightning occurs over the land as opposed to the oceans because the land surface heats faster than the ocean. In addition, more lightning takes place in regions closer to the equator than those in the poles (NASA, 2015). The reason behind this is that thunder clouds initiate in the presence of heat. The equator is the perfect place for thunder cloud formation because of the direct sun rays it receives. This results in stronger convection and greater atmospheric instability which further gives rise to the formation of thunder and lightning, producing storms (NASA, 2015). According to King (2011), the world's top lightning hotspot is over Lake Maracaibo in northwestern Venezuela, with an average lightning flash density of 232.52 per square kilometer per year.

Globally, several broad regions experience an unusual amount of lightning (King, 2011). These include the Democratic Republic of Congo in Central Africa. The DRC has the highest frequency of lightning on earth. This is due to the local convection and moisture-laden air masses from the Atlantic Ocean encountering mountains as they move across the continent. Another region with intense lightning according to King (2011) is Northwestern South America. In this region, warm winds from the Pacific Ocean carry moisture-laden air masses up the Andes Mountains, causing cooling and thunderstorm activities. The Himalayan forelands also form part of these intense lightning regions due to the seasonal winds that carry warm, moist air from the Indian

Ocean up the front of the mountain range resulting in thunderstorm activity. Central Florida between Tampa and Orlando, is known as the “lightning alley” due to the intense lightning activities that occur in the area. Table 3.1 below, summarizes the top 10 places on earth with the highest levels of lightning flashes.

Top 10 Lightning Hotspots on Earth

Global Rank	Flash Rate Density	Location
1	232.52	Lake Maracaibo, Venezuela
2	205.31	Kabare, Dem. Rep. of Congo
3	176.71	Kampene, Dem. Rep. of Congo
4	172.29	Caceres, Colombia
5	143.21	Sake, Dem. Rep. of Congo
6	143.11	Daggar, Pakistan
7	138.61	El Tarra, Colombia
8	129.58	Nguti, Cameroon
9	129.50	Butembo, Dem. Rep. of Congo
10	127.52	Boende, Dem. Rep. of Congo

Table 1: Lightning hotspots around the world.

Source: geology.com (2005-2021)

3.3.1 Lightning in South Africa

According to the South Africa Weather Services, South Africa has one of the highest incidences of lightning related injuries and deaths. Mohamed (2021) states that South Africa has made significant improvements in the advancements of technologies for lightning detection and monitoring. However, despite these improvements the vulnerability to lightning is still high and this is expected to be even higher as the climate changes. The country’s detection network operates at a national level, but information and warnings are not disseminated locally (Mohamed, 2021). In southern Africa, recent lightning research is focused on the new South African Lightning Detection Network (SALDN). The SALDN is a cloud-to-ground lightning detection network established in 2005. The SALDN analyses lightning data, the effects of lightning on electrical distributions, different forms of lightning protection, the development of a database on how lightning influences humans and animals, as well

as overcoming cultural myths to do with protecting people from lightning (Gijben, 2012). The South African Weather Service, SAWS, has since installed 19 new lightning detection sensors which can determine the time and location of a lightning stroke in real-time using state-of-the-art magnetic direction finding and time of arrival methods (Schulze, 2007). The locations of these sensors were selected to ensure that more than 90% of all cloud-to-ground lightning strokes in South Africa will be recorded with an accuracy of within 500 m (Schulze, 2007).

South Africa is a country that frequently experiences lightning. The summer (October to March) rainfall region is dominated by convective storms, and a large portion of the north-eastern region receives more than 60 thunderstorm days a year, whilst areas over the Highveld and the eastern escarpment record on average between 10 and 15 lightning flashes/ km^2/year. South Africa does not experience as much lightning activity as the equatorial parts of Africa and South America but is still considered a lightning-prone country (Gijben, 2012). According to Moyo and Xulu (2021), the northeastern parts of South Africa including the uMkhanyakude District Municipality in the province of Kwa-Zulu Natal form part of the most vulnerable regions in the country, with severe to extreme lightning risk. It is for this reason that this study will be conducted in uMkhanyakude District. Figure 3.2 below shows the spatial distribution of lightning ground flash density in South Africa.

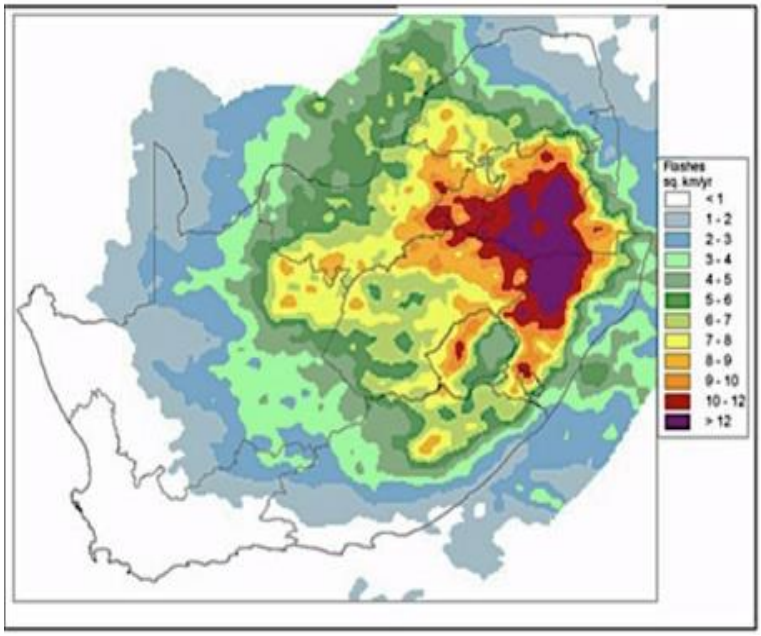

Figure 5: Lightning ground flash density in South Africa (Jandrell, 2009)

3.4 Socio-economic impacts of lightning

Almost all natural disasters have some social and economic impacts and lightning is no exception. Globally lightning has contributed to various deaths of humans and animals (Kalair et al, 2013). According to Kalair et al, (2013) lightning is responsible for major economic downfalls connected to re-establishing and repairing properties such as aircraft, wind turbines, light rail transits, electric grids, and telecom towers. It is estimated that over 1.5 billion flashes occur every year and some of them kill 2 to 233 people per year. In addition, lightning has been known to be the source of many abrupt fires around the world which often affect natural resources. Businesses, homes, and infrastructure in many countries are damaged by lightning and a vast amount of money has to be spent on mitigation (Holle and Cooper, 2019). In developed countries, there has been a decline in the number of fatalities caused by lightning. This is due to the migration of the majority of the population, from labour-intensive agricultural activities in rural areas to urban regions with rapid economic development that provides better lightning protection measures (Holle, 2016).

These impacts however are still adversely felt in many developing countries. The majority of the dwellings in developing countries are still rural with most of the population active in the primary modes of production namely agriculture. In many countries such as India, there have been several deaths reported on farms (Illiyas et al, 2014). In a study by Illiyas et al, (2014), it was shown that the lack of a national database or platform to bring out the lightning fatalities and economic damage to light makes it very difficult to compensate people for any economic damages caused by lightning. According to Trengove (2015), the number of people injured and killed by lightning in Africa is very high. Furthermore, Cooper and Holle (2019) state that electrical interruptions linked to lightning strikes in many developing countries result in a lot of businesses, small and large, preferring to deal with goods that do not need preservation by refrigeration, communication deficits, and often data loss. Often when there is no electricity, businesses seek alternative methods such as operating generators that use fossil fuels which have strict regulations on emissions and can introduce environmental risks. Businesses also lose a lot of money on repairs to direct damages from lightning and in the process pay inflated fees to service providers, who also have their damages to fix. Ultimately, the people buy and receive a lot of basic services at high prices as everyone is trying to minimize their losses (Cooper & Holle,

2019). More so, lightning also has adverse economic problems on industries and manufacturers who largely depend on electric power and are left with tremendous financial challenges after lightning accidents have occurred.

According to Cooper and Holle (2019), the economic effects of lightning damage to property are large, varied, and widely spread across society. Besides killing the masses and leaving its victims in miserable health conditions, there are direct and indirect costs from lightning strikes which affect a wide spectrum from individual homeowners and small businesses to large companies such as oil refineries as well as national heritage sites. Unfortunately, even in developed countries, little systematic research has been done on these areas, and the research that has been completed has often been considered proprietary by industry or insurance companies. There are few models to predict losses and no routine monitors to measure them. As a result, figures for economic damages may be erroneous (Cooper & Holle 2019). In South Africa, despite fairly rapid urbanization in the last few decades, many people still reside in rural or poorly constructed dwellings in urban areas. These, coupled with poor education around lightning safety and the fact that South Africa is a lightning-prone country, are the principal reasons for the high lightning-related mortality rate (Evert & Schulze, 2005). Not only are the people of South Africa at huge risk from lightning, so too are a host of economic sectors. Besides the loss of life, lightning is responsible for a considerable financial loss each year. Insurance claims resulting from the loss of electronic equipment or fires initiated by lightning strikes amount to more than R500 million per year (Evert & Schulze, 2005).

There has been a lot of media coverage documenting the impacts of lightning in the uMkhanyakude District Municipality. From reports of the individual to mass killings, the communities in uMkhanyakude have experienced it both ways. In addition, lightning strikes have also been connected to infrastructural damages in the area, from the destruction of homes to interruptions in electricity supply. This study used observations and interviews to document more of the socio-economic impacts of lightning in the uMkhanyakude district and in this way contribute to the body of knowledge on the impacts of lightning.

3.5 The perception of the communities towards lightning strikes

The perceptions of a particular disaster vary among individuals and cultures and it can be accounted for by the combination of the way that natural disasters are perceived, the nature of personal encounters with that hazard, and factors of individual personalities (Kates, 1971). People's perception has been studied in different types of disasters, including cyclones, floods, fire, earthquakes, volcanic eruptions, lightning, etc. (Johnston et al., 1999; Jackson, 1981; Glade et al., 2006; Grothmann & Reusswig, 2006).

Keeping in mind the high quantities of deaths that are recently rising, understanding the perceptions or the understandings that people have on the phenomenon could assist in shedding light on some of the reasons for the rise in fatalities. In developed countries like the USA, lightning killed a lot of people, golfers accounting for the majority of the deaths (Holle, 2008). All this has since changed as a result of proper knowledge dissemination and warning systems, now people know when a storm is approaching and are also well educated in terms of properly managing those situations (Holle, 2008).

African countries have been infested with problems, from poverty, high crime, and illiteracy. Many people have very little or no education, let alone education on lightning. As long ago as 1986 Eriksson and Smith (1986) pointed out that there is a need for lightning education in Southern Africa. This was further validated by Jandrell et al., (2009) as well as Dlamini (2009). According to Trengove and Jandrell (2015), the lack of this knowledge has left people to base their perceptions on the only available stories they know, which are often passed down from the elders in the communities, and sadly these stories are just myths and often not true. Moyo and Xulu (2021) indicate that the misconception or inaccuracy in people's perceptions of disastrous weather events can intensify the vulnerability of communities.

In their study of lightning myths in Southern Africa, Trengove and Jandrell (2015) state that South Africa has a very diverse population and culture which can cause different myths and beliefs about lightning in the absence of education. Studying the popular myths that South Africans have can give insight into their thought processes and ultimately link to how people perceive the lightning phenomenon. As already stated, one popular myth is one that lightning strikes can be controlled through witchcraft activity to kill enemies. Trengove and Jandrell (2015) state that traditional healers in

KwaZulu-Natal, the province within which the study area is located, claim that they can make medicine that can protect their clients from lightning. This causes great concern because more people will neglect to take precautionary measures or act recklessly believing that they are protected by the leaves, roots, and animal fat that are used to make the medicine (Trengove &Jandrell, 2015).

One other misconception that people have of lightning strikes is that there is a particular tree that can offer them protection from lightning (Trengove &Jandrell, 2015). This is contrary to the truth as trees are a high risk for lightning strikes, in several cases, people have been struck by lightning taking shelter under trees. Thus, instead of protecting themselves, they increase their vulnerability rates. Placing a tyre on top of the roof of a house to protect it against lightning is also a popular misconception in South Africa. The rubber is believed to absorb the lightning the same way it does with cars, but this shows just how little information people have regarding the physics of lightning as the tyre has no protective role when lightning strikes (Trengove & Jandrell, 2015).

All this demonstrates how much education is needed in South Africa, especially in rural parts of this country. It also shows that people perceive lightning striking people or homes as an act of retaliation from other humans or as punishment for sin. This perception has high risks associated with it especially if people think that they can prevent or protect themselves from lightning, higher fatalities than currently experienced are likely to occur. An analysis of lightning concentration by Gijben (2012) shows lightning is prevalent over the central to northern interior of the country, with areas along the northern escarpment extending from the northern part of KwaZulu-Natal into the Mpumalanga Lowveld topping the scale of lightning densities. According to the findings, it can also be verified that these areas fall into the extreme risk category (Gijben, 2012). This background is important because it provides an insight into how lightning is perceived in many South African communities which could be a contributing factor to the increase in fatalities. Therefore, based on objective three of this study, the perceptions of people in the uMkhanyakude District Municipality towards lightning were also assessed.

3.6 The communities' responses to the lightning strikes

Developed countries have come a long way in terms of their development not only in infrastructure but also in science and technologies. Not only do they have safer buildings that make them less susceptible to lightning but they also have advanced lightning protection equipment such as having lightning rods installed in their homes. Many American homes and business premises have lightning detectors that assist in early detection and warning if there is a lightning risk (National Lightning Safety Institute, 2021).

The way people perceive lightning sufficiently influences how they respond to it and the reality of the situation is that lack of education on this hazard has created a lot of misconceptions among Africans (Trengove et al, 2015). As a result, instead of effective measures being put in place many people resort to ineffective measures which increase their exposure and vulnerability. In a study looking at the mitigation of lightning injuries and deaths across Africa, Cooper et al, (2019) found that many African countries are developing at different rates hence migration to the urban areas does not guarantee accommodation in lightning-safe buildings as in the USA. Many developing countries also have little or no access to lightning detection data sources (Cooper et al, 2019).

Governed by the misconceptions, many Africans use different measures to protect themselves from lightning, with some consulting traditional healers to get medicine (umuthi) to guard against fatal strikes as well as protect their wealth (Trengove et al, 2015). Others take ineffective actions such as covering mirrors during a lightning storm to avoid attracting the lightning and placing car tyres on rooftops to cope with the high rate of lightning deaths and injuries. The dissemination of African Centres for lightning and electromagnetic network in many parts of Africa has also contributed to how people respond to lightning strikes. In Uganda for instance the programme has infiltrated the school learning plans where teachers are raising awareness of lightning to the school pupils. This helps change people's perceptions and responses (Cooper et al, 2019). In South Africa like in many other developing countries, people stay indoors when there are lightning strikes but on top of that, they use additional measures. For example, placing tyres on top of the roofs, it is believed that the rubber absorbs the lightning (Trengove, 2012). Others say that just like the car tyres protect a person when lightning strikes a car, it protects the house in the same way.

Furthermore, many of the dwellings with a corrugated tin roof are painted as people believe that this type of roof (corrugated iron) attracts lightning (Trengove, 2012). More so some people believe that mirrors attract lightning so they cover them up during a storm to protect themselves. Another popular lightning protection method in South Africa is to switch off all mobile devices such as cell phones as people believe that using a cell phone can cause a person to be struck by lightning (Trengove, 2012). Other people just respond by staying indoors until the storm is over (Trengove, 2012). This background knowledge is crucial as it provides a context for addressing the fourth objective of the study, which focuses on the responses by communities to ensure their safety from lightning.

3.7 The response of the government towards the fatal lightning strikes

In other parts of the world, government responses to lightning strikes take many forms. For example, in the USA the installation of lightning detectors in many of its states has proved that early warning systems enable people to prepare themselves for what's to come and has reduced the lightning fatality incidents in the country (Holle, 2015). According to Cooper et al, (2019) the establishment of the African Centres for lightning and electromagnetic network, is playing a major role in countries around Africa, through assisting with assessing the impact of lightning on each nation's citizens and economy, educating teachers, parents, pupils, and the public on lightning safety and injury prevention. They assist governments to ensure that code-compliant lightning protection systems are designed for a few new schools and other important buildings. They also work with universities to train Africa's own lightning experts for the future, improve engineering training professional qualifications in lightning protection, advice on code-compliant lightning protection of utilities and other economically important industries. Lastly, they assist with improving the availability of accurate and timely lightning data, weather forecasting, and warnings[4].

In South Africa, the major breakthrough in terms of initiatives government and other stakeholders have in efforts to combat the issue of lightning impacts was the establishment of the South African Lightning Detection Network (SALDN) (Gill, 2008). Over the years there have been several research studies/articles written in South Africa, all raising awareness about lightning (see e.g. Holle 2015; Gill 2008; Gibjen

[4] http://ACLENet.org

2012; Holle &Copper 2019; Moyo & Xulu 2021). According to the South African constitution “everyone has the right to a healthy and safe environment that will ensure their physical and mental health or well-being, including adequate water supply, sanitation, and waste disposal as well as protection from all forms of environmental danger…” (South African Bill of Rights). This suggests that the government must put in place measures to respond to lightning. This is the context within which this study explores responses by the government towards the fatal lightning strikes in uMkhanyakude District Municipality, in response to objective five of this research.

3.8 Chapter summary

This chapter presented the relevant literature to support the study by answering the objectives using work from other scholars who have contributed to this topic in the past. The chapter began by briefly explaining what lightning is. It then went on to discuss the general consensus about each objective with available literature. The next chapter details the background information on the study area.

CHAPTER 4: THE SETTING OF THE STUDY

4.1 Introduction

This chapter focuses on the setting of the study, it does so by giving a detailed background of the physical setting of the study area, the demographics, and socio-economic and cultural circumstances of uMkhanyakude District Municipality.

4.2 The physical location of the uMkhanyakude District Municipality

UMkhanyakude District Municipality is located in the north-eastern parts of Kwa-Zulu Natal in South Africa. It shares its borders with Swaziland and Mozambique, as well as with the districts of Zululand and King Cetshwayo. In a total of 10 other district municipalities, uMkhanyakude is the second-largest district in the province and consists of the following four local municipalities namely uMhlabuyalingana, Jozini, Big 5 Hlabisa, and Mtubatuba. It is a very rural district, the largest town being Mtubatuba in the south, with Hluhluwe, Mkuze, Jozini, Kwangwanase, and Ingwavuma further to the north (uMkhanyakude District Municipal Integrated Development Plan, 2020-2021). Below is a map showing the physical location of the study.

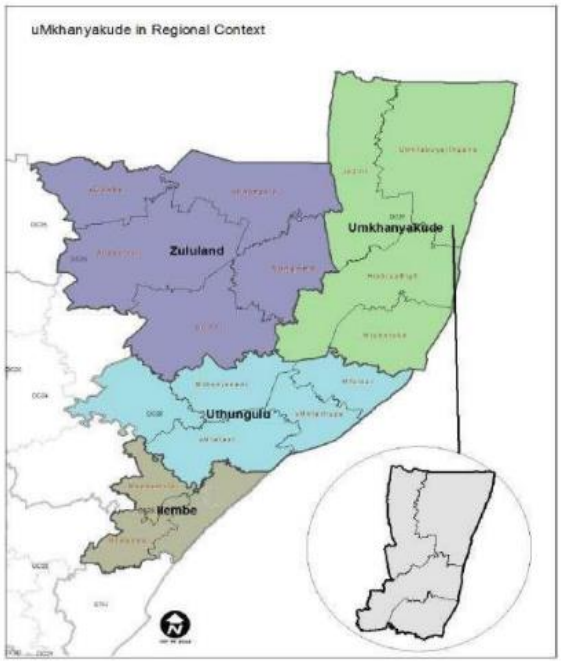

Figure 6: Map showing the physical location of uMkhanyakude District Municipality

Source: uMkhanyakude District Municipal IDP 2020-2021

4.3 The climate of the uMkhanyakude District Municipality.

The uMkhanyakude district is located within the summer rainfall area, experiencing more of its rainy season from January to March. The region has what's known as the

subtropical climate, with the average annual rainfall varying from 671 mm in the north to 1002 mm in the south (Morgenthal et al., 2006). Morgethal (2006) further states that in UKDM, it is estimated that 50- 70 days in a year are rainy and that the temperatures range from 20 degrees' Celsius maximum and above 10 degrees' Celsius minimum temperatures on average a day.

4.4 Social Demographics

The total population of UKDM is 689,090 with a growth of 9.2% between 2011 and 2016. A majority of this population is found in Mtubatuba and Jozini (UKDM IDP, 2020/2021). The outcomes of the STATSSA community survey 2016 show that most of the population in UKDM is made up of the youth with 50.7% (349 279) of the population being younger than 18 years. In all the local municipalities of the district, IsiZulu is the dominant language. The majority of the population is made up of black Africans followed by very few whites and even fewer coloureds and Indians. In terms of gender constructs, the majority of the population in the district is female (UKDM IDP, 2020/2021).

4.5 socio-economic status of uMkhanyakude

Unemployment is a huge problem in many parts of South Africa, uMkhanyakude is no exception. The district has a youthful population of 35.2% of the unemployed population younger than 25 years of age while 34.9% more unemployed are between the ages of 25 and 34. This shows that over 70% of the district's unemployed population is younger than 35 years (UKDM IDP, 2020/2021).

Roughly 14% of the unemployed population in the district has no formal schooling and only 17% has primary level education. A large proportion of the unemployed population, however, have completed grade 12 education and approximately 30% have secondary education. There is also a fraction amount of the population that has completed tertiary education (UKDM IDP, 2020/2021). A high level of adult illiteracy in the district exists, whereby more than 27% and 22% of the female and male population respectively have not received any form of schooling. The educational status of the district was crucial in this study as literature has proven that one of the major contributing factors to the perpetuation of the negative impacts by lightning results from lack of education or knowledge as noted by researchers such as Eriksson and Smith (1986), Jandrell et al, (2009) and more who suggested there be an improvement

in education on lightning. Studies have also shown that in places where lightning had adverse negative impacts before, such as in the US, educating people has played a significant role in reducing the impacts (Holle, 2009). Also assuming that adequate education and knowledge influences a person's perception as stated by Gibson (1972), this information helped in the understanding of what the community members in UKDM perceived about lightning, how they did as well as how that then influences their protective responses towards lightning.

In terms of the economy, the UKDM has been steadily growing, experiencing significant growth from the year 2000 and onwards. The major economic contributors to the district's economy are agriculture and tourism with the Mtubatuba and Jozini local municipalities as the two dominant local economies within the district (UKDM IDP, 2020/2021). According to Illiyas et al, (2011) in many countries such as India, a majority of lightning fatalities occur in farms and rural areas, this is because the economy in these places is highly reliant on agriculture which employs the majority of the workforce, leaving a lot of people vulnerable to lightning. This study attempted to find a link between the major economic activities and the rise in lightning fatalities in UKDM.

4.6 Chapter Summary

This chapter consisted of detailed background information on the study area. It provided amongst other things the physical location of the study area in relation to the world, the demographic information such as the total population of the district as well as information on the climate and the socio-economic status of the district all of which played a significant role in this study. The next chapter is the methodology chapter, covering all the steps that were followed to gather the necessary data to complete this study.

CHAPTER 5: METHODOLOGY

5.1 Introduction

This chapter discusses the research paradigm, the research design, population, and sampling as well as the data collection techniques. Also discussed are the data analysis procedures and the ethical considerations underpinning this research.

5.2 Research paradigm

A research paradigm is described as a way of viewing the world and a framework from which to understand the human experience (Kuhn, 1962). There are several research paradigms such as postmodernism, positivism, and critical paradigm. This study employed the interpretive paradigm. Interpretivism rejects the notion that a single, verifiable reality exists independent of our senses (Grix, 20004, p.82). Research in this paradigm is grounded on the assumption that reality is a subjective phenomenon that is individually constructed (Guba & Lincoln, 1994; Scotland, 2012). According to Flick (2004), perception is seen not as a passive-receptive process of representation but as an active constructive process of production. In this study, the researcher argues that the communities in which lightning strikes and fatalities occurred the most are where sufficient information on the topic of the study can be gathered. The researcher further argues that these communities are best suited to provide insight on the perceptions based on their lived experiences.

The researcher based these arguments on the fact that interpretive methodology requires that social phenomena be understood through the eyes of the participants rather than the researchers (Cohen et al, 2007). Therefore, the researcher saw that there was a greater chance of gathering the best and relevant information from participants that have had experiences with lightning incidents to be able to answer the questions posed in this study. According to Rehman et al, (2016), interpretive researchers utilize methods that generate qualitative data. Although numerical data will be used, it only supports qualitative data. Rehman et al, (2016) list some of the data collection techniques often used that yield qualitative data, including open-ended interviews with varying degrees of structure, observations, field notes, and documents to name but a few. Some of these methods were used in this study and this is explained later in the chapter.

5.3 Research design

This study followed a qualitative research design. The researcher chose this design as it is aligned with the research paradigm adopted in the study. Qualitative research design is primarily exploratory research; it is used to gain an understanding of the underlying reasons, opinions, and motivations (Nieuwenhuis 2007). In addition, qualitative research is admired for its ability to construct data and provide new information. This is because data is obtained directly from primary sources. This design is also effective in collecting information on the meanings people attach to their lives and lived experiences, making it a very suitable choice when investigating people's perceptions.

5.4 Qualitative research methods

According to Hammarberg et al, (2016) quantitative research methods are popularly used in cases where factual data are required to answer the research question, these methods are also used to get information based on opinions, attitudes, views, beliefs, or preferences. Qualitative methods are also usually used to answer questions about experience, meaning, and perspective, most often from the standpoint of the participant. It gives a researcher the ability to obtain data that cannot otherwise be obtained through counting or measuring. The following examples are part of the various methods used to collect data in qualitative research; small-group discussions, interviews, analysis of texts and documents, case studies, and observations. In this study, two of these methods were used. These were semi-structured interviews with municipal officials as well as observations by the researcher to see what methods or ways people use to protect themselves from lightning. In addition, questionnaires were used to gather more information from community members.

5.5 Sampling technique

According to De Vos et al, (2005) a sample is a subset of measurements drawn from the population in which the study is interested. Various sampling techniques were used in this study for different reasons. The first sampling method was used to identify where in the whole district of uMkhanyakude the data was going to be collected.

The uMkhanyakude District Municipality is made up of 5 local municipalities but in all five it is the Jozini local municipality that has frequent media reports involving incidents of lightning occurrences. Therefore, purposive sampling and convenience sampling techniques were used in this regard. The researcher wanted to understand the

people's perceptions in a manner that would not only be true to them but also to be a true reflection of what rest of population was experiencing and dealing with lightning. The researcher visited various rural communities in Jozini through which the data regarding the study was obtained. Table 5.1 below further illustrates the sampling techniques that were used:

Name/Designation	Number	Reason for selection
Community members	40	They are located in the rural areas of Jozini which has the highest number of cases of deaths by lightning.
Municipal officials and Cooperative Governance and Traditional Affairs (COGTA) officials	2	To gather information on what or how the matter of increased fatalities by lightning in the district is being dealt with and what measures have been put in place to protect the community from more harm brought by lightning.
Total sample	42	All together the researcher interviewed 42 respondents.

Table 2: Summary of sample

5.6 Data collection techniques

According to Elmusharaf (2012), data collection techniques allow us to systematically collect information about objects under study and the setting in which they occur. The object under study was the uMkhanyakude district community whose perceptions regarding lightning were being investigated. For this study, the researcher used the following qualitative data collection methods.

5.5.1 Structured interviews

Semi-structured interviews involve a series of open-ended questions based on the topic areas the researcher wants to cover. The advantage that semi-structured interviews provide includes the ability for the researcher to probe the interviewee to go into detail on information that the researcher finds to be unique and valuable. The researcher can even go as far as asking new questions that were not originally part of the questions prepared. It also provides opportunities for both the interviewer and interviewee to discuss some topics in more detail (Mathers et al, 2002). In this study, semi-structured interviews were used with municipal officials in connection with objective 5 of the study.

5.5.2 Observations

Observations are used in social sciences as a method for collecting data about people, processes, and cultures (Kawulich, 2012). Observations assist in enabling the researcher to gather information visually by studying people's behavior and how they interact with the setting and identifying how things are organized and prioritized in that setting. Another objective of observations is to learn what is important to the people in the social setting under study (Schensul, Schensul, & LeCompte, 1999). In this study, observations were brought in to be used in connection with the 4th objective of the study where the researcher aimed to discover how community members in UKDM protected themselves from lightning.

5.5.3 Questionnaires

More information particularly that was based on the 2nd and 3rd objectives of the study was collected using questionnaires. Questionnaires are made up of a series of questions used to find useful information about the topic, they are a vital instrument through which statements can be made about specific groups, people, or the entire population. In this particular study, questionnaires were used with the community members in UKDM to gather data that addressed objectives 2, 3, 4, and 5 of the study. These questionnaires were structured into sections. The first section required demographic information which gave the researcher more background information about the person. The second section looked at the perceptions that the respondents have towards lightning. The questionnaires had a third section looking at the socio-economic impacts that respondents feel are caused by lightning. The last section focuses on the responses through which community members try to cope with lightning.

5.6 Data analyses

The data collected in this study were analyzed using a thematic approach (Figure 5.2). Braun et al, (2012) state that thematic analysis is a method for systematically identifying, organizing, and offering insight into, patterns of meaning (themes) across a database. This form of analysis allows the researcher to see and make sense of collective or shared meanings and experiences. Regarding step 1, the researcher gathered up all the information collected and started reading and familiarizing him/herself with the responses. In step 2 the researcher then went back to the key questions/objectives of the study and while reading through the data, started finding

possible answers to those questions. The 3rd step involved creating themes from the answers provided by the different respondents, the themes were created by grouping similar responses together. As the 4th step, the researcher identified patterns in the information and made connections. In the 5th step, the researcher then analyzed the data and interpreted it using various illustrations, and lastly, in step 6 the findings were explained in more detail.

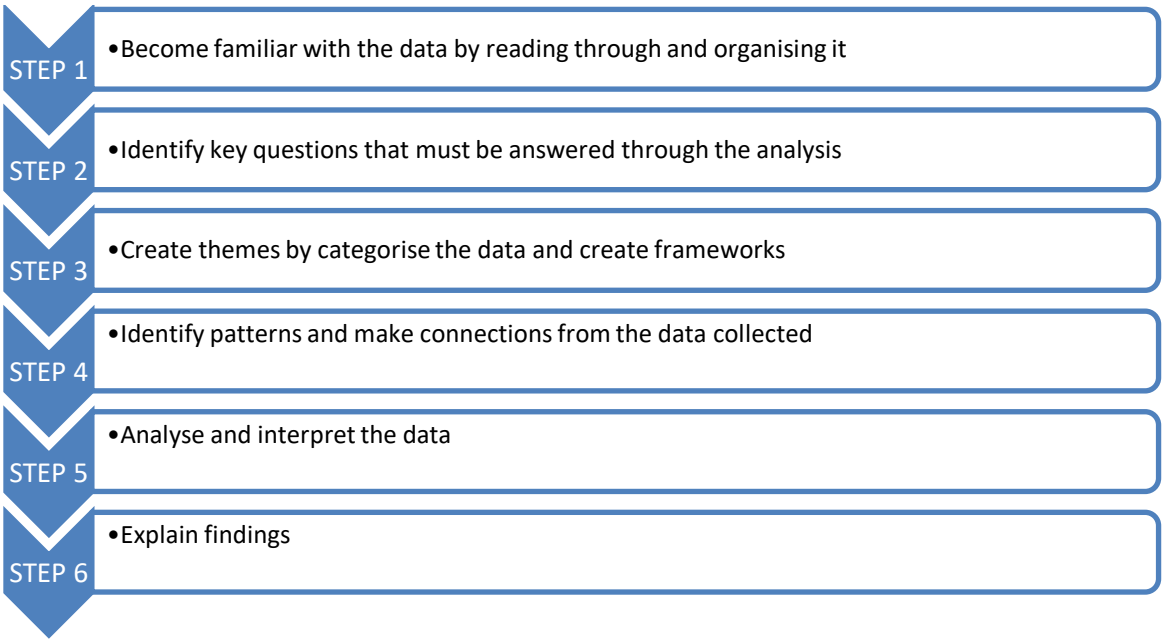

Figure 7: Thematic data analysis

In addition, Figure 5.3 below summarizes the whole methodological steps followed in this study.

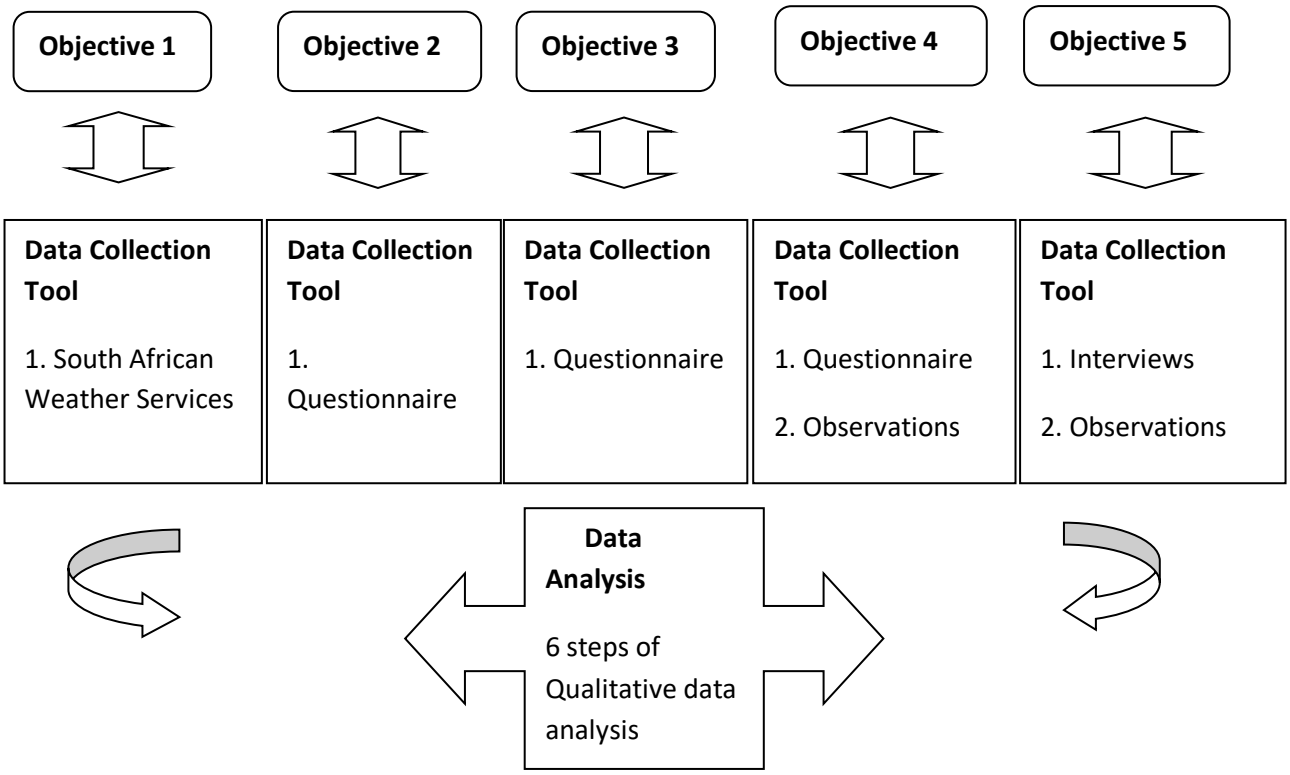

Figure 8: Diagram summarizing the methodology of the study

Furthermore, Table 3 below is the Goal Achievement Matrix (GAM), which illustrates the link between research objectives, sampling, data collection methods, analysis, data presentation, and research outcomes.

Research objectives	Data collection methods	Sampling	Analysis and data presentation	Outcomes
1. Map the fatal lightning strike hot spots in the study area.	• Questionnaires/secondary data sources (articles)	Convenience sampling	• Qualitative data analysis- Thematic analysis and Arc maps.	• Mapping of the fatal lightning hotspots in UKDM.
2. Assess the socio-economic and cultural impacts of lightning strikes in the uMkhanyakude District Municipality.	• Questionnaires	• Convenience sampling	• Qualitative data analysis- Thematic analysis and Microsoft Excel. Presented in graphs and frequency charts.	• Insight on various socio-economic and cultural impacts of lightning from first-hand experiences.
3. Explore the perceptions of the community in uMkhanyakude District Municipality towards lightning strikes.	• Questionnaires	• Convenience sampling	• Qualitative data analysis- Thematic analysis and Microsoft Excel. Presented in graphs and frequency charts.	• Obtained detailed knowledge on the perceptions held by communities in UKDM on lightning and its fatalities.
4. Analyse the community response to the lightning strikes in the study area.	• Questionnaires and non-participant observations	• Convenience sampling	• Qualitative data analysis- Thematic analysis and Microsoft Excel. Presented in graphs and frequency charts.	• Heard about the many methods community members use to protect themselves from lightning and also observed some of the methods live.
5. Evaluate the response of the government towards the fatal lightning strikes in the uMkhanyakude District Municipality.	• Semi-structured interviews. • Questionnaires	• Purposive sampling	• Qualitative data analysis- Thematic analysis and Microsoft Excel. Presented in graphs and frequency charts.	• Received information on what the government says it does for communities in UKDM to ensure they are safe from lightning. • Received information on what people saw and knew about in terms of assistance from the government regarding the communities' safety against lightning and lightning fatalities.

Table 3: The Goal Achievement Matrix (GAM) Source: (Researcher's compilation, 2021)

5.7 Chapter summary

Chapter five elaborated on the methods used to gather the data that answered the questions posed by this study. This chapter amongst other things focused on the sample, the data collection techniques as well as the methods used to analyse the data after it was collected.

CHAPTER 6: DATA ANALYSIS

6.1 Introduction

This chapter is an analysis of the results of the study, commencing with a description of, the demographic characteristics of the respondents. The chapter then later discusses the results of the study sequentially based on the objectives of the study.

6.2 Demographic characteristics

In this study, there were more females (60%) than males (40%) (Figure 6.1).

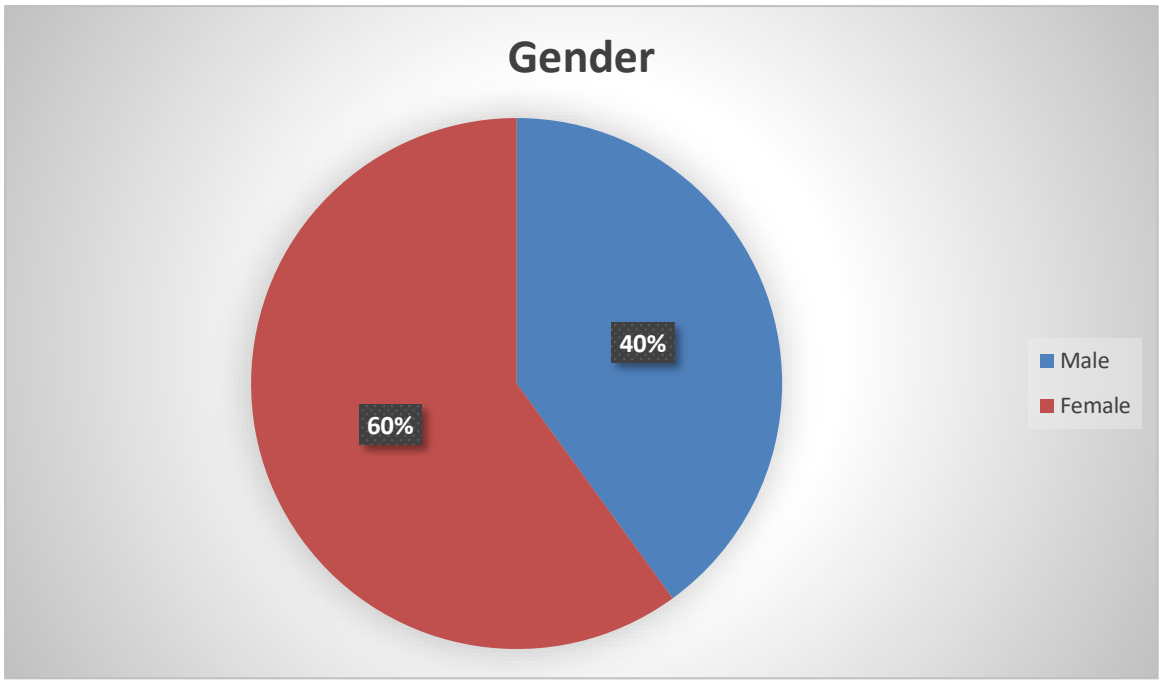

Figure 9: Gender characteristics

In terms of age, findings show that the majority of the respondents fell between the ages of 46-59 (Figure 6.2).

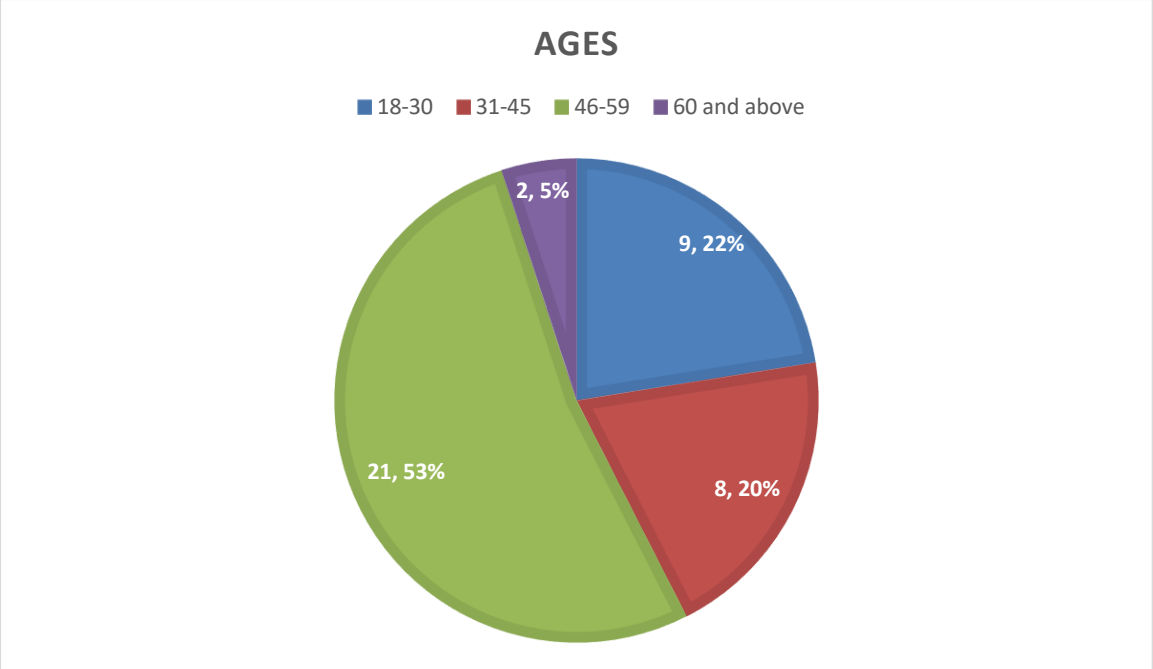

Figure 10: Age

The education characteristics of the respondents show that most (39.5%) had received primary school level education as well as secondary school level. The results also show that only 18.5% went to college and university, while there were even fewer respondents who specified that they had no schooling. Figure 6.3 below demonstrates this.

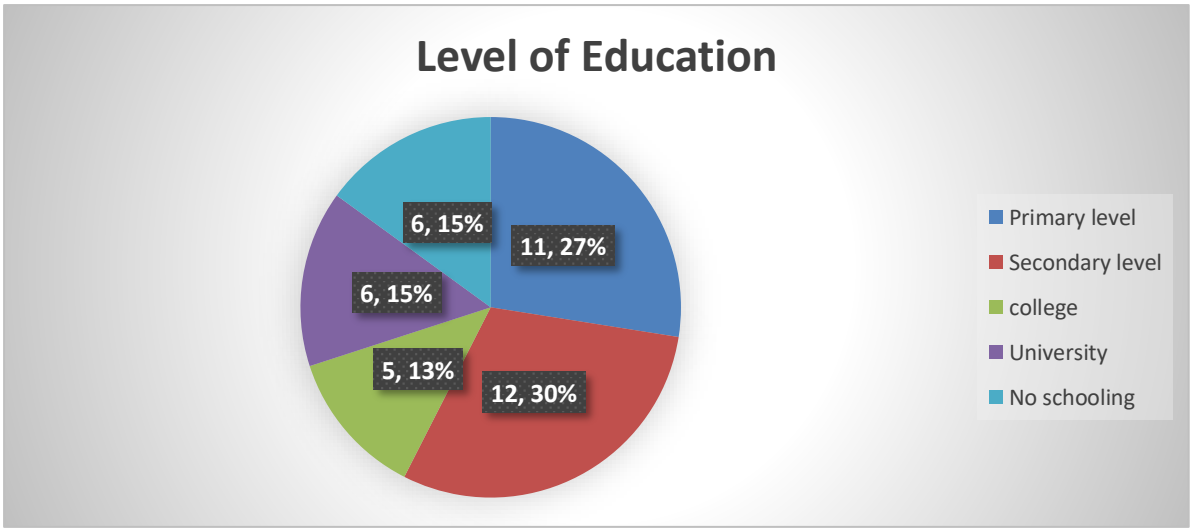

Figure 11: Levels of education

Concerning sources of income, the results depict that many of the respondents received a social grant as a means of income. Others stated that their income came

from their businesses (in farming). Farming was a popular economic activity in UKDM including livestock and vegetable farming.

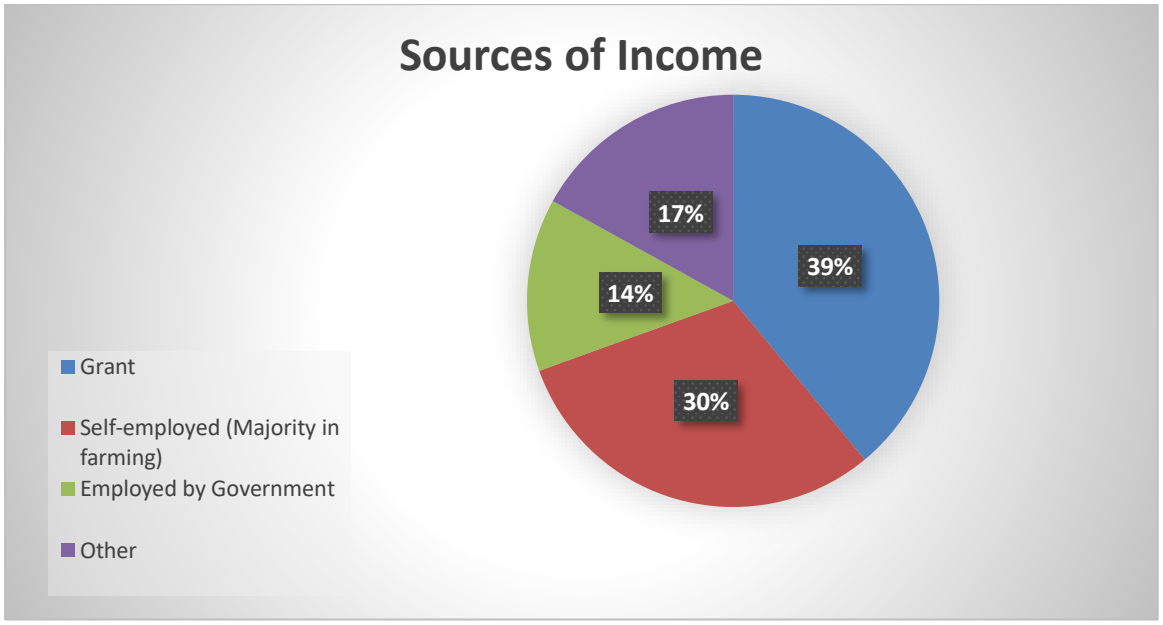

Figure 12: Sources of income

There was also a significant number of respondents who stated that they had 'other' sources of income and these included student loans among others. The specific levels of income also varied. According to the findings, most of the respondents' monthly income was less than R5000 (Figure 6.5). This generally suggests that the respondents were rural residents with limited income-generating activities.

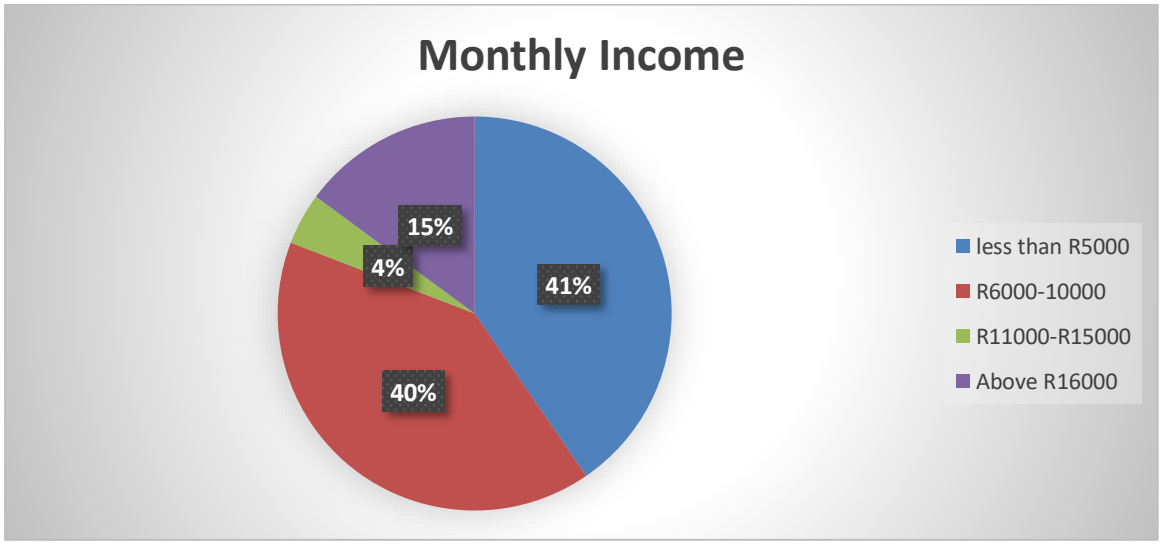

Figure 13: Monthly income

6.3 The lightning hotspots in the uMkhanyakude District Municipality

The first objective of the study was to map the fatal lightning strike hot spots in the study area. Using the information from respondents it was established that the majority of fatalities occurred mostly in the rural areas of Jozini and Mtubatuba (Figure 6.6).

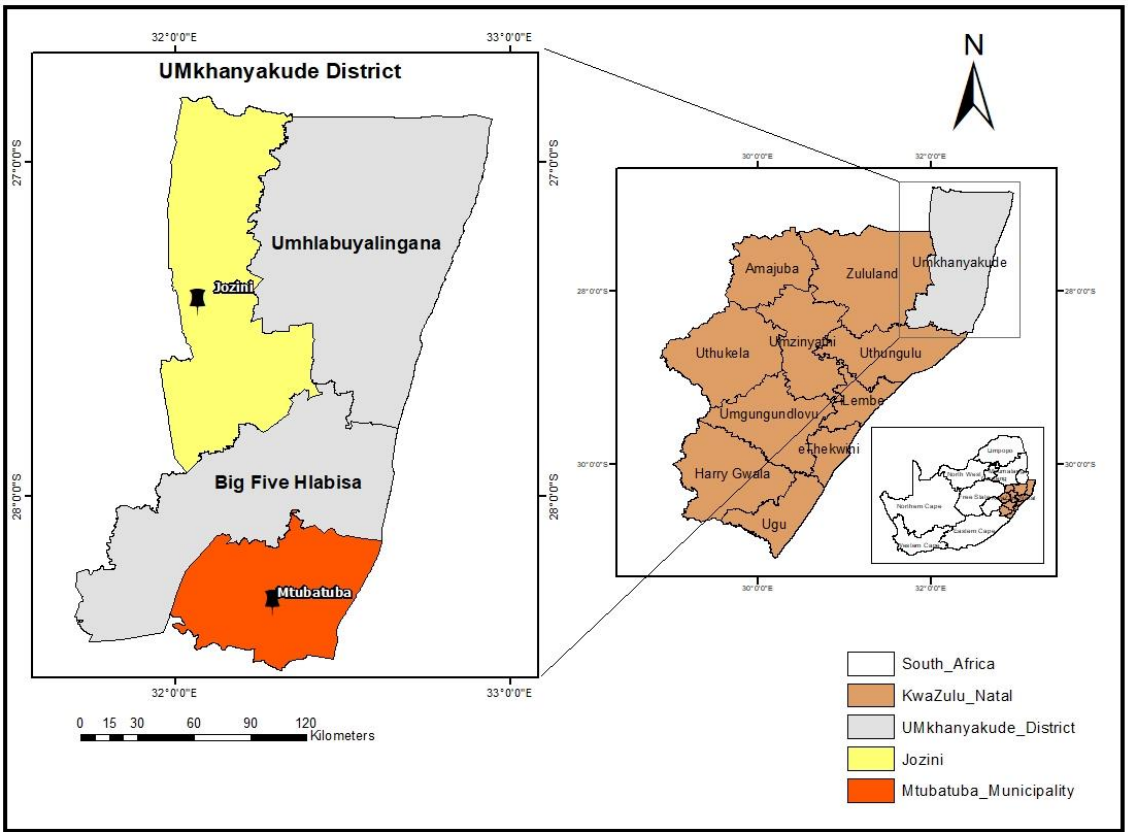

Figure 14: Location of most lightning fatalities in UKDM

Communities such as Emakhoneni, Elangeni, and Emabhanoyini in Jozini and Cinci and Nqopheni in Mtubatuba were notorious for deaths caused by lightning (Interview with community members, September 2021). According to the respondents more than 8 deaths have occurred at Emakhoneni in Jozini and over 5 occurred in Mtubatuba in the past 5 years. Many of the victims are said to have been young and happened to be outdoors during a lightning storm with no safe shelter. This resonates with a report by Kubheka (2019) who highlighted that the young population was at higher risk of being struck by lightning in the study area because they enjoyed outdoor activities such as sports. For instance, 4 young people aged between 16-20 years from Mkhuze

in UKDM and 2 others in Jozini died after being struck by lightning while playing outdoors. This was similar to the case of the USA in which some of the dead victims were golfers who were outdoors playing and got struck (Holle, 2008). There have been many other incidents reported having taken place in soccer fields where young boys are often found playing soccer (see e.g. Harrison 2021).

In addition to this, people who died of lightning strikes were working in the fields/farming. As indicated in Figure 6.4 farming is a significant activity in the study area and many of the fatalities in UKDM take place outdoors which puts farmworkers at an even greater risk of being struck by lightning. This corroborates a study by Illiyas et al, (2014) who also established that in India because most of the dwellings are in rural areas and the majority of the population works in the agricultural sector, most of the lightning fatalities that occur there are reported in farms.

The findings of the lightning hotspots in this study area are not surprising because as a whole UKDM is located over the highveld of South Africa This makes such an area to be vulnerable to the high and frequent thunderstorms occurring over the highveld and the eastern escarpment in KwaZulu-Natal (Gijben, 2012). This is reinforced in a study by Moyo and Xulu (2021), which also established that the north-eastern parts of South Africa including the uMkhanyakude District municipality in the province of Kwa-Zulu Natal form part of the most vulnerable regions in the country, with severe to extreme lightning risk. The vulnerability of UKDM was also confirmed by the South Africa Weather Services (SAWs), which have shown that the eastern escarpment records on average between 10 and 15 lightning flashes/km^2/year with fatal consequences. However, an important point to emphasize is that it is mostly the rural areas that are affected the most while urban areas are relatively spared. This suggests that although the whole UKDM is exposed to lightning, rural areas do not have or have limited infrastructure to protect against lightning. This speaks to the need for government and other stakeholders to assist and develop rural communities by various means. Assistance such as educating rural communities about lightning, improving housing so they have safe shelters, providing basic services such as water and electricity, and alternative sources of income in cases where they can not work during lightning storms would reduce the stress and effects of lightning in communities. The government can also assist by providing these communities with equipment to help protect them from lightning such as lightning rods.

6.4 Socio-economic and cultural impacts of lightning in UKDM

As per the second objective of the study, this study also focused on the socio-economic and cultural impacts of lightning in the study area. Several issues were brought forward by the respondents connected to the social and economic and cultural impacts in the study area. Many (66%) of the respondents stated that damages and loss of property were the main problems caused by lightning. This included damages to equipment such as cellphones, televisions, radios, refrigerators, and many other items which were found not functioning after lightning activities. Hence one respondent stated that 'the lightning keeps interfering with the electricity, and leaves many devices burnt' (Repondent 1 at Elangeni, September 2021). Other damages included property, like houses. In two of the cases, houses caught fire after being struck by lightning (Interview with a community member at Emakhoneni, September 2021). There were more other people, however, who stated that their houses were struck but few items got burnt such as curtains and the rest of the houses were unharmed.

Slightly more than half (53%) of the respondents also shared that lightning often interfered with their work/jobs. Many of the self-employed respondents work on farms planting and selling vegetables. During lightning storms, they do not go to work in fear of being struck while working. Even businesses suffer sometimes, especially when there are electrical problems caused by lightning meaning that business cannot continue as it normally would (Respondent 2 at Emakhoneni, September 2021). This resonates with the findings by Cooper and Holle (2019) who found that electrical interruptions because of lightning in many developing countries result in a lot of businesses, small and large, preferring to deal with goods that do not need preservation by refrigeration, communication deficits and often data loss. Most of the farmers in UKDM expressed that lightning also caused them economic losses as it was responsible for the deaths of their cattle. The researcher observed that most of the respondents in the study area owned and considered cows and/or goats as their wealth. The majority of the respondents did indicate that they sell their cattle for capital gain. Thus when these are injured or killed by lightning, it strains their economic wellbeing (Respondent 2 at Emakhoneni, September 2021). Again, this confirms a study by Moyo and Xulu (2021) who established that in the study area, farming and domesticating livestock are significant activities. The authors noted that the livelihoods of a majority of the people depended on agriculture in the form of crop and livestock

farming. This meant that it was not an option for the communities in the study areas not to engage in these farming activities and yet this exposed them to lightning strikes, some of which were fatal. To this extent, the observation by Elsom and Webb (2017) that the type of activity being undertaken plays an important role in exposing people to lightning strikes is true. This could shed more light as to why a majority of children, men, and some women died from lightning strikes in the study area. This, as the children were either playing outdoors at their homes or walking to rural schools/playing on school grounds during lunch breaks. In addition, many men and some women died from lightning strikes as they were either working in the farm/fields or travelling to and from these economic activities.

The major social impact was sadness and sorrow in the communities. Lightning is responsible for many deaths in the study area and so from time to time, the community members are faced with a situation where they must grieve the loss of a loved one which can cause sorrow, fear, and restlessness. Many of the respondents indicated that they had so much fear for lightning because anyone could be the next. One other social issue which resulted from lightning in UKDM as stated by many responders was the increase in tension and conflicts in the communities. As many people in the study area believe lightning deaths to be a taboo or an act caused by witchcraft, they consult traditional doctors. These traditional doctors, do not use scientific evidence and they supposedly go as far as telling the person consulting, the name of the person responsible for the witchcraft. This leads to hatred and conflicts between the people and even within families. Hence, one community member stated that;

Lightning has struck more than twice here in our home but luckily in all instances, no one was hurt because we too have our way to protect ourselves. But it did burn the rondavel roof and a TV stopped working after one of the incidents. When we consulted the inyanga (traditional doctor) we were told that it was a close neighbor of ours. We didn't confront them but now we know who is after us and we are just watching them, one day God will answer for us. (Respondent 3 at Elangeni, September 2021).

According to Trengove and Jandrell (2015), the belief that witches can control lightning is widespread in Africa. Many people across the continent indeed believe that witches can send lightning to kill people, livestock and destroy property. Trengove and

Jandrell (2015) further state that many people strongly believe that the only form of protection from lightning sent by witches involves using traditional medicine (*umuthi*).

Another social issue that was said to be rife in the study area due to lightning, was that it disturbed the daily routines of many community members. School children often have to stay at home and skip school when there is bad lightning and rain outside. This also affects the parents who must find babysitters or they also can't go on with their daily businesses. Many of the respondents also said that they work in the farms/plantations for a living which they are forced to stay away from during lightning storms. Lightning has also left many children orphaned and dependent on extended family members. The social impacts of lightning as discussed in this section are shown in Figure 6.7.

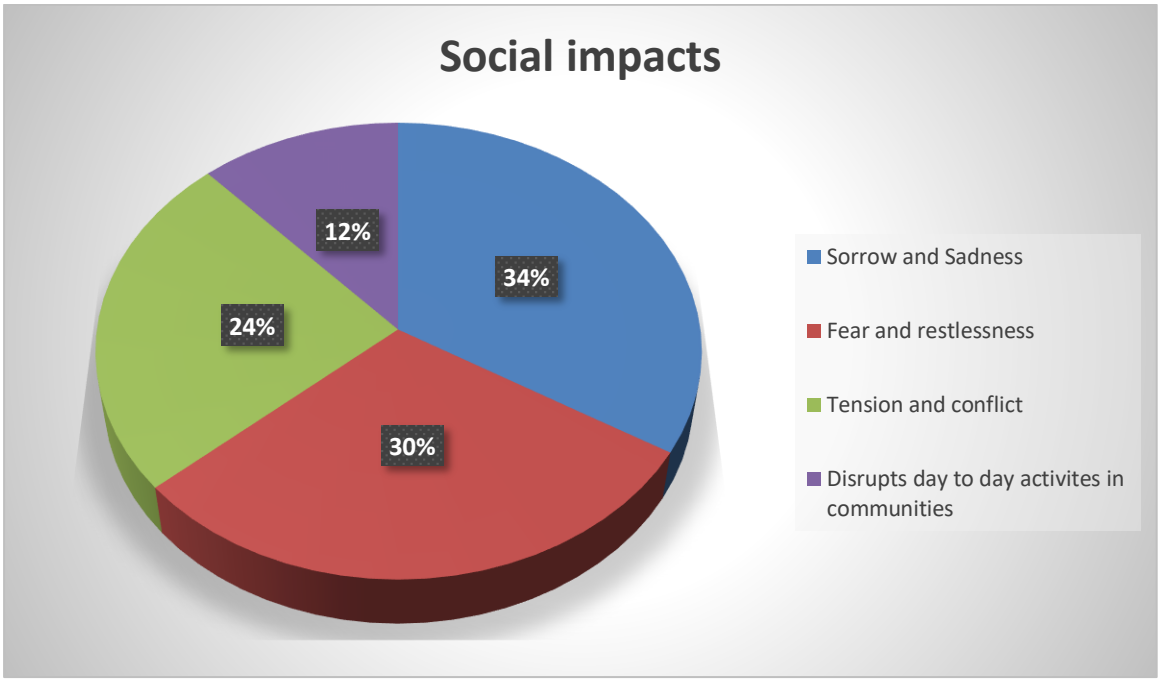

Figure 15: The social impacts of lightning

In terms of cultural impacts, the majority (67%) of the respondents stated that it led to the reinforcement of their culture or tradition to some extent. This means those individuals who knew of traditional methods but did not use them are now going back and using these methods due to the fear brought by the increasing fatalities. Many respondents indicated that they have gone to traditional doctors seeking help to prevent lightning deaths. Even the people that did not necessarily believe or engage in such activities have now joined, because of the danger they feel is posed by

lightning in their lives. This is suggested by the view of one community member who stated that "the way people are dying scares me, so I have to do whatever it takes to protect myself and my family even if I don't believe in it, but if people say it helps I go for it, better safe than sorry" (Repondent 4 at Emabhanoyini, September 202*).*

Many of the respondents stated that after consulting the traditional doctors then a process called *ukuqinisa umuzi* followed (this is when the traditional doctor came to a home and performed a ritual using traditional medicine to make the home strong and not susceptible to lightning or any other dangers that could occur). Others in the community who had previously not believed that these traditional methods played a part in protecting them and their families from lightning had new opinions about the matter. If all this is understood through the lens of the Disaster Management Theory (DMT) particularly on the proposition by the DMT that disasters must be managed and minimized and if possible eradicated, it becomes evident that there is the need for active methods to eradicate or reduce risk from lightning strikes in the study area.

The high frequency of lightning in UKDM puts the communities at risk of death and or destruction of property as explained in the preceding sections. Therefore these findings amplify the 4 stages of the DMT on risk and how it can be eradicated. Being prepared for the risk ensures that the economic, social, and cultural impacts that are caused by lightning could be lessened. Preparation also entails finding responses/ ways or methods to deal with the lightning threats, and their impacts, as discussed in Section 6.6. Recovery is also pivotal in this cycle as well as prevention where community members ensured that through various strategies, the impacts discussed in the previous sections would not occur or have minor consequences.

6.5 Peoples' perceptions towards lightning and its fatalities.

Understanding the views and opinions that communities have about lightning and the fatalities that are resulting from lightning was a crucial part of this study because the researcher believed that, perceptions influence the reaction. According to the findings, various respondents (70%) believed that lightning fatalities resulted from witchcraft. The researcher was able to observe that it was primarily the adult population from 35 years and above that believed in this theory. The researcher was also able to note that 50% of the respondents who believed in this only had primary to secondary school level of education or no education at all. Many respondents stated that they believed

this to be true because it is the information they got from their parents and it was a common belief in their communities.

Trengove (2012) wrote about some of the myths that were associated with lightning and lightning fatalities and found that it is common for people to perceive lightning as a phenomenon caused by witchcraft, these perceptions are usually influenced by various things. One such thing is the rural settings of the communities. Rural areas are often disadvantaged when it comes to information, scientific knowledge dissemination in rural areas has always been much more poor compared to other settings. Many people in rural areas depend on informal means to access information. Much of the knowledge and practices that the respondents partook in, had been learned from their parents who also learned from their parents which then created a culture which many depended on and forms the basis of their judgement. There are, however, fewer (30%) respondents that did not believe in witchcraft, their viewpoint on the matter was that it is all part of nature and the causes of the deaths are caused by risky human activities and lack of knowledge on how to react or respond to lightning to be safe. They believed that if people acted safely during lightning storms then the fatalities would be fewer. Many of the respondents who believed this were young (18-30 years) and had higher education (college/universities) backgrounds.

These findings, therefore, suggest that the perceptions of lightning and its impacts can be influenced by the level of education and/or exposure to information. This is to say that, the study shows a strong correlation between the community who had primary and secondary levels of education or no education at all and a belief that lightning was caused by witchcraft. However, those who had attained higher levels of education had different views in that they understood that lightning is a natural phenomenon and those lightning deaths occurred because the victims were at risk due to various reasons but the most common reason being that they were outdoors during the incidents which increased their chances of being struck.

The different perceptions towards lightning in which the majority of people believed that it is caused by witchcraft show that there is an information gap. This means that people who are not educated do not know much about the causes of lightning and its impacts. This gap provides an opportunity for the government to develop programmes and strategies to assist the communities based on these findings. Government should

ensure that whatever initiatives they propose are linked to the known shortcomings of the community, which is the lack of accurate information in this case. Therefore, as a strategy, the government can start awareness campaigns to educate people about the causes, dangers posed by, and protection measures for lightning. Such a strategy was seen to be beneficial in the United States of America, which had staggeringly high numbers of deaths by lightning. According to Holle (2008) as a result of proper knowledge dissemination and warning systems, people in the USA now know when a storm is approaching and are also well educated in terms of properly managing those situations.

6.6 Methods used by communities to protect themselves from lightning

For this objective of the study, and in addition to using a questionnaire to obtain the various methods that community members in the study area used to protect themselves, the researcher also conducted observations to find out where these methods were applied. Approximately all of the respondents were familiar with the method of putting tyres on the roof to protect themselves from lightning, almost all houses around the areas where the researcher observed had a car tyre on their rooftop. Figure 6.8 below demonstrate these facts:

Figure 16: Tyre on the roof to protect from lightning (Source fieldwork, September 2021)

Figure 17: Tyre on the roof to self-protect from lightning. (Source fieldwork, September 2021)

According to the respondents, the tyres are just as effective on the rooftop as in cars. Many of the surveyed people stated that cars never get struck by lightning and it is all because of the tyres' ability to deflect lightning strikes. Trengove et al, (2015) also found that many South Africans believe that an old car tire on the roof of your house will protect it against lightning. The tire method is so popular in UKDM so much so that tyres are now commercialized to cater to the growing demand of people needing tyres (Figure 6.10).

Figure 18: Sale of tyres. (Source fieldwork, September 2021)

Many of the community members believe in traditional methods as a means to protect themselves, not just from lightning but from various other dangers that they might feel vulnerable to. During the observations, the researcher also witnessed this. In many of the homes visited many of the people said they also followed the process of *ukuchela*. One of the respondents, a traditional doctor explained this process as, taking several natural herbs and medicines mixed with “a special ingredient”, and sprinkling the mixture around the home with a whip made out of cows tails (*ishoba*) (Respondent 4, October 2021). Also, many respondents planted certain trees in their homes as they believed that the trees had the powers to shield their homes from lightning. One such tree was found in a lot of the homes and they called it the *uMvungutha*. According to the respondents, the presence of this tree in a homestead reduced the chances of that home being struck by lightning. Figure 6.11 below is a picture showing the *uMvungutha* tree.

Figure 19: uMvungatha tree believed to protect homes from lightning. (Source fieldwork, September 2021)

Other trees popular in the area and whose existence in many homes in UKDM was in response or attempts to protect against lightning was *uMganu* formally *called a Marula tree (Figure 6.12 below)* which was linked to a process called *ukuphahla* (a small ritual to communicate with a persons ancestors) whereby a person could, with the help of traditional methods manipulate lightning to focus on this tree if the lightning has been sent to cause harm in his home and kill people. Thus, the damages will be to the tree instead, this re-enforces the perception of lightning as a thing caused or resulting from witchcraft (Respondent 6 at Elangeni, Jozini, September 2021).

Figure 20: Showing an uMgano a tree used to protect homes from lightning. (Source fieldwork, September 2021)

According to Trengove et al, (2015), some of these misconceptions can increase the risks or perpetuate the fatalities by lightning. For example, the belief that certain trees can protect people from lightning whereas trees are often the victims of lightning themselves and can have fatal consequences. Other methods included having *izikhonkwana, ukubethela (crucifixion),* using *intelezi (A charm), uMphamepuce (which translates to give and take),* and *uMthathe* (meaning to take) which are all traditional medicines prepared with herbs and animal oils. They were also part of the strategies that were popular as lightning protectors in the study area. Interestingly the

researcher was also able to observe another method that was supposedly also very effective when dealing with lightning. The figures below (Figure 6.13 and Figure 6.14) show rocks identified to the researcher as *izithende zezulu* (simple translation of this means, the heels of lightning) which were being sold to people for the minimum amount of R20. The rocks are placed in yards around peoples' houses and when lightning strikes the rock redirects the strike away from the area where the rocks are.

Figure 21: Izithende zezulu(lightning rock) (Source fieldwork, September 2021)

Figure 22: Izithende zezulu (lightning rocks) believed to deflect lightning. (Source fieldwork, September 2021)

According to the salesmen who spoke to the researcher, the rocks appear in areas where there have been recent lightning activities, which gives it the properties to deflect lightning. There were, however, respondents (30%) that did not follow this traditional route when it came to protecting themselves from lightning. The other (30%) of the respondents from the various rural communities that the researcher visited indicated that they ensured their safety by switching off all electrical appliances which they believed attracted lightning. They also stated that the presence of mirrors also makes people more susceptible to lightning, so they covered the mirrors during lightning storms. Silverware and cutlery were also covered as they too had some reflective mechanism making them just as dangerous as mirrors, according to these respondents. Other respondents were also aware of lightning rods but complained that they are too expensive. They did indicate, however, that there are some communities in UKDM that had already been assisted with the installation of the lightning rods by the municipalities and they too were keen on having this happen in their communities. The protection motivation theory is essentially based on people's decision-making and coping skills in times of harmful or stressful events in their lives (Clubb et al, 2015). According to this theory, two factors contribute to or influence people's decisions to engage or disengage in safety precautionary measures and these are; the threat appraisal and the coping appraisal (Clubb et al, 2015). In this study, the researcher was able to understand some of the individual motives that people had when protecting themselves from lightning as well as what influenced their choices of the methods that they used to protect themselves. This is because the people have identified or are awakened to the possible threat that is caused by lightning. In the view of the PMT, there must be a perception of vulnerability in which a person thinks that they are most likely to be a victim of a certain disaster, such that the feeling of vulnerability will lead to the individual being afraid. It is because of this fear that communities then react by finding ways to ensure that they are less susceptible. If the coping strategies are correct and not guided by false information then communities do indeed have a better chance to cope with the disaster.

If the coping strategies or methods used by people in UKDM are viewed through the Protection Motivation Theory (PMT), it becomes clear that coping appraisal and threat appraisal played an important role. This is because this study's finding portrays that these two cognitive processes (threat and coping appraisal) were present and guided

the decision-making processes of the community members. The community members had realised the threat created by lightning strikes in their lives and were motivated to then act towards it as suggested by the PMT and illustrated in the findings of this research explained in this section.

6.7 Government and municipal responses to lightning fatalities in UKDM

The final objective of this study looked at what the government and the municipalities were doing in response to the lightning threats which continue to claim the lives of people in UKDM. To avoid being biased the information based on this objective was gathered from both parties involved, the people and the municipality. Using the questionnaires the researcher asked the respondents of any means that the government was using to help people in the communities in efforts to protect them from lightning. The majority of the people said they had not received any help from the municipalities regarding protective gear. Many indicated that the government or municipal officials only help when the damage is already done. The respondents agreed on the government taking part in funeral preparations and visits to the families that are affected and they also do provide shelters in cases where homes were destroyed. Figure 6.15 below show the municipal responses as seen by the people/community members.

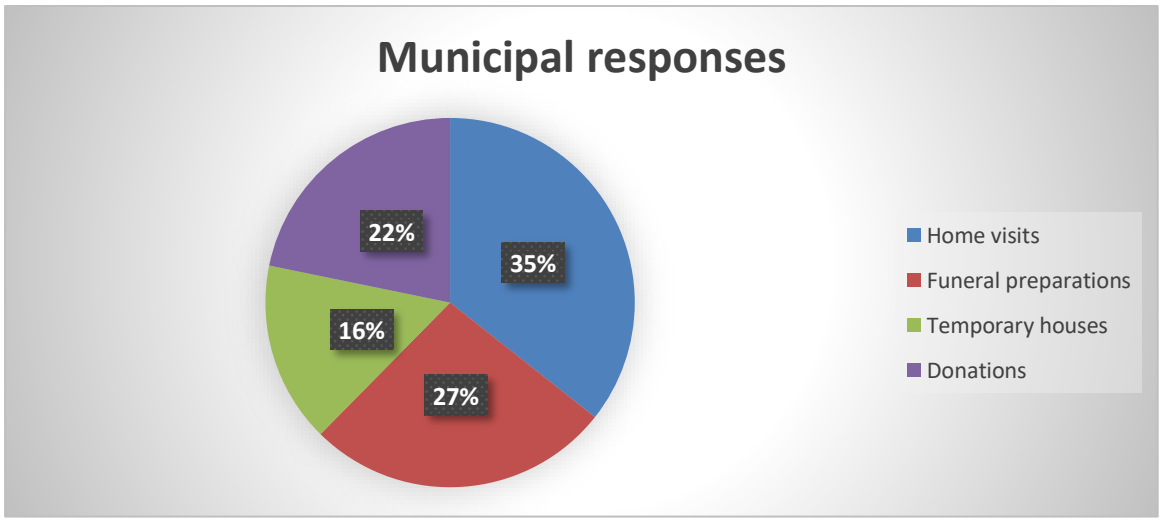

Figure 23: Municipal responses to lightning threats and fatalities in UKDM according to the people.

Some people did indicate that they had seen other areas in UKDM where lightning rods were being installed and stated that they would like the same to be done in their

parts. According to the municipality representative who was interviewed, they were aware of the surge in lightning fatalities in UKDM and as a result had recently begun to implement some initiatives to help and enable people to help themselves face this threat. Some of the initiatives that the municipal official claimed to have been or planned to be implemented were awareness campaigns. According to the municipal official, there were several campaigns that they had hosted. Hence, he stated that;

> Educating the communities about the dangers of lightning and in particular the methods to use when protecting themselves from lightning form the basis of these campaigns. Many people in our district have beliefs that contradict the scientific settings of lightning and as a result, their judgements are skewed (Respondent 7 , October 2021)

A similar approach was used in the USA and resulted in ensuring that fewer people were killed by lightning (Holle, 2008). In addition to the awareness campaigns, the official indicated that the municipality is also in the process of installing lightning protective gears around UKDM. Regarding the families that have already been affected the municipality helps them by giving monetary donations to cover the funerals. The municipality also provides shelter for the people whose homes get destroyed or damaged by lightning (Interview with a community member, September 2021). Some of these initiatives were indeed confirmed by several community members especially the donations and housing (Interview with a community member, September 2021). Some respondents also confirmed the initiative of installing lightning rods but also stated that this had not yet taken place in the areas they lived. (Respondent 8 , September 2021). This means that the communities where the lightning rods are yet to be installed remain vulnerable and still face higher chances of being struck by lightning.

When all of this is viewed through the DMT, the relevance of the disaster management cycle can be identified. The first cycle involves the prevention phase which includes actions taken to prevent, reduce the cause, impact, and consequences of disasters. According to the findings of this study, there are a few ways that community members used to ensure that the impacts of lightning were reduced or even prevented. One such strategy was planting trees that community members believe helped to redirect lightning strikes away from their homes. Community members were also aware of the more advanced methods used in other parts of the study area such as lightning rods

and expressed that they would also like to have the lightning rods which they can not install on their own as they are expensive. The second stage of the DMT entailed being prepared for disasters (preparedness). This stage in the cycle entails planning, training, and educational activities for events that cannot be mitigated. According to the findings of this study, community members did various things to ensure that they are prepared for lightning events that could threaten their lives. Activities such as installing car tyres on roofs, staying indoors when there was lightning, and even using traditional medicines were some of the methods that the communities used to stay safe. Stage 3 of the cycle is the response phase which comes into effect in the immediate aftermath of a disaster. In this stage, the focus is on how people react after having faced the repercussions of a disaster. In this study, the community members did indicate that government supports families who have been affected by lightning strikes by firstly funding the funerals expenses. Where property was destroyed such as people`s homes, then the government provided those people with accommodation. Lastly, there is the recovery phase which involves the restoration of whatever was damaged during the calamity. Many of the people in the study area had to rebuild or fix damages to their houses after being struck by lightning and the majority of the people had to repair damaged property like TVs, refrigerators and cellphones, etc. The government in UKDM is active in responses after lightning has struck and caused harm. This is because many of the respondents stated that the government does provide temporary shelter for families whose homes were destroyed by lightning and also support by meeting the funeral costs in cases where the lightning strikes are fatal. Concerning preventing the risk, the government has failed the communities in UKDM. This failure is evidenced by the fact that after the various deaths that have occurred from lightning in UKDM, the communities are still ill-equipped for lightning incidents. There are no evident measures that the government has taken to ensure the prevention of the fatalities, and little has been done to ensure preparedness for cases when lightning does strike. Even though the government states that it has plans and is implementing them, the researcher couldn't identify these measures in all the rural parts of UKDM where the study was conducted, and in addition, the people themselves stated that the government was of no aid regarding the matter. The best way the government can respond to such an issue is by preventing lightning fatalities in UKDM. This can be done by installing lightning rods in the rural communities as well as

educating the people about lightning and how to protect themselves from lightning strikes in particular.

6.8 Chapter summary

This chapter provided an in-depth analysis of the findings of the study following the objectives and also included evidence of some of the findings as witnessed by the researcher. The main findings in the data analysis are that rural communities are more susceptible to lightning fatalities than other settings. This is due to the lack of development and services such as providing rural communities with equipment to protect themselves from lightning. Secondly, the level of education and age played a crucial role in how lightning was perceived. Many of the young and educated respondents did not believe that lightning could be controlled or used for witchcraft. However, the older respondents who had only basic level education or none, strongly believed that lightning could be controlled and used for witchcraft in which case people could send lightning to strike a person or their property for whatever reason. As a result, these perceptions had a significant role in the choices or methods people used to prevent and/or protect themselves from lightning. According to the finding of the study, lightning causes lots of social, economic, and cultural problems. It has been the cause of many tensions and disputes in communities leaving many people in financial crises and has resulted in some cultural variations. The findings also show that the are many methods that people in rural areas use to protect themselves. Many of these methods, however, are traditional, and very few are scientific, ranging from placing tyres on rooftops to planting trees and using traditional medicines. The findings also show that rural communities are forsaken when it comes to safety assurance. The government is not strongly active when it comes to plans and actions to prevent and prepare for disasters such as lightning but is more involved where the damage has already been done. The next chapter concludes the whole study and proposes recommendations based on the study findings.

CHAPTER 7: CONCLUSIONS AND RECOMMENDATIONS

7.1 Introduction

The study aims to investigate the socio-economic impacts of and community perceptions towards lightning storms and lightning fatalities in the uMkhanyakude District Municipality. It is composed of seven chapters. Chapter 1 introduced the study by reviewing the main concepts of the study and looking at the aim, objectives, problem statement, and also the significance of the study. Chapter 2 provided the theoretical frameworks through which the study was viewed, while chapter 3 was the review of available literature regarding lightning and lightning fatalities. Chapter 4, dealt with the methodology used, and in this chapter, the researcher discussed how the data regarding this study was obtained. Chapter 5 provided a detailed account of the findings/results of the study and also provided an analysis and interpretation of the data. Chapter 6 provided a critical analysis and interpretation of the data according to the objectives of the study. In line with this analysis, the following themes which respond to the objectives of the study emerged.

7.2 Lightning hotspots in the uMkhanyakude District Municipality

Lightning occurs in every part of the world but the fatalities are severe in some areas while in others they are rarely heard of. UKDM is one of the areas with severe lightning strike occurrences and lightning fatalities, but even then some areas in the district are affected worse than others. Jozini and Mtubatuba were identified as the lightning fatality hotspots in this study. In particular, the rural areas such as Emakhoneni, Elangeni, and Emabhanoyini in Jozini were the most affected. This can be explained by that these communities are rural and have no scientific methods of protection against lightning. It can also be explained by the lack of scientific knowledge about lightning, most of the information the community members have is based on assumption and non-factual information.

7.3 Socio-economic and cultural impacts of lightning

The second objective of the study was to identify the social, economic, and cultural impacts of lightning and its fatalities. The major economic impact was that as a result of lightning, property and infrastructure were damaged, thus resulting in money lost through repairs as people had to rebuild and repair houses, which was an expensive process. Socially, lightning resulted in immense tension and conflicts in communities in the study area because many of the locals believed that witchcraft could also be

performed using lightning. Hence this led to many suspicions between community members, creating tension and conflict. In terms of the cultural impacts, lightning strikes had led to the reinforcement of some cultural practices. This is because, due to the increase in the number of fatalities by lightning combined with the various misconceptions around lightning (such as the witchcraft one), many of the community members who did not initially believe in traditional mechanisms as safety cautions, had started to rely more and more on the traditional methods to protect themselves from lightning.

7.4 People's perceptions towards lightning and its fatalities

Many people believed that lightning was caused by witchcraft and as a result relied on traditional methods of protection. They had no belief in scientific explanations of lightning and its impacts, this became evident in the methods they used to protect themselves from lightning.

7.5 Methods used by communities to protect themselves from lightning

The findings of this research show that most of the methods that are used are more traditional than scientific. The choice of the methods was influenced by the information that people had about lightning and in the case of many community members in Jozini the information was passed down from generation to generation and based on hearsay. Placing tyres on rooftops, covering mirrors, putting away cutlery, planting trees believed to deflect lightning, switching off cell phones and many other methods were identified to be the most commonly used in the study area.

7.6 Government and municipal responses to lightning fatalities in UKDM

According to the municipality, they are aware of the challenges imposed by lightning in the study area. This has led to the implementation of various strategies to help remedy the situation. These strategies include awareness campaigns especially in rural communities, installing more advanced equipment such as lightning rods, aiding victims of lightning with shelter while they find ways to get back on their feet. In cases where there was a fatality, the municipality assisted the bereaved people with funeral costs. The community members however indicated that the government was not so helpful when it came to precautionary measures and only provided assistance when it was already late and the damage was already done.

7.4 Recommendations

7.4.1 Recommendations to the community members

The analysis in Chapter 6 revealed that most community members in the study area depend on agriculture such as crop farming for livelihoods and yet this is dependent on rainfall which is accompanied by lightning. It is therefore recommended that;

a) Community members should diversify their economic activities by, for example, forming co-operatives through which they venture into tourism-based economic activities. This is relevant because the study area is a national and international tourism destination.
b) Establish safe shelters around the farms so that in case lightning occurs they can find safety close by.
c) Community members should research the causes of lightning and methods which can be implemented in response to it. This research can be coordinated by the traditional leaders during their traditional council meetings which are held at the beginning of every month in Mkhuze. They can invite community members and host professionals or scientists that can educate the community members about lightning and give them scientifically proven methods to protect themselves from lightning.

7.4.2 Recommendations to the local government

Based on the findings of the study, it is evident that the community in the study area faces several challenges related to lightning strikes. For these reasons, it is recommended that;

a) The government should educate rural communities about lightning, giving them factual information so that the misconceptions are minimized. They can do this through awareness campaigns or even infiltrate the national education systems and introduce learning about lightning in schools so that the younger generations have accurate information and their perceptions can be based on what's real.
b) The government must focus on measures to prevent and reduce the impacts of lightning rather than focusing on the aftermath. One way to do this is to introduce early warning systems that will alert people of changing weather

conditions that are conducive to lightning. In this way, people can find safe shelter before they are caught outdoors during a storm, leaving them vulnerable and at a higher risk.

7.5. Suggestions for further research

The study was delimited to a particular scope and therefore other elements encountered during the study fell outside of the study's intended investigation. For these reasons, the following are suggested as the possible areas for future research;

1. Assessing the contribution of municipalities and other stakeholders in providing services that ensure the safety of communities from lightning.
2. Study the effectiveness of the traditional methods used by rural communities such as those mentioned in this study.

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Annexure A: Questionnaire used for gathering data from community members.

UNIVERSITY OF ZULULAND

Nokuphila Mthethwa from the Department of Geography and Environmental Studies, University of Zululand has asked for my permission to participate in the above mentioned study. The aim and objectives of this study, and of this informed consent declaration have been explained to me in a language that I understand. I am aware that my participation is entirely voluntary and should I, at any stage wish to withdraw from participating further, I may do so without any negative consequences. The purpose of the research project is to investigate: ***The socio-economic impacts of and community perceptions towards lightning storms and its fatalities in uMkhanyakude District Municipality,*** The University of Zululand has given ethical clearance to this project, and I have seen or may request to see the ethical clearance certificate. I understand that by participating in this study, I will be contributing to the body of knowledge. I understand that there is no right or wrong answer, my views are of great significance and valuable for the research project. I also understand that I will not be waged for participating in the research. The researcher intends to publish the research results in form of a study confidentiality and anonymity of records will be maintained and that my name and identity will not be revealed to anyone who has not

Section A: Demographic characteristics

Indicate your answer with an X

1. Gender

Male	
Female	

2. Age:

18-30	
31-45	
46-59	
60 and above	

3. Level of education:

Primary school level	
Secondary schooling	
College	
University	
No schooling	

4. Source of income:

Grant	
Self-employed	
Employed Government	
other	

If other please specify below.

_____

_

5. Monthly Income:

Less than R5000	
R6000-R10000	
R11000-R15000	
Above R16000	

Section B: Community perceptions towards lightning.

1. According to your understanding, what causes lightning?

_____

_____

_____

____

2. What have your past experiences with lightning been like?

_____

_____

____

3. What do you think is causing so many deaths by lightning in this area?

4. When do most deaths or lightning accidents occur in the area?

_____

_____

____

5. Has anyone in your family or a family you know experienced an incident with lightning?

_____

_____

_____

6. Was it a fatal incident?

_____

_____

_____

7. If yes, how has it affected your family?

_____

_____

_____

_____

Section C: Socio-economic impacts of lightning and community perceptions towards lightning.

8. What social problems do you think are caused by lightning and lightning fatalities in communities?

   _____

   _____

   _____.

9. What economic impacts do lightning and lightning fatalities create in the community?

   _____

   _____

   _____.

Section D: Community responses to protect themselves from dangers posed by lightning.

1. What do you do to ensure that you are safe when there is a lightning storm approaching?

   _____

   _____

   ____

2. How do you ensure that the rest of your family is protected from the same event?

   _____

   _____

   ____

3. Besides the measure you already use, how do you think you can improve your safety and the safety of your family from lightning?

   _____

   _____

   ____

4. What assistance do families or people who have been affected by lightning receive from the rest of the community?

   _____

   _____

   ____

5. Does the government support families and or businesses that experience losses as a result of lightning? State how?

   _____
   _____
   _____
   _____

*********Thank you so much for your participation this is the end*********

Annexure B: Interview questions for the municipality and other stakeholders

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My name is Nokuphila Mthethwa a Master's student at the University of Zululand. As part of my research I am investigating: ***The socio-economic impacts of and community perceptions towards lightning storms and its fatalities in uMkhanyakude District Municipality,*** and request that you assist me in this matter. The information to be collected in this study is to be used strictly for academic purposes. The purpose of this study is to investigate the socio-economic impacts including the perceptions that communities have regarding lightning and the fatalities caused by it. Participants are allowed to terminate their participation at any time should they feel uncomfortable and all information collected will be kept confidentially.

1. How many deaths by lightning are reported or experienced in uMkhanyakude per year?

2. In which parts of the district are the most incidents being reported or experienced?

3. What can you say is a contributing factor to the increase in lightning fatalities in uMkhanyakude?

4. What are some of the social impacts of lightning and lightning fatalities in the district?

5. What are the economic impacts of lightning in the district?

6. To your knowledge how would you say the community members in the district perceive lightning?

7. What measures if any are you aware of or have witnessed the people of uMkhanyakude use as means to protect themselves from, or reduce vulnerability to being struck by lightning?

8. What has government/ other stakeholders done to ensure that the people in this district are protected from the future inevitable events of lightning storms?

9. Do you think these measures (mentioned above) are effective, why?