Fire as an agent of change: The Social, Economic and Environmental Impacts of The Knysna Fires.

Masters Thesis

Submitted in partial fulfilment of the requirements for the Degree of

Master of Development Studies

Awarded by the School of Development Studies

University of KwaZulu-Natal

Submitted by: Andries Motau

October: 2019

Supervisor: Dr. Catherine Sutherland

DECLARATION

By submitting this thesis electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by the University of KwaZulu-Natal will not infringe any third party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

Signature student _____

Signature Supervisor_____

Date_____

Abstract

The world has seen an increase in natural hazards in recent years and these hazards are showing their impacts in Africa as well. Climate change has been regarded as a catalyst to some of these disasters as they are now frequent and disastrous. This study uses the Knysna fire to study the social, economic, and environmental impacts of an environmental risk event in coastal towns. Fires such as the one that occurred in Knysna are not typical and occur in longer disaster risk cycles. Traditionally, social scientists have focused on the economic impacts of fire, especially financial burdens that come with them. However, interesting questions emerge when the focus includes the social and environmental impacts rather than just the economic impacts. Do people have an understanding of natural disasters? Is there any chance of livelihoods before and after the fire? Are people resilient to the impact of large fires? To explore these questions, this dissertation uses the disastrous 2017 Knysna fires as a case study.

A sample of twenty participants was selected using purposive sampling. Interviews and observations were used as a tool to collect data, which was analysed using content analysis. The primary source of data was obtained from the residents of Knysna, including both informal residents and middle and high-income residents, the insurance sector, municipality officials, local businesses, and environmental consultants. Findings show that most people in Knysna have an understanding of what natural hazards are. Fire was identified as the most common natural hazard in Knysna. Also, the findings show that the informal settlement residents were the most vulnerable, but that there were also middle and high-income residents and some local businesses that were vulnerable to the fire. The social, economic and environmental impacts of the fire were largely negative but there were positive outcomes in response to the disaster. The study reveals that the municipality lacked the capacity to deal with the fire disaster at the time of the event. The community of Knysna is resilient and has managed to rebuild itself. Although the fire resulted in significant impacts, particularly for those who lost their homes and properties in the fire, with informal settlers being the least resilient as they are more vulnerable due to the poverty trap.

Acknowledgments

I can never imagine this journey without the incredible supervision of Dr. Catherine Sutherland. The contribution and impact you have had in my life is immense and I can never thank you enough. You have been beyond a supervisor but an academic mother and I will cherish the support, the advice, the friendly conversations and the moments in getting this paper together for as long as I can live. To my sponsors, Ernst & Ethel Ericksen Trust and the NRF BRICS scholarship, thank you for the financial support, it really went a long way. To Mr. and Mrs. Nkwane thank you very much for the love and the support you have given throughout my studies. To Lesego thank you for always been there; indeed the world must be faced. To my friends Luu, Lwazi, Ross, Oupa, Khayo, Wezo and Thabo I can never wish for better friends and thank you for the inspiration and for making this journey worthwhile. To you Zanele Makoko, thank you for being my cheerleader and friend even at my worst. To Maemo Machaba, your brotherly love doesn't go unnoticed, I appreciate you especially for the support you have shown in this journey. To my family, bana ba Pula le Malome, I thank you. To my Mother Seopedi Ethel Motau and siblings Philemon and Nthabiseng Motau, this is for you and thank you for the prayers and the love and lastly to Flavie Bettex, thank you for everything, my dear.

Dedications

This dissertation is dedicated to the Knysna Community. To those that have lost their lives, homes, and businesses. Also a special dedication to Richard Oelofse who went out of his way to make sure that I had a good understanding of the fire and that the data was well collected, your kindness will always be treasured. To my friend Fikile Mlisana, thank you for coming through and for being the best research assistant, I appreciate you. To my study participants, it was a terrible ordeal that you went through but I appreciate the great strength you have shown in participating in this study. To George, you may have left before the task was complete but your contribution is earnestly appreciated. Indeed Knysna rises!

Table of Contents

Roman Figure

List of Figures

List of Tables

Chapter One: Introduction

1.1. Introduction

Wildfires are known to create immense damage in areas they affect. Natural hazards have been part of humanity throughout time, but in recent years they have become much more frequent and destructive. Wildfires in natural disasters literature were not always recognised or referred to as natural hazards, as natural hazards are considered to be hurricanes, floods and earthquakes (McCaffrey, 2004). However, the frequency and intensity of wildfires has resulted in them being included in the natural hazards literature. There are many deadly wildfires that have occurred, most of which are in North America and Asia. According to USGCRP (2017) the increase in wildfires in the world and their severity is mostly due to climate change. Wildfires in turn also contribute to climate change due to their high emissions.

The increase in wildfires has also occurred in Africa, many of which have taken place in South Africa. Strydom and Savage (2016) have shown, by using an 11-year data set, that wildfires are common in the north-eastern and eastern regions of the country, but that they also occur in the southwest of South Africa. This is due to the climate conditions and the vegetation found in these areas. On the 7th June 2017, the small coastal town of Knysna experienced what is one of the greatest fires to impact on South Africa, as it caused far more destruction than expected. Given the significant impact of this fire, and its unexpected outcomes, it is a good case study to explore how small towns respond to environmental risk and natural hazards.

1.2. The motivation for the Study

The fires which impacted on Knysna were detrimental to the town of Knysna, as they killed seven people and destroyed many homes and businesses. To add, they also negatively affected the biodiversity of the area as they killed insects such as cape bees, which are important in the area. According to Knysna Municipality (2017), the fires destroyed billions of Rands of the built environment, which included 564 houses. However, from this devastation, much attention is needed on natural hazards as they are becoming more in South Africa and are affecting small towns. There is a need to explore how and to what extent natural hazards impact on the future of sustainable development of small towns in South Africa; especially looking at a small town such as Knysna, which was still in recovery from the 2008 economic crisis. There has not been much work that has been done on natural hazards and how they are impacting small towns especially looking at the economic, social and environmental aspects of these small towns. Hence, it is important in establishing more information in this regard and to conduct this study.

1.3. The rationale of the Study

The rationale of this research is to understand the impacts of climate change and fires on different groups of people in Knysna. This study is important in understanding how such disasters can affect people and their livelihoods as the fires have ravaged a big part of Knysna and have left the town and its people in dire circumstances. However, this study is also important, as it will try to contribute to solutions of moving Knysna forward in its recovery and to help in coming up with solutions in dealing with such disasters better in the future.

1.4. Aim of the Study

To explore how, and to what extent, natural hazards impact on the future sustainable development of small towns in South Africa.

1.5. Objectives

1. To assess people's understanding and perceptions of natural hazards
2. To determine their vulnerability to them
3. To assess the social, economic and environmental costs of the fires on the Knysna community.
4. To assess the social, economic and environmental benefits of the fires on the Knysna community.
5. To identify disaster risk management responses that have been put in place in Knysna and to evaluate their effectiveness.
6. To assess what the fires reveal about Knysna's resilience.

1.7. Questions to be asked

1. What are people's understanding and perceptions of natural hazards?
2. How vulnerable are they to them?
3. What are the social, economic and environmental costs of the fires in Knysna?
4. What are the social, economic and environmental benefits of the fires in Knysna?
5. What relief mechanisms are in place for the Knysna community?
6. What does the fire in Knysna reveal about Knysna's resilience?

1.8. The organisation of the dissertation

This dissertation is divided into six chapters. Chapter One of the dissertation is an introductory chapter that encompasses an explanation of wildfires as natural hazards, the motivation of the study, rationale, research aim, objectives, and questions. Also, this chapter shows how the rest of the dissertation is outlined. Chapter Two of this study comprises of the literature review in which different literature was considered that relates to the topic; the theoretical framework used in this study is discussed in this chapter. Chapter Three of this dissertation is the background of the study which gives a clear indication of where the research was conducted. In Chapter Four, an overview of research methodologies that were applied and used in this research are presented and this includes the study location, research design, data collection methods, data analysis, and ethical considerations. In Chapter Five of this research, the results and findings of the study are presented and discussed. Chapter Six presents the conclusion and recommendations of the research.

Chapter Two: Theoretical Framework of Natural Hazards and Resilience

2.1. Introduction

This chapter provides a review of the global literature on natural hazards, with a particular focus on the effects of natural hazards on people and development. It also looks at what is a disaster risk and its components and the connection between natural hazards and climate change. It also explores resilience and responses to natural hazards and further looks at different case studies on the social, economic and environmental impacts of natural hazards in North America, Asia, and Africa, so that there is a clear indication on how natural hazards have impacted other parts of the world. It also provides a brief overview of the Knysna fires and the importance of holistically studying the social, economic and environmental impacts of the fires.

2.2. People, risk and natural hazards

There are natural processes that have been occurring on earth throughout time, and these natural processes which include earthquakes, floods, volcanoes and fires are regarded as hazards, disasters or catastrophes when they affect people (Keller and DeVecchio, 2014). There are many perceptions of natural hazards and risks but often these perceptions differ from person to person. According to Wachinger et al. (2012) the type of risk, the social context, the risk context and the personality of an individual result in varying perceptions and experiences of risks by people. To add, Wachinger, et al. (2012) state that the seriousness and acceptability of risks are influenced by various factors such as emotion, values knowledge, experience, and attitudes. Knuth et al. (2014) attest to this by stating that even though concurrent disasters can occur, the experience of individuals of disasters plays a role in influencing risk perceptions. Kung and Chen (2012) show that survivors of disasters such as earthquakes in Taiwan had increasing fear as a result of the threat of the possibility of the perceived disasters recurring. Similarly, several scholars hold that direct experience with single type events such as floods and bushfire increased perceived risk for these hazards by people (Gow et al., 2008; Kellens et al. , 2011).

There have been increasing natural hazards in the world and the occurrence of theses hazards has come with different trends. According to Sorensen, et al. (2006) there has been a dramatic increase of natural hazards turning into disasters in the world and this is both in terms of destructive capacity, complexity, frequency and scope; with small-scale disasters often having

the capabilities to have greater impact in the long run than big disasters that occur infrequently. The impacts of natural hazards and disasters in the world vary with certain areas experiencing greater devastation than others and this is often due to socio-economic and socio-political status of the geographies affected. In most instances, developing countries are the ones that suffer the most when these disasters occur and this is of the fact that developing countries are poor and more vulnerable in comparison to developed nations. When natural hazards occur, often they become serious to people when they turn into disaster and as noted in most cases this is driven by the socio-economic and political context within which they happen. Natural hazards are defined as "a process and event that is a potential threat to human life and property" (Keller, and DeVecchio, 2014, p. 33). Natural hazards are an important component in understanding disasters risk as they are an element to disaster risk, together with exposure, vulnerability and capacity.

Risks are defined as anything that occurs to a system, society or a community in a specific period of time and in turn has the potential to cause loss of life, injury, or destroyed or damaged assets and is determined probabilistically as a function of hazard, exposure, vulnerability and capacity (United Nations Office for Disaster Risk Reduction, 2017). According to United Nations Office for Disaster Risk Reduction (UNISDR) (2017) there are underlying disaster risk drivers which are influenced by conditions and processes that are often development-related and play a role in the level of disaster risk by heightening levels of reducing capacity, vulnerability and exposure. However, in order to understand disaster risk it is important not only to look at hazards but to take into consideration other components such as exposure, vulnerability and capacity. According to Lavell et al. (2012) exposure is regarded as the potential harm to people's infrastructure, livelihoods, resources, environmental services or social, economic or cultural assets in place that could be adversely affected by physical events and are subject to future loss, harm and damage. It is important to note that in most cases exposure can be quantified especially when looking at its measures in an area as this can be assessed by the number of people affected or assets.

In many disaster risks, the vulnerability aspect is often emphasised as it is one of the important components. According to UNISDR (2017) vulnerability is a condition which is given by the physical, social, economic and environmental issues or processes which give rise to the exposure of a person, a community, assets or systems to the impacts of hazards. Sorensen, et al. (2006) indicates that there is an interlink between development and human disasters as developing nations and poor people are the most vulnerable. There is a greater loss in terms of

their livelihoods, lives and economic status due to the effects of natural hazards (Rufat et al., 2015). According Thomas et al. (2019) vulnerability is influenced by many factors but access to resources is a key driver in developing nations and poor communities, as it creates inequalities that result in individuals lacking the adaptive capacity to protect themselves. However, it must be noted that access to resources also triggers other factors that increase poor people's vulnerability to disasters. An interaction of the social, physical and other factors reflects a community's vulnerability to a disaster, often poor people are forced to occupy locations that can be dangerous to them such as reclaimed land, flood plains, river banks and steep slopes and in these locations poor people use inadequate material, poor infrastructure and housing which in turn aggravate their vulnerability (Sorensen, et al. 2006). However, it must be noted that this influences individuals or countries capacity, and as mentioned this is an important component to risks. Capacity encompasses many factors as it includes how individuals or society can cope and adapt. According to UNISDR (2017) capacity is a mixture of all the attribute, strengths and resources obtainable by society or a community or organisation to manage and decrease disaster risks and strengthen resilience. It must be noted that capacity enables individuals, organizations and systems to cope using the available resources and skills even in cases of natural hazards that are influenced by climate change.

2.2.1Climate Change impacts on Natural Hazards

Climate change impacts are now evident and this global phenomenon will be part of humanity for years to come, especially given the increase in natural hazards in recent years. Many scholars believe that many of these natural hazards are driven by climate change, which is a major contributing factor to changes in weather patterns across the globe. According to Houghton (2009), global warming has resulted in the climate changing, which has led to challenges to the earth with rising social, economic and environmental impacts. Moreover, the Energy & Climate Change Intelligence Unit (2017) state that natural hazards are bound to happen without the climate changing, but increasing climate change exacerbates natural hazards which has contributed to some of the extreme events by making them more common, longer-lasting and much stronger.

A research study by Energy & Climate Change Intelligence Unit (2017), showed that 41 extreme events across the world post the 2015 United Nations Climate Change Conference, COP 21 which include heat (15), drought (9), rainfall/flooding (9), storms (3), wildfires (4) and cold, snow, ice (1) had positive links to climate change. To add, the relationship between climate change impacting on deaths and the economies where these disasters occurred is

evident (Energy & Climate Change Intelligence Unit, 2017). However, it can be argued that given that global environmental change is ongoing and increasing more rapidly, there is a high probability for more climate-related disasters in the world. There is no doubt that natural disasters such as floods, storms, and heatwaves are linked to climate change and if this phenomenon continues, people, livelihoods, ecosystems, environmental services, resources, infrastructure, and economic, social, and cultural assets will be negatively affected (Thomas and López, 2015). With the increasing climate change, risks, natural hazards and vulnerability of people it is important to have mitigations measures in place and to equip countries and people to have better resilience when responding to these disasters.

2.3. Resilience as a response to natural hazards risks.

A theoretical framework is important in shaping research. According to du Plooy-Cilliers, Davis and Bezuidenhout (2014), it is important to have a thorough and integrated theoretical framework, which helps in investigating and scrutinising a specific research topic, problems and questions. The framework chosen for this study is the resilience framework. Resilience builds on the work of modernisation and sustainable development frameworks. These two frameworks were established in the 1980s to guide policy and practice while shaping and ultimately transforming the relationship between humans and the environment. According to Sutherland et al. (2017), the emergence of Sustainable Development and Ecological Modernisation as both theoretical and applied frameworks was to re-orientate the relationship between the economy, society and the environment. However, even though these frameworks came in to place, humans continued to impact the environment at an unprecedented level, and this has resulted in what many call the Anthropocene, as there are now more risks to humanity than ever before, and this is due to the continuous degradation to the planet by humans.

Sutherland et al. (2017) indicate that the Anthropocene as a term remains contested and has created debate amongst natural and social scientists on whether a new geological era has started. This concept reflects the influence and control of humanity on the levers of change to society and the planet. The emergence of the concept of the Anthropocene contributed to the development of the resilience framework which takes into considerations risks due to environmental change as a result of degradation and also threats that may arise due to this. Sutherland et al. (2017) state that there already existing ideas about resilience which were developed in the 1980s in ecology and psychology and have emerged to address the challenges of the Anthropocene and the "risk society". According to Cote and Nightingale (2012) models of ecosystem dynamics in ecological science in the 1970s has resulted in discontent and this

was a consequence of the emergence of resilience thinking. Olsson et al. (2015) hold that the longest work of resilience was in psychology rather than in ecology. According to Vernon (2004), the original conceptutalisation of resilience began in the 1970s through research, following the work of psychiatrists Bowlby, and Ainsworth on child trauma and how to cope with negative aspects of adversity.

Briske et al. (2016) state that the recognition that the prevailing concept of ecological stability was not a realistic interpretation of observed ecosystem dynamics led to the emergence of the resilience theory as a response to this. This is evident from the work of scholars such as Holling, who was amongst the first to contribute to resilience by focusing on the ecological aspect of it. Holling (1973) initially saw resilience theory by acknowledging the possible occurrence of multiple stable states associated with the nonlinear dynamics in theoretical predator-prey models. The definition coined for resilience was "persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables and parameters, and still persist" (Holling 1973, p. 17). However, it must be mentioned that there have been many emerging ideas added to the definition of resilience. Martin-Breen and Anderies (2011) state that it is difficult to define resilience, hence the definition of resilience is coined from different fields such as economics, engineering, and psychology in which systems are looked at.

To add, Martin-Breen and Anderies (2011) indicate that resilience to a certain extent must be flexible, but also needs to focus on its core ideas which are the capacity of a system to cope despite outside drivers (both shocks and directed change). Equally important, Beilin and Wilkinson (2015) attest to this by stating that resilience definitions are about coping with shocks and threats to a defined system. The theory through the years has progressed and has been used in mainstream development especially in addressing environmental disasters. Bhamra (2015) states that the emergence of resilience comes in knowing that social, economic, and environmental and governance systems cannot be treated in isolation as the world is constantly changing; however, through resilience lasting well-being for people and places can be created after the experience of these changes. In addition, Bhamra (2015) mentions that the resilience of the social and ecological systems can be important measures for sustainable development.

Many scholars see resilience theory as a good solution to ecological problems that are facing the world; however, there are also those that are highly critical of it. Sutherland et al. (2017) hold that resilience does not favour a bottom-up approach, as it framed largely as a consequence of its conceptualisation by northern academic communities and the practices and experiences of cities in the north. Brown (2014) states that there are perceived limitations to resilience. These limitations are first, the failure to recognize resilience as socially contingent, and the failure to understand and answer the question who resilience is for? Secondly, its mainstream practice is conservative, focused on the persistence of a system; third, it is based on a system, which is concerned of external or exogenous forces, so it understates the internal, endogenous and social dynamics of the system (Brown, 2014).

Moreover, Béné et al. (2012) state that though resilience may have positive aspects to it, qualities of a tyrant are still found within it, as it does not favour a pro-poor strategy but a poor-neutral one and it also does not have a specific link to the poor. Furthermore, Béné et al. (2012) state that resilience's main concern regarding development is creating resilient building instead of putting emphasis on poverty alleviation and wellbeing. If the politics of resilience are ignored this will result in false expectation, disappointment even conflict. Furthermore, Brand and Jax (2007) state that there is a vague and malleable meaning attached to resilience and this has made it a 'boundary object' which can be a hindrance to scientific progress.

Despite the negative connotations attached to this theory, the resilience framework is fundamental for this study as it deals with coping after a disaster has struck. It outlines how communities can better prepare for future disasters. One of the ways it does this is through its ability to using a systematic approach in framing issues under consideration. Béné et al. (2012) state that a systematic approach is important because it is not only limited to idiosyncratic shocks that affect specific households. As it takes a look at many of the several shocks that affect households and/or societies, which are now becoming covariant in that they are inclusive of economic crises and climate-related shocks. Moreover, a systematic approach is also important in that it can take a holistic view to processes and dynamics that affect individuals and their environments across the scale. These are great advantages to the study. However, Béné et al. (2012) indicate that resilience is then relevant as it can account for these cross-scale and feedback dynamics.

This is important in the Knysna fire case as it will guide on how Knysna can better prepare for future disasters and how other towns can learn from Knysna through the use of the systematic

approach. Moreover, what also makes resilience relevant it is its ability to create a platform for different stakeholders to work together. According to Béné et al. (2012), different people (academics, practitioners and policymakers) can work under its banners irrespective of their experience and background and this makes it have the fundamentals in creating an integrated discourse. This is also important in the Knysna case as the fires have affected different sectors and a platform is needed for different stakeholders to work together in moving Knysna forward.

Resilience is vital to this study as it is able to support sustainable development especially in addressing risks due to natural hazards that make individuals vulnerable to poverty and inequality. Lal et al. (2009) mention that there are several studies that have proven a clear link between natural disasters and poverty. For instance, Walters and Gaillard (2014) state that people that are faced with natural hazards and other risks lack resources and means of protection and this makes them much more vulnerable in society. According to Walters and Gaillard (2014) if people were vulnerable prior to the impact of a hazard, their vulnerability is increased after a disaster has struck and they face the likelihood of marginalisation as structures that create and sustain marganilisation continue to exist. These structures result in the rich continuing to be rich, while the poor still remain worse off.

According to Hallegatte et al. (2017) when a natural hazard strikes, the resilience of the poor is threatened as they are highly vulnerable and this can lead them to increased poverty. Their well-being is compromised as they have less ability to cope or recover from a disaster. Moreover, Hallegatte et al. (2017) state that what makes communities less vulnerable and much more resilient are social protections and market insurance. However, market insurance generally excludes poor people as it is expensive for poor people to afford. Atreya and Kunreuther (2016) found in America there is a well-established rationale that people should get insurance as it has proven to help victims of disasters to recover quickly and to be much resilient. Furthermore, Rodriguez-Oreggia et al. (2012) found that natural hazards drive poverty, as poverty levels at the municipal level in Mexico increased after natural disasters and also found that natural hazards have negative impacts on Human Development Index (HDI). However, it must be mentioned that this link proves that natural hazards are a threat to sustainable development which puts emphasis on poverty alleviation and the reduction of inequality.

The United Nations Economic and Social Commission for Asia and the Pacific (ESCAP) (2017) supports this and indicates that implementing the 2030 Sustainable Development Goals

Agenda countries must use the resilience framework. However, it must be mentioned that this is important when looking at the political ecology of the world. According to Lal et al. (2009), natural hazards affect the poorest in any community as poor people or communities in poor countries have a moderately higher sensitivity to natural hazards compared with communities of upper development status. Lal et al. (2009) hold that continuity of hazardous events increase people's vulnerability and results in increasing poverty and this makes it difficult for poor people to break out of the poverty cycle and this is a good example showing that natural hazards (Risks) equal to hazard multiplied by vulnerability. However, using resilience, issues of sustainable development can effectively be addressed especially in the context of the Knysna fires which occurred in a small town of a developing country which has a moderately higher sensitivity to natural hazards compared to first-world nations.

Moreover, what makes this theory significant for the study, is its ability to holistically look at resilience from different perspectives i.e, disaster resilience, engineering resilience or system resilience. For instance, when one looks at disaster resilience it fits the Knysna fires case. The disaster resilience approach according to Walsh-Dilley, Wolford, and McCarthy (2013) emanates from the work on hazards mitigation and disaster risk reduction (DRR). This approach puts emphasis on two components which are measures that are taken in reducing or preventing hazard-related losses and damages; as well as measures that are undertaken when a disaster has occurred for individuals to cope and minimize the impacts. Walsh-Dilley et al. (2013) state that unlike other approaches of resilience that emphasise adaptive capacity, this approach sees mitigation as a key driver in building resilience. However, it must be highlighted that this approach is important in the Knysna case as it will be able to direct on which measures can the Knysna community and town use in preparing for future disasters and also, it will help in understanding the coping mechanisms that have been put in place or can be put in place for the whole town. Moreover, resilience can help in identifying which mitigation measures are appropriate in moving the town forward. To add, in the case of Knysna, this approach is important as Walsh-Dilley et al. (2013) assert that this approach recognises the importance of local and indigenous knowledge in disaster risk management.

Resilience is important for the study as it holistically looks at social, economic, and environmental and governance systems, which are the fundamentals of the study. The impacts of natural disasters are already felt in the world and communities must find ways to be able to be resilient to these impacts and in doing so, communities must find solutions that are suitable

for their environment, which can be better suited to the social and economic needs that also, involve the government in them.

The fires in Knysna were not only a major disaster to the environment but their effects have been felt by the community, the economy and the municipality; however, there are solutions needed in addressing the future of the town in terms of disasters such as these. Resilience theory will help in understanding or assessing vulnerabilities that natural hazards especially fires bring to different groups of people in Knysna. Furthermore, this theory will help in outlining the costs and benefits of natural disasters in small towns. Moreover, this theory will help in guiding how the town must go about its sustainable growth as Knysna is a growing tourism hub for South Africa and contributes greatly to the tourism sector. This study focuses on social, economic and environmental impacts of a natural hazard in Knysna and how the town has responded. The following incidents provide examples of natural hazards impacts in other context.

2.4. Case Studies of Natural Hazards impacts in different contexts

It is important to consider different case studies of natural hazards in the world as these case studies are able to give a glimpse of the impacts of natural hazards in different geographic areas. These case studies are able to give understanding when a natural hazard becomes a disaster. Examining and analysing the social, economic and environmental impacts of natural hazards in different geographies is fundamental to this study, as this is one of the focal points of the study and it will be important in establishing the differences and similarities of these natural hazards to that of the Knysna Fires.

2.4.1. Social Impacts of Natural Hazard

Social impacts of natural hazards in North America

There have been social impacts of natural hazards in North America and this can be seen from hurricane Katrina. According to Sastry (2010) Hurricane Katrina left many of the people of New Orleans, Louisiana temporarily and permanently displaced as the entire population of 455,000 people was forced to leave. Moreover, Picou and Marshall (2007) mention that the hurricane also negatively affected schools in the area as 3,681 students were forced to change school and be enrolled at the coastal Alabama School. To add, Brunkard, Namulanda and Ratard (2008) state that Hurricane Katrina was the deadliest hurricane to hit the US Gulf Coast since 1928, as there were 971 Katrina-related deaths in Louisiana and 15 deaths among Katrina evacuees in other states. However, Hurricane Harvey also had serious social impacts on the

people of America. According to Jonkman et al. (2018) Hurricane Harvey caused many casualties, with 70 deaths being attributed to the hurricane. Moreover, Wang et al. (2018) state that out of all the estimated fatalities it was also estimated that approximately 30 000 people were displaced from their homes.

Floods have also impacted North America from a social perspective. According to Ashley and Ashley (2005), in their study on nationwide flood fatalities in America, they show that since 1959 to 2005, there have been a total of 4 586 fatalities that have occurred due to floods. Floods have socially affected the people of Louisiana and this can be seen from the 2016 floods that impacted on the state of Louisiana. Terrell and Terrell (2016) state that the floods in Louisiana affected approximately 109 000 housing units. There were at least 13 deaths that were recorded and thousands of people were evacuated and rescued from their homes and placed in refugees centres.

Natural hazards have also socially impacted America through fire. A good example of this is the 2012 Waldo Canyon Fire that impacted on Colorado. According to Ferris et al. (2012) although there were high numbers of evacuations but more dwellings were destroyed in the fire compared to 2018.. Moreover, wildfires that have socially impacted America are the North Bay and Southern California fires. According to Nauslar et al. (2017) the North Bay fires destroyed 5 636 structures and caused 22 deaths which made it the deadliest wildfires in the history of California. However, Southern California fires resulted in two fatalities and destroyed 1 063 structures and contributed to the post fires scar that fuelled other disasters such as flooding and post-fire debris flow which resulted in more deaths and structures destroyed (Nauslar et al., 2017).

Social impacts of natural hazards in Asia

Asia is a continent that is also prone to the social impacts of natural hazards. Some of the social impacts of natural hazards have been contributed to by disasters such the 2004 Indian Ocean earthquake and tsunami. According to Rodriguez et al. (2005) the tsunami negatively affected India and Sri Lanka socially but different communities had different impacts; however, in one community it was estimated that there were deaths of 5000 people and a loss of livelihoods. Moreover, Rodriguez et al. (2005) indicate that the tsunami had affected the infrastructure of Sri Lanka and India and this included damages to electricity, potable water, and fishing

communities lost their equipment to fish. In communities that relied on water from wells, the water was contaminated.

Equally importantly, Rodriguez et al. (2005) state that the tsunami also caused mental illnesses which were due to a high number of deaths in both countries and there were anxiety issues and fears especially amongst children that the tsunami might return. Similarly, Japan also felt the negative social impacts of a natural disaster like a tsunami. According to Hrabrin (2011), the tsunami in Japan resulted in approximately 15 900 deaths and over 6 100 injuries and most of these devastations occurred in Miyagi, Iwate and Fukushima prefectures, where entire communities were destroyed out. Moreover, Hrabrin (2011) states that there were also issues of depression, anxiety, respiratory diseases, and pneumonia. For example, three months after the tsunami there were 225 pneumonia cases of which were admitted to Kesenuma, Motoyashi and Otomo hospitals.

Cyclones and typhoons have also socially affected the continent of Asia. One can make an example of typhoon Bopha which moved over the Philipines in 2012 and typhoon Haiyan/Yolanda which destroyed the coastline of the Philipines in 2013. According to United Nations Office for the Coordination of Humanitarian Affairs (2013) (OCHA) typhoon Pablo, had negative impacts on the Philipines as there were deaths of 1 248 reported, 2 916 were injured and 797 were declared missing and in the entire population 900 000 people were displaced. To add, OCHA (2013) states that infrastructure was also affected and from the Department for Social Welfare and Development statistics, approximately 158 768 houses were damaged. The typhoon caused severe flooding which made places inaccessible. Moreover, the social impacts of Haiyan/Yolanda were almost similar to those of Bopha.

According to Makhoul (2014) apart from the estimated 6 241 deaths, the devastation of Haiyan was felt by almost all regions. Telecommunications were disrupted, there was destruction to public infrastructure which included damages to many houses and there was also negative impacts on the health sector, as supply of medication was affected and medical facilities to accommodate the injured, were also damaged. Furthermore, the typhoon contributed to an influx of migration most of which was from rural areas to towns and cities in hope of assistance (Makhoul, 2014).

Fires have also had significant social impacts on Asia. This can be seen from the wildfires in Indonesia. According to Heil (2017), the Indonesian fires have had a negative impact on the people of Indonesia as they have caused respiratory suffering to approximately 20 million

people and 19 800-48 100 premature mortalities due to respiratory problems. Moreover, Amul (2013) states that fires in Indonesia, with their associated haze, have resulted in 70 million of the population suffering from haze-related diseases such as eye, skin and chronic respiratory illnesses. To add, Adam and Heiduk (2015) mention that though the fires had serious negative impacts in Indonesia and other neighbouring countries; the haze that came from them posed great human and security threats.

Social impacts of natural hazards in Africa.

Natural hazards have also socially impacted the continent of Africa. This can be seen from events such as the 2011 East African drought that affected many people in East Africa. International Federation of Red Cross and Red Crescent Societies (IFRC) (2011), state that there were dire humanitarian impacts to Somalia, Kenya, Ethiopia and Djibouti, as there were 13.5 million people who suffered. Somalia was the worst affected due to famine, with 3.3 million people on the brink of starvation. Moreover, Somalia as the worst affected. It was estimated that one in three Somalis were displaced as a result of the drought and in Kenya, there were 3.7 million people in need of food and other assistance (IFRC, 2011). Furthermore, the agricultural sector in Kenya was in crisis as 2 million pastoralist and farmers were in dire need (IFRC, 2011).

Natural hazards have socially impacted West Africa as well, for example the 2009 floods. The floods impacted most countries in West Africa and negatively affected many individuals.According to WHO (2009) there were several deaths that were caused by the floods. In Sierra Leone, 103 people were killed and in Mali 25 people died. Furthermore, there were many displacements from the floods, with the worst displacements occurring in Burkina Faso, as over 90 000 people were found to be displaced. Moreover, there was an increase in the number of waterborne diseases in countries that were affected and these diseases included malaria and acute respiratory infections with more prevalence in Ouagadougou (WHO, 2009). These floods had a significant impact on the urban environment. Engel et al. (2017) attest to this by stating that the floods in Ouagadougou negatively affected many people and increased their longer-term vulnerabilities.

Natural hazards have also socially impacted Southern Africa. For example Cyclone Dineo affected the country of Mozambique, particularly the provinces of Gaza and Inhambane and their small towns. According to the United Nations (2017) Cyclone Dineo caused a lot of damage in Mozambique, especially in the province of Inhambane which was the worst affected

as roads, school, businesses and health care facilities were destroyed. Seven deaths were recorded as a result of the cyclone and 653,000 people were affected overall. Another cyclone that has caused far greater damage is cyclone Idai which was the most destructive on record in Southern Africa.

South Africa has also been socially impacted by natural hazards, such as the 2007 storm surge along the coastline of Durban. The damages of the storm surge in Durban were extensive. According to Hunter, Stander and de Coning (2006) shark nets were destroyed in most areas and this made bathing impossible in these areas; restaurants were destroyed and tons of sand was removed from the beaches and surfing was affected as sewage was released into surf zones. Another example of the social impacts of natural hazards in South Africa is through the 2010-2011 floods which impacted on seven provinces in South Africa. However, it must be noted thatThe Eden and Central Drought Disaster 2009-2011, also had severe impacts on people's livelihoods (Chasi et al. 2012). According to the International Federation's Disaster Relief Emergency Fund (2011), the floods which impacted most parts of South Africa in 2011 disrupted services, caused displacement of people, loss of livelihoods and 40 deaths out of the 20 000 people that were affected.

2.4.2. Economic Impacts of Natural Hazards.

Economic impacts of Natural Hazards in North America

Natural hazards have occurred in different forms in the world, with some regions experiencing the worst impacts than others. One of the continents that have seen an increase in natural hazards is North America, due to its geographical characteristics. In 2005, Hurricane Katrina moved over the southwestern coast of North America and impacted significantly on large cities and rural areas. It was one of the worst hurricanes to impact on the world, with many people dying and losing their resources and livelihoods. Hurricane Katrina impacted on places such as Louisiana, New Orleans, Alabama, and Mississippi. In all these places it had detrimental effects especially on small towns and the economy of the areas affected. According to Burby (2006), Hurricane Katrina was one of the worst disasters to have impacted on America as its economic costs were estimated to be over $200 billion, which was recorded to be the highest costs for any disaster in the history of the United States of America. When looking at a city such as New Orleans, Hurricane Katrina had negative costs to its economy. According to Dolfman, Wasser, and Bergman (2007), Hurricane Katrina impacted the economy of New Orleans direly especially the labour markets of the city.

The suffering of the city resulted from the loss of jobs as there was an average loss of 95 000 jobs ten months after the hurricane and this impacted wages, as lost wages between September 2005 to June 2006 were estimated to be $2.9 billion (Dolfman et al., 2006). However, the negative effect of Hurrican Katrina was also seen in the tourism industry of Mississippi. According to Garber et al. (2006) in Mississippi there was a significant loss in employment with the leisure and hospitality industry losing 9 percent, manufacturing losing 2 percent and the information sector losing 3 percent; however, the 3 percent loss of the information sector was the same percentage as professional and business service and natural resource mining industries. Deryugina, Kawano and Levitt (2014) in their study argued that though there were large amounts of money lost in Hurricane Katrina and many parts of New Orleans being negatively affected, there were positive aspects as a result of the federal and state relief programmes as they have helped with long-term economic gains for the people of New Orleans especially looking at their earnings. This study on the impact of the fires in Knysna will also reflect on both the negative and positive impacts of natural hazards on small towns in South Africa.

The economic costs of natural hazards in America is evident from Hurricane Harvey which was categorised as a Category 4 storm, which resulted in billions of dollars in losses. According to Greater Houston Partnership Research (2017) Hurricane Harvey is the third-largest economic disaster in the U.S., after Katrina ($174.5 billion) and the 9/11 attacks ($109.5 billion) as it was estimated that its losses accounted to $81.5 billion, which included; $17 billion in damages to commercial property and public infrastructure; $28 billion in business interruptions; $5 billion in autos and household items and $40 billion in damage to homes. Furthermore, Stupak (2017) attest to this by stating that Hurricane Harvey, like many other natural disasters, has affected the property market and this had resulted in a large short-term decrease in economic activity and this was due to high disturbances in the production and consumption of goods and services. Moreover, Stupak (2017) state that the impacts of Hurricane Harvey can be seen from the rise in energy prices by 2.8% in August 2017 and gasoline price increased by 6.3%. This was due to the fact that Hurricane Harvey destroyed assets and resources in the Gulf coast, which is responsible for a large portion of the U.S. petroleum refining capacity. It must be mentioned that an increase in petroleum prices has the potential to affect the broader economy by increasing the prices of other goods and services.

Floods have also impacted on the economy of the U.S.. One such example is the Mississippi floods of 2011 which had an impact on the economy of places such as Illinois, Missouri,

Kentucky, Tennessee, Arkansas, Mississippi, and Louisiana. According to Industrial Economics Incorporated (2014), the floods in the Lower Mississippi River resulted in large damages in the local infrastructure of roads and bridges, businesses, houses, private properties, as well as farmlands. However, in terms of farmlands, these floods had detrimental costs in the agricultural sector, which is the third largest sector in the area. There were an estimated 1,233,100 acres of flooded agricultural land which resulted in damage of crops (cotton, corn, rice, soybean including winter wheat, grain sorghum, and sugarcane and non-crops such as farm roads and drainage ditches (Industrial Economics Incorporated, 2014).

Fires have also shown their presence and impacts on the economy of North. One such example is the 2017 fires that raged through the North Bay and Southern California. According Nauslar, Abatzoglou, and Marsh (2017), the fires that impacted on North Bay resulted in high negative costs as there were 109 insurance claims which were filed and these claims resulted in a cost of $10 billion to the insurance industry. However, the overall costs when looking at the impacts on the evacuation and displacements of local residents were estimated to have exceeded $85 billion. Nauslar et al., (2014) state that Southern California fires costs were still being calculated but the total costs for Thomas Fire were estimated to be $382 million (federal: $207 million; state: $175 million) with an estimated $2.5 billion in insurance claims. However, fires have also affected the economy of a country such as Canada.

One can mention of the 2016 Fort McMurray fires which had both negative and positive impacts on Canada. According to Statistics Canada (2016), the Fort McMurray fires were the most expansive in the history of Canadian fires. For the Canadian insurance providers, their costs amounted to $3. 7 billion with an estimated -0.4% impact on real GDP in the second quarter of 2016. Moreover, the fires had also impacted 4000 small business which lost their infrastructure and lost revenue due to their businesses being closed after the fires (Alberta Government, 2016, p. 33). The Conference Board of Canada (2016) argue that there are positive aspects to the Fort McMurray fires, as it was expected that in 2017 they were going to add an estimated $1.3 billion in real GDP to Alberta's economy and contribute 0.4 percent to the overall growth and 9 000 jobs were going to be created. Reinvestments in an area that has experienced a disaster often lead to growth as there a rebuilding process that must occur and this contributes to an active economy with short and long term jobs being created.

Economic impacts of Natural Hazards in Asia

The impacts of Natural Hazards have also been felt by the economies of Asian countries. According to The United Nations (2015), Asia is one of the continents prone to a high number of natural disasters and this can be seen from the 2015 natural disasters, as 47 percent of the world's 344 disasters in 2015 were reported to be in Asia and the Pacific, with economic costs of over US$ 45.1 billion. Indonesia is one of the countries whose economy has been affected by natural hazards. According to Japan International Cooperation Agency (2015), some of the natural disasters that have affected the economy of Indonesia are earthquakes which have been prevalent since 1797, however, the worst earthquakes are the 2004 Indian Ocean Earthquake, the 2006 Central Java Earthquake, and the 2009 Sumatra Earthquake. Athukorala and Resosudarmo (2006) mention that the earthquake that was followed by the 2004 Tsunami resulted in approximately US$4.45 billion in costs, which were almost 100 percent the GDP of the Indonesian province of Aceh.

The costs also showed their impacts in the country's inflation, as inflation in Banda Aceh in January 2005 was 7.02 percent, whereas for the whole country it was only 1.43 percent. Japan International Cooperation Agency (JICA) (2015) argues that the total losses of the earthquake were USD 10 billion which is 1.5% of Indonesia's GDP. To add, the earthquakes that followed the Indian Ocean earthquake, also had an impact on the GDP of Indonesia. JICA (2015) state that both the 2006 Central Java Earthquake and the 2009 Sumatra Earthquake were not big in magnitude but had impacts on GDP as the Central Java Earthquake total losses were USD 3.1 billion which was 0.40% of GDP and the losses for Sumatra Earthquake totaled to USD2.2 billion which was 0.23% of GDP.

Natural disasters have also shown their impacts on Myanmar. The South Asian country experienced one of the worst cyclones to hit Asia in 2008. According to Markus, Min and James (2018), the estimated costs of the cyclone Nargis are about US$4 billion and most of which are in the agricultural sector which the country is heavily reliant on for its economic growth. Tripartite Core Group (2008) indicate that the economy in Myanmar was affected and this was driven by damage to assets which included high costs in goods and services and a loss in production. Moreover, Tripartite Core Group (2008) state that the damage by the cyclone contributed to malnutrition and food insecurity in the area, as the agricultural sector which contributed 45 percent of the national GDP in 2007 was badly affected and resulted in a cost of K570,000 million to almost K700,000 million. The devastation of Cyclone Nargis to Myanmar was still felt two years after it had happened, as there were large-scale farmers who

had become small-scale farmers, and the debt in many households was increasing, as well as unemployment amongst labourers who were resorting to do low paying odd jobs (Tripartite Core Group, 2010).

To add, floods have also been another form of natural disaster that has affected Asia. One of the worst flooding cases being the 2013 North India floods which were due to heavy rainfalls. The floods struck the state of Uttarakhand and they had a negative impact on the economy of the area especially the tourism sector which the area is famous for. According to the National Institute of Disaster Management (2013), the Uttarakhand flash floods had a negative impact on the economy of the area as they had affected the majority of the urban infrastructure as there was water damage in most towns of the state of Uttarakhand. Moreover, there were negative impacts on agriculture, horticulture and animal husbandry, as there were people who lost their livelihoods due to the floods (Institute of Disaster Management, 2013).

The World Bank (2013) state that the floods had negatively affected the tourism sector which was contributing over 25 percent to the state's GDP; due to the floods there was an expected aftermath, as 19 000 of small and medium enterprises were damaged and there was a loss of US$3.8 billion in the tourism sector which was expected over a period of three years. Moreover, floods have impacted other economies in Asia such as China, such as the 2016 China floods. According to Lyu, Xu, Cheng and Arulrajah (2018), the 2010 China floods were not as hazardous as the 1998 floods but had far higher economic costs than the 1998 floods. Lyu, et al., (2018) states that the high economic costs of the 2016 China floods were a consequence of impacted rapid economic developments which was accompanied by increasing urbanization.

To add, natural hazards have also shown their impacts through fires in Asia, including the 2015 forest fires that impacted on most of South East Asian countries especially Indonesia. According to The World Bank (2016), the fires in Indonesia had detrimental costs to the country especially to the environment and the economy, as they have cost the country about USD 16.1 billion and have resulted in disruption in tourism, transport industry, trade and schools. As noted, the fires affected several South East Asian countries and in Singapore, they showed their effect through a haze. According to Lin et al. (2017), haze from forest fires has always been a problem to Singapore, as it affects the economy badly. For instance, the 1997 haze resulted in approximately $163.5–286.2 million worth of costs, which was 0.18%–0.32% of Singapore's GDP at the time; and in 2015 the total costs of the haze was estimated to be $69.3–78.8 million, which was 0.08%–0.09% of Singapore's GDP. To add, Lin et al., (2017)

state that in all of Singapore's economy, the impacts of the haze were worse felt by the tourism sector than any other industry.

Economic impacts of Natural Hazards in Africa

The African continent has also seen an increase in natural hazards that have affected the economies of some of the countries on the continent. The 2011 East African droughts had a major impact on the countries within this region. According to The World Bank (2011), Kenya suffered significant losses as a result of the droughts as the droughts had caused the death of livestock. This had an impact on the country's GDP, as livestock contributes five percent to Kenya's GDP. Moreover, the World Bank (2011) stated that the droughts in Kenya also contributed to food inflation by increasing prices of food items, as items such as maize increased; with the price of 90 kilograms bag of maize at 55 percent higher at US$43 to the world market price, which was double compared to the year earlier.

Equally important, Feinstein International Center (2014) stated that the droughts also had negative impacts on the country of Somalia especially its economy, as the famine resulted in the country increasing its loans for aid relief which increased the country's deficits. Similarly, the negative impacts of drought have also been felt by Southern African countries, including Malawi. According to Pauw and Thurlow (2009), Malawi is a country that has faced many droughts in its history and these droughts have affected its economy especially the agricultural sector on which the country is heavily reliant upon. Pauw and Thurlow (2009) make an example of the 1991-1992 droughts that reduced national GDP by 10 percent. The droughts have shown to have had an impact on the country's households incomes and food prices and this resulted in poverty increasing in the country. Droughts have also shown their impacts in South Africa, and this can be seen from the worst droughts that have occurred in the Western Cape especially the City of Cape Town, which experienced the worst droughts in a century in the year 2017.

Masante et al. (2018) state that the droughts in the Westen Cape were devastating to the City of Cape Town, as they resulted in water restrictions and had almost driven the city to 'run out of water'. However, Barnes and Shippey (2017) state that water restrictions in the area have threatened agricultural productivity and employment and have resulted in profit loss and reputational loss of suppliers in the area. However, another way natural hazards have economically affected South Africa is through storm surges. Smith et al. (2007) state that the costs of the March 2007 storm along the KwaZulu-Natal coastline were estimated to be R1 billion worth of damage. In addition, Mather and Theron (2011) state that storm surges have

shown a trend of becoming dominant, for example, the Cape Storm of 2008 had a repeat of its kind in 2011. Storm surges are a concern in areas they affect as they cause dune erosion, which results in flooding and damages to property especially to properties that are closer to the ocean. According to Shaw et al. (2016), in a case where there is sea-level rise, the damage from storm surges is faster and far-reaching, especially to dunes and property.

2.4.3. Environmental Impacts of Natural Hazards

Environmental Impacts of Natural Hazards in North America

Without a doubt, natural hazards have the potential to affect the environment and this can result in either positive or negative impacts on the environment. For example, Hurricane Katrina has had a great impact on the ecology of America. Sheikh (2006) state that Hurricane Katrina had negative consequences to the environment of the areas that were affected as it was able to alter several barrier islands off the coast of Louisiana and this resulted in the wildlife of the area being affected as there were significant land loss and damages to seagrass bed which is important for many species especially aquatic life which uses it for nesting, spawning and feeding.

Moreover, Sheikh (2006) states that the hurricane also affected wildlife refugees which were home to some of the species that were conserved due to being closer to extinction which included Kemp's ridley sea turtle, the endangered Alabama beach mouse, and some species of wading birds. According to Faulkner et al. (2007) Hurricane Katrina also affected forests as it destroyed and damaged floodplain forests of the Pearl River and these forests are important to the biodiversity of the area as they are an important habitat for Neotropical migratory birds. To add, Sheikh (2006) states that Hurricane Katrina severely impacted the forests sector as forests in The Gulf Coast state were badly affected, with almost $5 billion loss in potential timber revenues. Equally important, Howes, FitzGerald et al. (2010) indicate that Hurricane Katrina has also affected wetlands within the Louisiana coastal plain and this has had negative impact on wetlands in the area as there were stresses to them which were between 425–3600 Pascals, adequate to cause widespread erosion of the low salinity wetlands.

Natural hazards have shown their environmental impacts in North America through fires. One can mention the Canadian fires that affected the environment extensively. According to Landis et al., (2018), the 2016 Fort McMurray Horse River Wildfire had negative impacts on the air quality of the area that was affected and this posed health risks to the people of Alberta. Moreover, Landis, et al., (2018) state that the fires with their high emissions posed threats to

the terrestrial and aquatic ecosystems. Martin et al., (2016) attest to this by stating that fires can have large ecological impacts on the environment as they rerelease chemicals that cover a large extent of the environment which results in water and air pollution. Moreover, Martin et al., (2016) mention that hazards that come from fires can have effects on the terrestrial environment for a long-term than a short-term and this can be catalyzed by the fact that fires have a potential to create a pathway for effluents. Moreover, Robinne et al. (2017) state that wildfires contribute to water scarcity, but the severity of water scarcity is more prevalent in water-insecure countries, many which are developing countries.

Environmental Impacts of Natural Hazards in Asia

Asian countries have experienced significant impacts from natural hazards. The 2004 Indian Ocean Earthquake, affected most of the environment of Indonesia. According to Srinivas (2015), the environmental destruction caused by the tsunami in Indonesia was extensive, as it badly damaged mangroves, coral reefs, wetlands, forests, coastal areas, agricultural fields and aquaculture areas. To add, Srinivas (2015) mentions that State Ministry of National Development Planning in their damage assessment found that a projected 30 percent of coral reefs, 20 percent of seagrass beds, 50 percent of sandy beaches of the west coast and 25-35 percent of wetlands were damaged or destroyed.

The FAO (2007) states that the environmental damage of earthquakes, including the 2004 tsunami in South East Asia, occurs as a result of waves or tsunamis. It is evident that waves can damage resources and ecosystems, and this was seen in the 2004 tsunami earthquake when it devastated Sri Lanka's numerous species nearshore. This resulted in mass mortality of estuarine fish populations, which were washed into inland areas (FAO, 2007). Moreover, the impacts of earthquakes on the environment can also be seen in earthquakes such as the Great East Japan Earthquake in 2011. According to the Nature Conservation Bureau, Ministry of the Environment and Biodiversity Center of Japan (2013) the Great East Japan Earthquake had negative impacts on the environment of Japan as it had caused destruction to trees and there were also changes to sandy beaches, as sand was removed after the earthquake. Moreover, the Nature Conservation Bureau, et al., (2013) state that wetlands were weakened and the earthquake also affected the ecosystem by destroying nesting of seabirds and causing disappearance of the sandbar. This resulted in the estuary opening up directly into the sea, which resulted in new organisms being introduced and as a consequence there were changes to the ecosystem.

The environment of Asia has also been affected by natural disasters such as cyclones, such as Cyclone Nargis that impacted on Myanmar. According to Besset et al. (2017) cyclone Nargis had negative impacts on the Ayeyarwady River basin and delta as it had increased erosion. Moreover, Besset, et al. (2017) mention that if events such as cyclone Nargis are accompanied by human activity and sea-level rise continues to happen, this poses great danger to the Ayeyarwady delta mangrove forests and wetlands. To add, UNEP (2009) asserts that cyclone Nargis had serious negative impacts on the environment of Myanmar as it had affected the natural resources and biodiversity of the country by destroying approximately 16,800 ha (41,514 acres) of natural forest and 21,000 ha (51,892 acres) of forest plantations. Moreover, UNEP (2009) state that social and economic activities in Nargis had increased Myanmar's vulnerability to natural hazards due to deforestation and forest degradation.

Fires as natural hazards have also affected the environment of Asia. According to Karya et al. (2017) fires have negatively affected the environment of the Indonesian province of Riau, since 1997. Karya et al. (2017) state that the Riau forests fires have had a negative impact on the environment as they have reduced the air quality of the province and have threatened the sustainability of protected wildlife. Moreover, Karya et al. (2018) state that the forest fires have not only affected the air quality of Riau Province but their impacts were felt by other areas of Indonesia as well, and they have contributed greatly to the carbon footprint of the country. Similarly, Tessler (2012) states that wildfires have also had a negative impact on Israel, especially in the Mount Carmel and Jerusalem hills as fires were the main cause of ecological and geomorphological damages.

Environmental Impacts of Natural Hazards in Africa

Natural hazard impacts on the environment are also evident in Sub-Saharan Africa. One can mention the floods that continuously devastate Kenya. According to Opere (2013), flooding has affected the environment of Kenya, most particularly the 1997/1998 floods which impacted on the environment of Kenya through the severe loss of animals, land degradation in the form of soil erosion and silting of hydropower dams. However, floods have also resulted in significant impacts in West Africa, such as the floods impacting on the delta region in Nigeria. According to Loveline (2015), floods in Nigeria have negatively affected wetlands in the delta region, as wetlands continue to be degraded by them and this has also negatively affected the biodiversity of the area. However, Bariweni et al. (2012) argue that though floods might have negative impacts on the environment, they also have positive impacts on the environment, such

as helping the land to be more rich and fertile from the deposited material from floodwaters flow.

To add, the impacts of floods have shown themselves in South Africa as well. According to Nel et al. (2014) an increase in floods over the years in the Eden district has led to land cover changes. Flows from flood waters have resulted in an introduction of invasive alien trees into untransformed vegetation. Moreover, Nel et al. (2014) state that the land cover in the Eden district has not only been affected by floods alone but other natural disasters such as fires. Forsyth et al. (2010) argue that natural hazards such as wildfires can have positive impacts on the environment by protecting biodiversity and maintaining ecosystem services, as regular burning forms part of the maintenance and restoration of fynbos vegetation, hence there are instances where they are allowed to burn. However, Forsyth et al. (2010) state that wildfires can also have negative impacts on the environment. The Mpumalanga 2007 wildfires can be taken as an example as they degraded land through plant invasion and destroyed the structure of the surface soil horizon, which resulted in excessive erosion during the rainy season.

2.5. Knysna Fires as a Natural Hazard

It is without a doubt that climate change is referred to as a catalyst for natural hazards around the world and those that have posed pressure on many areas in South Africa, especially those along the coast. King (2017)states that there is evidence in the Knysna fires of the role of climate change in increasing the frequency and severity of the event . This is due to the extreme weather that has contributed to drought in the area. The CSIR (2018) attest that the fires in Knysna were fuelled by a two-year drought which was present in the Western Cape since 2015. Furthermore, Knysna Municipality (2017) states that the fires that destroyed the town of Knysna in June 2017 its likelihood was increased by drought, shortage of water, and a proliferation of alien vegetation, predominantly wattle and eucalyptus, which contributed to the fires. Littell et al. (2016) stipulate that continuity of drought for a long time can become an easy trigger to the spreading of fires and raising the risk of widespread burning. The fires in Knysna came as a shock to many in South Africa; however, there is a need to consider and investigate the social, economic and environmental impacts of these fires, as events such as the Knysna fires are not common in South Africa, and there is not much information on their impacts, however, they are set to increase in number due to the impacts of climate change.

2.3. Summary of the Chapter

This chapter has outlined how climate change contributes to increasing natural hazards, as it contributes to weather changes. The chapter has presented the main theoretical framework of this research, namely the contested concept of resilince. The chapter has provided an overview of how natural hazards have different impacts in the world by looking at three continents in the world which are North America, Asia and Africa. From these continents, an overview of different social, economic and environmental impacts of natural hazards was provided which was looking at some of the deadliest and direst natural hazards e.g hurricane Katrina. The chapter has also introduced the need to study social, economic and environmental impacts of natural hazards in South Africa, using the Knysna case. Moreover, this chapter has also introduced the theory that is going to be used and it has looked at different aspects of the theory and why it is important for the study.

Chapter Three: Background of Knysna

3.1.Introduction

This chapter provides the context and background of Knysna by explaining its location and which municipality it falls under. It also describes the economy of Knysna and some of the natural hazards that have impacted Knysna. Moreover, a description of the Knysna fires and the destruction they caused in June 2017 is provided.

3.2.Background to the study

Knysna is located on the Southern Cape coast which is part of the Western Cape Province. The town is found in one of the most scenic places in South Africa called the Garden Route. Knysna is part of the Knysna Municipality which is made up of the following small coastal and rural towns: Knysna, Sedgefield, Rheenendal, Noetzie, Brenton and Belvidere, including informal settlements and other small towns (Knysna Municipality, 2017). The town of Knysna is famous for its tourism, most of which is based on its natural wonders. According to Vromans et al. (2010) some of the wonders that are found in Knysna are the Knysna estuary, Knysna forests, Groenvlei-Swartvlei mouth dunes, Caracals and Knysna Seahorse. All of these wonders are important as they form part of the rich biodiversity of the area. Some of these natural wonders are habitats to important species in the area. Many of these environmental assets such as the estuaries and the forests attract tourism, provide spaces for recreation, fishing and mariculture activities, help with employment, provide food and are valuable ecosystems and this makes them highly important to the well being of the town and the municipality (Sutherland, 2016)

Knysna Municipality is still a growing economy which has gone through many fluctuations of growth and decline over the past thirty years. The regional gross domestic product of Knysna Municipality amounted to R4.19 billion in 2015, which was mostly from the tertiary sector, which included tourism (Knysna Municipality, 2017). However, the secondary sector which includes manufacturing, electricity, gas and water and construction was still struggling, but growing at a slower pace since the 2008 financial crisis (Knysna Municipality, 2017). According to Sutherland (2016) there was a shift in the economy of Knysna Municipality, especially in the nature of industrial and commercial activities and part of it was due to the rapid growth between 1996 and 2008 which resulted in a booming construction sector of property developments, especially high-income property developments. However, the

booming constructions sectors came to a halt because of the 2008 financial crisis (Sutherland, 2016).

Natural hazards are common in the world and in recent years there has been an increase in natural hazards; some of which have shown their impacts in South Africa. The Energy & Climate Change Intelligence Unit (2017) argue that natural hazards have become much more frequent in recent years and a catalyst to this is climate change. The impacts of natural hazards are widely felt and can be both short and long-term. South Africa is no exception to natural hazards; Knysna municipality like many parts of the world has experienced natural hazards. The most common hazards that have occurred are droughts, storm surges, and floods which have impacted on the municipality. The 2004-2005 floods impacted significantly on the Garden Route, and although the floods were not a declared a national disaster, there were significant damages that they caused in the areas they occurred with Knysna being one of them (Tempelhoff, et al., 2009).

Knysna as a coastal town has been impacted upon by natural hazards that come from the ocean, the majority of which are strong winds, storm surges, and coastal erosion. According to Theron and Rossouw (2008), the South Cape which Knysna forms part of was identified as one of the coastal areas that are vulnerable to predicted climate change. In 2015, the Western Cape experienced the worst drought ever which also affected the Southern Cape and towns such as Knysna were also affected (CSIR, 2018). From the drought, it is believed that the fires that occurred in Knysna on 7 June 2017 were catalysed by this drought. However, not only the drought, but also invasive alien plant species which were rife prior to the fire. These plant species include Black Wattle, Pine trees, Port Jackson, Rooikrans, and Blackwood and all these plant species had a role in fuelling the Knysna fire. To add, these species were only recognised as a concern to biodiversity but they are now recognised from a disasters risk point of view as they pose risk to water and fire security.

The fires in Knysna was a result of three fires which also impacted Pletternberg Bay, one was due to smouldering vegetation in Elandskraal, another in Kruisfontein to the east of Knysna and the third one which was near the Knysna Heads (Forsyth et tal, 2019).According to the CSIR (2018), the smouldering vegetation in Elandskraal resulted in what is known as holdover fire which was catalysed by the severe weather conditions at the time which included north-westerly berg winds. The holdover fire became the Knysna fire.

Figure 1: Smouldering in Elandraal

(Source: CSIR, 2018, p. 20)

The Knysna fires became a major catastrophe as people's livelihoods were destroyed. The fire killed seven people and destroyed over 500 houses, both in formal and informal settlements. It is estimated that the costs of the fire were over R6 billion as the fire negatively affected the economy of Knysna and raised costs to the people of Knysna (Knysna, 2018). There are many people that were evacuated as a result of the fire. According to the CSIR (2018) over 100 000 people were evacuated in the combined, Sedgefield to Knysna and Knysna-Plettenberg Bay area fires

Figure 2: Brenton on Sea cottages one

(Brenton on Sea Cottages, 2018)

These images were provided by the Brenton on Sea Cottages during the data collection process. The images captured show when the fire burnt the cottages, their ruins and the rebuild. Brenton on sea was one of the data collection sites, hence the context of the area is reflected in Figure 2.

To many, the fire reminded people of the "Great Fire" 1869 which ravaged the Southern Cape, as this was the second biggest fire since the 1869 fire. The Knysna fire was graded as a level 1 fire which means it was the most destructive fire that has occurred in South Africa. The fire destruction can be seen post the fire as there are those that are still struggling to rebuild and those that have migrated due to the fire. However, this sparked interest in the impacts of fires on small towns in South Africa, which forms the focus of this study. This research therefore makes a contribution to understanding how and to what extent natural hazards impact on the future of sustainable development of small towns in South Africa.

Chapter Four: Methodology

4.1. Introduction

This chapter outlines the research methods that were used to collect the data for this research. It also shows and provides an overview of the study location. The research took place in Knysna and a map of the area is provided in this chapter. The research design that was used is a case study design as it was important in giving a detailed examination of the impacts of the Knysna fires. The study used a qualitative approach with a sample of twenty participants who all were interviewed and participated in the study. This chapter also shows how the data collection process was categorized with sector interviews, participants interviews, and observation. Moreover, the chapter also provides an overview of the data analysis method/process, the ethical clearance granted and the limitations to the study which were encountered.

4.2. Study Location

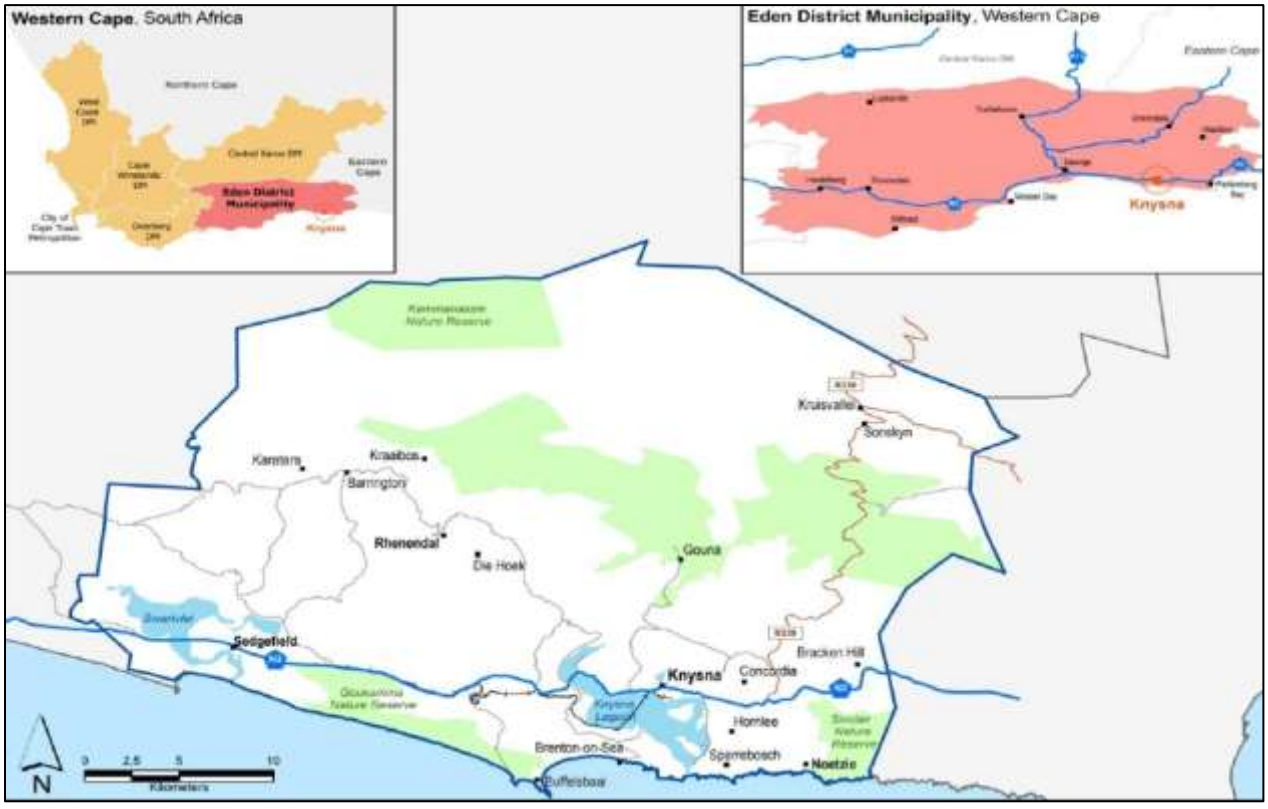

Figure 3: The location of the town of Knysna within the Knysna Municipality in the Eden District Municipality and the Western Cape Province

(Source: Michela du Sart)

Knysna is a town in the southern coast of the Western Cape Province of South Africa. It is a town located on one of the most scenic places in South Africa named the Garden Route and this town forms part of the Eden District Municipality which is now known as the Garden Route District Municipality, which includes local municipalities such as Knysna, Kannaland, Hessequa, Mossel Bay, George, Oudtshoorn, and Bitou. The town is home to about 74 606 people and 25 877 households (Western Cape Government, 2017). Knysna is famous for tourism which is one of the great economic contributors to the town's economy. The economy of the town of Knysna, according to Western Cape Government (2017) is now highly boosted by the tertiary sector which encompasses of wholesale and retail trade, catering and accommodation. These sectors produced 72.1 percent (R3.01 billion) of Knysna's GDP in 2015 which increased by 0.8 percent in 2016. Moreover, Knysna forms part of the Cape Floristic Region; an area known for the beauty and for containing one of the richest concentration of flora in the world, which is crucial in terms of plant species biodiversity (Manning and Goldblatt, 2012). The reason for the location of this study is of the fact that fires, as a form of a natural hazard, occurred in this area and affected different sectors and this makes it important to look at different impacts of these fires.

4.4. Research Methods / Approach to Study

4.4.1. Research Design

The research design directs where the research is going. According to Creswell (2014), research approaches are sorts of enquiry and include qualitative, quantitative and mixed methods that give an absolute path for procedures. These approaches have developed over the years with the progression of technologies such as computers. The research approach that was used for this study is a qualitative approach. Qualitative research approach goes into the depth of the matter unlike quantitative research design, which is characterised by numbers. Qualitative research has enabled me to develop a holistic understanding of the situation studied. This design was important for the study as it has helped me to interact with citizens of Knysna and it helped in assisting me to draw knowledge about the fires from different citizens that have participated in the study. However, it must be mentioned that this was done through a case study design.

4.4.2. Case Study Design

Case study research design was chosen for this study as it goes hand in hand with qualitative research due to its methods being broadly used in qualitative research. According to Yin

(2014), case study research supports the goal of understanding complex social phenomena and this permits scholars to give attention to a case and retain a comprehensive and real-world viewpoint, such as studying separate life cycles, the maturation of industries, small group behaviour, neighbourhood change, organizational and managerial processes, international relation and school performance. Moreover, Zainal (2007) indicates that case study methods give way for researchers to closely observe the data within a definite context and in different cases; and this is due to the ability of a case study method to choose a very restricted amount of people as the subjects of a study or a small geographical area. However, the Knysna fires are a perfect example of a case study as they have caused neighbourhood change and have impacted signficantly on a small geographical area.

4.4.3. Data Sample

The sample for this study consisted of eighteen people from a wide range of stakeholder groups in Knysna. This included three municipal officials; two environmental consultants from Knysna; five residents from the informal settlement (English Speaking); five residents from middle and upper-income residences, three local businesses, and two representatives from the insurance industry. The municipal officials were chosen as they were responsible in dealing with the fire from a governance point of view. Ther environmental consultants were selected because they are experts when it comes to environmental issues. The residents were chosen because the fires impacted them directly, which is essential to find out from their experiences. The research used non-probability sampling, employing a purposive sampling method. Purposive sampling is about one taking control of the elements that must be included in their research, based on a set list of characteristics (du Plooy-Cilliers, Davis and Bezuidenhout, 2014).

4.4.4. Data collection

The data collection methods that were used in this study were in-depth interviews and observations. The interviews were standardised and open-ended. The interviews were conducted on an individual basis. The reason interviews were chosen out of all the data collection methods in qualitative research is that the study aimed to understand different people in Knysna's conceptions and experiences of the fire. The interviews were done in different parts of Knysna, which reflect the different dimensions and realities of life in Knysna. However, in addressing the efficiency and cost of the study, interviews have made the data collection process efficient and valuable, as knowledge and understanding was obtained through in-depth interviews. The interviews in this research were categorised into two types:

sector-specific interviews and participant interviews. Participant interviews in this regard are those that include households and sector interviews representing the differents sectors i.e, insurance industry and consultants. However, it must be noted that these interviews have helped with a better interaction with the participants in an environment they were comfortable in. The participants for these interviews were recruited through the help of the municipality and my supervisor. As they had given who names and contacts of those that were affected. However, before arriving in Knysna; dates and times were arranged for the interview telephonically with the participants.

4.4.5. Sector Interviews

The sector interviews were a way of understanding the impacts of the fire in more depth by interviewing people from different sectors who were engaged with and responsible for managing the disaster. The person from the insurance industry shared the estimated costs, benefits and lessons learned from the fires. The municipal departments selected for the study were represented by different officials who explained and discussed how their departments played a role in managing the fires and how the fires have impacted the town of Knysna, especially in terms of its social, economic and environmental needs. When it comes to local businesses, it was important to interview someone from the tourism sector to understand the cost of the fires and how Knysna has planned to go forward in terms of its tourism. A local forestry company representative was selected to participate in the research. As the company had lost most of its timber and was still grappling with another fire at the time of the interviews, which was adding to its costs. However, the construction company representative gave an overview of how the fires have impacted the previously struggling industry. It was important to have input from environmental consultants in the study to understand the impacts of the fires on the environment in as the two consultants are experts in this field.

Table 1: Overview of Sector Interviews

Respondent	Organization	Name	Date of Interview	Interview Method
1	Santam Insurance	Insurance-1	5 September 2018	In person
2	Knysna Municipality (Environmental Planning)	Muni-1	24 October 2018	In person
3	Knysna Municipality (Local Economic Development)	Muni-3	29 October 2018	In Person
4	Knysna Municipality (Disaster Risk Management)	Muni-4	25 October 2018	In Person
5	Knysna Tourism/Accommodation owner.	LocB-2	31 October 2018	In person
6	Construction Company	LocB-1	30 October 2018	In Person
7	Forestry Company	LocB-3	31 October 2018	In person
9	Consultant	Enviro-1	31 October 2018	In Person
8	Consultant	Enviro-2	31 October 218	In person

4.4.6. Participants Interview

The participants selected were from informal settlements and middle and high-income households. As much as middle and high-income households were affected the most in the case of the Knysna fires, it was important to have people from informal settlements as participants in this study, as most of them have a relationship with middle and high-income households and these relationships occur from the jobs they get from the middle and high-income households

and they are most vulnerable to the impact of fires. All ten participants from the different residential areas discussed the impact of the fires in relation to how it impacted on their lives.

Table 2: Participants Interviews

Respondent	**Type of establishment**	**Respondent Coded Name**	**Date of interview**	**Interview Method**
1	Informal settlement	Informal-1	26 October 2018	In person
2	Informal settlement	Informal-2	26 October 2018	In person
3	Informal settlement	Informal-3	26 October 2018	In person
4	Informal settlement	Informal-4	26 October 2018	In person
5	Informal settlement	Informal-5	26 October 2018	In person
6	Middle and high-income households	Middle-1	24 October 2018	In person
7	Middle and high-income households	Middle-2	29 October 2018	In person
8	Middle and high-income households	Middle-3	30 October 2018	In person
9	Middle and high-income households	Middle-4	30 October 2018	In person
10	Middle and high-income households	Middle-5	30 October 2018	In person

4.4.7. Observations

Observations were used as a data technique as this has enabled me to witness and see how the town is recovering from the fires and how the people of Knysna are rebuilding their homes, businesses and infrastructure. As much as the study has relied on verbal input of participants; observations were important in seeing what is done around the town in making it better with the help and the information from the municipality and the support of NGOs and CBOs, such as WESSA. While traveling around Knysna to meet different participants, I was able to observe the ruins of the fires and how the town was going about its rebuilding.

4.5. Data Analysis

The data analysis method used in this study is that of qualitative content analysis. Plooy-Cilliers et al. (2014) state that qualitative content analysis can be used to discover and recognize overt and covert themes and patterns embedded in a specific text. The data was manually coded and organised into themes. What was important about this data analysis method to this study, was its ability to minimize large amounts of data to specific data through the approaches it uses. According to Hsieh and Shannon (2005), the different steps that this method follows include formulating the research questions to be answered, picking the sample to be analysed. Defining the categories to be applied, outlining the coding process and the coder training, implementing the coding process, determining trustworthiness, and analysing the results of the coding process. The analysis of the results was done on a computer following the stated process. This thorough process was beneficial in bringing the best results possible in this study.

4.6. Ethical Consideration

The research went through a ethical research application process which was submitted to University of KwaZulu-Natal Higher Degrees committee. I obtained ethical clearance and was given full approval for the research to be conducted. Prior to the interviews in the study, I communicated the need for the study to the participants and assured them that those that wanted to withdraw at any time of the interview were were able to do so, as well it was communicated that participating in the study was voluntary. To add, a consent form was given to the participants prior to the interviews for them to go through it and to ask questions if there were certain things that they did not understand. It was also communicated that those that wanted to

remain anonymous had a right to do so and were going to be given false names to keep their confidentiality in my thesis.

4.7. Limitations to the study

Some days required the research to conduct more than one interview in a day at different places in Knysna, and this proved to be a challenge due to time constraints. The time constraints resulted in time allocated for interviews shortened. However, I allocated adequate time to travel around Knysna to different places and to meet different people, as I had experienced delays due to traffic in my initial interviews. I therefore allocated thirty minutes extra to the travel time before each interview to ensure that I arrived on time as this is essential in conducting interviews with people.

Another problem that arose was of the fact that I did not know the places in Knysna very well to conduct interviews and observations. However, I then decided to invite a friend who is a local resident to help me navigate the town of Knysna. I also encountered a problem in convincing people to participate in the study. However, I then assured the participants of the worthiness of the study and the benefits it was bringing to local and global knowledge. I also assured the participants that the interviews were not going take more than an hour, as some mentioned time to be a constraint, such as the Santam representative. I also encountered a problem in speaking to the informal settlement residents in English, as they were non-english speakers, but my assistant played the role of a translator and this was effective in carrying out the research interviews and understanding how these settlements were impacted.

4.8. Summary of the chapter

This chapter has presented the methods used for the research. The research has used a qualitative approach with a case study design. This chapter has also provided a map and an overview of where Knysna is located. For the data collection process, interviews were used which were in-depth and open-ended. There were eighteen participants who participated in the study and their interviews were categorised into sector interviews and participants interviews. Observations were also used as a data collection method and this was to see how the town was rebuilding. The process of ethical consideration was properly stated, and the approval given; as well as the voluntary participation of participants and their confidentiality for participating in the study and this was done through a consent form. There were limitations that I came across and they were also stated and how they were dealt with in keeping with producing the best results for the study.

Chapter Five: Results and Findings

6.1. Introduction

This chapter outlines the themes that emerged from the research for this dissertation. There were four themes that emerged namely: people's understanding and notions of risks and hazards; the vulnerability and coping mechanisms and support systems of the people of Knysna and their resilience; and the social, economic and environmental impacts of the fire and responses to fire or interactions.

6.2. People's understanding and notions of hazards and risks

It was important to find out from the participants about their understanding of natural hazards and risks, which they think Knysna is prone to. It was also important to establish if the participants knew of any other natural hazards apart from the fire that had devastated Knysna. The majority of the middle and high-income participants had a clear understanding of natural hazards. For instance, one participant from a middle and high-income household explained that:

> "*The entire weather pattern is shifting. Because, of the change in weather patterns, the rain patterns have changed in Knysna. In terms of Knysna, the natural hazards are fire and flooding; flooding is the next big threat because we are living closer to water, so if the water had to rise places like Thesen Islands, Leisure Isle and all those which are built close to water are going to be like Atlantis*" (Middle-1, 2018).

The information that was given by this participant showed a great understanding of natural hazards and risks, as the participant also mentioned what factors impact on the outcome of a natural hazard, such as having built close to water in a town prone to flooding. However, one participant from the informal settlements had a different view on natural hazards in Knysna. She expressed her understanding of natural hazards but did not see natural hazards as something that could happen in South Africa, especially in Knysna as she explained that:

> "*the only natural hazards I know, are those that I see on tv, I don't know much about them apart from seeing them on tv, which is houses being flooded but I have never seen such disasters happen in Knysna"* (Informal-1, 2018).

In contrast to the information given by both middle and high-income households and informal households, two participants from the informal settlement showed no understanding of natural hazards, For instance, one participant indicated that:

"*I don't have any understanding of natural hazards*" (Informal-3, 2018).

From the above information, it is evident that not everyone in the informal settlement had an understanding of natural hazards and risks, as there are those that did not know what they are. The information gathered from households was interesting as it showed that middle and high-income households had a better understanding of natural hazards, than informal settlement residents. To have a better understanding of natural hazards and risks, it was important to consult experts who had sound knowledge of natural hazards. One expert who is a municipal official articulated that:

> "*natural hazards are anything that originates in the natural environment, so it could be coastal, it could be riparian, it could be rainfall related, heat or drought"* (Muni-1, 2018).

The indication of location increasing risk, which was mentioned by one of the middle and high-income household residents, revealed a good understanding about natural hazards. This is also evident in the information that was conveyed by two environmental consultants in Knysna who expressed their understanding of natural hazards from a living environment context, recognising that the Garden Route has high exposure to natural hazards due to its physical characteristic. They stated that:

> *Living in the Garden Route where there is a lot of nature, makes people to be exposed to a lot of natural hazards such as flooding, fires, sea level rise and storms* (Enviro-1 & Enviro-2, 2018).

The location of Knysna might have a role to play in how people perceive natural hazards that are prevalent and are the most significant risk in Knysna. This could be established from the varying ideas that participants had when the prevalent and most significant risks in Knysna were discussed. For instance, the fire was identified as the most common risk especially amongst participants from the informal settlement. This is understandable as given the materials used in building houses in informal settlements and the way energy is used in the absence of safe electricity, fire is a common hazard in informal settlements. The middle and upper-income residents also elevated fire as a risk in the town and this was influenced by what was happening in the town at the time the data was collected. There was a very large fire coming from the west of Knysna which later progressed to the outskirts of Knysna during the time that the interviews were undertaken. Hence, one informal settlement resident stated that

"*fire is a natural hazard I have experienced ever since living here, as it is, there is another fire coming from George. So, fire always happens here, and this is scary*" (Informal-4, 2018).

The middle and high-income residents identified two or more risks that are prevalent to Knysna which included flooding and fire. However, it must be mentioned that this could be influenced by how long the respondent had lived in Knysna as this is an important factor to take into consideration. For instance, one middle or high-income resident who had lived in Knysna for over ten years mentioned that

"*fire definitely but there have been floods that didn't affect us. In fact, strangely enough, even though our house was on a very steep slope but when we first got there, there was substantial floods and in that December 2004, our neighbours were busy having to shovel soil out and also on a very steep slope. So, we knew that was also a potential hazard, but it didn't affect our house, our house was fine*" (Middle-3, 2018).

There were participants that had a different view on what was the common or prevalent risk to Knysna. For instance, the officials from the municipality identified that the common risk to Knysna was drought, as there was a major drought that impacted on Knysna prior to the fire and Knysna was still grappling with it (Muni-1, 2018; Muni-2; 2018; Muni-3, 2018). When traveling in town to common places like restaurants and accommodation facilities, there were many signs that people should use water sparingly as Knysna was in drought. This reveals the high awareness in the town of the impact of drought.

Furthermore, it was also interesting how some participants identified other risks than the fire and drought as the most prevalent risks. For instance, one business representative whose business is operating closer to the sea in Brenton on Sea mentioned that

"*Strong winds were a common risk as they are the ones that normally cause damage to the property especially the covers of our parking"* (LocB-3, 2018).

To have a better understanding of the occurrence of natural hazards in Knysna it was important to consult experts such as the environmental consultants as they had a holistic understanding of these hazards. One environmental consultant mentioned that the occurrence/prevalence of natural hazards…

"*Depends on the scale, fire has occurred fairly often. Every year there is fire depends on the severity, so we had a bad one now, 18 months ago we had obviously severe*

fires. Flooding is less frequent, but floods do occur regularly. We've got small catchments and the mountains are close by, so when you have a big rainfall, the reaction is quite quick. I think the big floods tend to be more around once a decade kind of thing like that. But then from the ocean side, we've got a lot of big surges, if there is a surge now, there would be a whole lot of dune collapse on those houses over there. So, threats from the ocean are very regular. So also, clearly with the winds like yesterday and the day before there were big winds; so, power lines have been going down all over the shore and it gets complex. The hazards are quite multiple for instance, big winds cause fires, or you have things dropping like power lines and they cause other fires. So, hazards here are quite complex because they are interconnected; lots of connectivity and that is the thing the government doesn't engage with that connectivity at all" (Enviro-1, 2018).

However, both environmental consultants argued that the most prevalent natural hazard in Knysna or the most significant risk is alien vegetation, due to it threatening Knysna's water resources and also invading the natural vegetation to create high fuel loads which are a big fire threat in Knysna. The presence of alien vegetation was visible in Knysna if one was traveling in and out of Knysna, from both the east and west direction. Alien vegetation is evident on slopes of the Knysna Basin. The alien vegetation grew back very quickly and dominantly after the fire and others like pine trees were just dead trees after the fire. These were evident in the landscape and vegetation in Knysna. From all the participants there was a range of prevalent risks that were mentioned but the fire was the dominant one.

6.2.1. Understanding natural hazards and common risks in Knysna

The following tables and diagrams present people's understanding of natural hazards amongst different sectors in Knysna.

Table 3: Respondents level of understanding of natural hazards in Knysna

Sector	Number of people understanding/able to explain	Number of people that participated
Informal Settlement	3	5
Middle and high-income residents	5	5
Local Businesses	3	3
Insurance Sector	1	1
Municipal Officials	3	3
Environmental Consultants	2	2
Total	17	19

The following table shows what people from different sectors in Knysna think is the most prevalent or common risk in Knysna.

Table: 4 Common risks in Knysna

Most prevalent risk	Number of people	Total number of people
Drought	3	19
Floods	3	19
Alien Vegetation	3	19
Winds/Hail/Storms	2	19
Fire	11	19
Not sure	2	19

6.2.2. Understanding natural hazards as a prevalent risk

The majority of the participants in the study showed that they had an understanding of what natural hazards are. The only problem was that only three individuals out of the five individuals from the informal settlement knew or had a basic understanding of what natural hazards and

risks are, as it is shown in *Table 3*. One of the informal settlement residents identified television as a tool that has given her understanding of natural hazards and risks. This goes with the findings of Wachinger et al. (2012) that informational factors are indirect experiences of natural hazards by people which help individuals to base their risk understanding. However, when looking at other sectors that were interviewed each participant had a clear understanding of what natural hazards and risk are, as they were able to explain them and give examples of them; this is also shown in *Table 4*. Part of some of these participants' understanding was of the fact that they have had previous experience with natural hazards, as some had lived in Knysna for many years. For instance, one middle and high-income resident had noted that weather patterns were changing and the rain patterns. This concurs with Rufat et al. (2015) in their paper which found that prior experience, the occurrence of a disaster and long residency in an area contributed to people's understanding of natural hazards or risks.

It was interesting when the participants were asked about what the common hazard and risks in Knysna are; fire was identified as the most common hazard and risk in Knysna by the majority of the participants, but there are other risks that were identified, as one local business had identified storms; the environmental consultants had identified alien vegetation and municipal officials had identified drought; this is shown in *Table 4*. When analysing the findings, it was surprising that, other than the municipal official, no one identified drought as a prevalent risk, even though Knysna municipality was impacted by drought for a longer period of time. This was evident from the signs in some of the facilities which were encouraging proper use of water and is supported by Sutherland's (2016) research on society-environment relations in the town. Also, alien vegetation, which is a dominant land cover, was not regarded by most participants as a prevalent risk, even though it had fuelled the fire and was growing back at a faster pace.

The fires that were taking place in Knysna during the data collection period had an influence on the data that was provided with regard to the most prevalent natural hazard in Knysna, especially in the informal settlement where participants identified wildfire fire as the most prevalent risk. This can be seen in *Table 4*. With the identification of fire as the most prevalent risk by the participants; one can argue that people were reminded of the bad experience they have had and this relates to what was found by Wachinger et al. (2012) that the risk context and social context play a role in how people perceive risks. Moreover, when looking at how different people perceived the risks in Knysna that are most prevalent, people identified the

most common risk or hazards as a hazard that they have experienced before, or which had severe impacts to their lives such as the fire, alien vegetation and storms. This is supported by Wachinger, et al. (2012), who state that factors such as emotion, values knowledge, experience, and attitudes influence the acceptability and seriousness of a risk. However, it must be mentioned that another complex issue that emerged was that the risks and disasters in Knysna are often interconnected, hence there are instances were some participants identified more than one risk and this was due to the risks that they have experienced while living in Knysna. This is aligned with the findings of Knuth, et al., (2014) that risk can be concurrent, but individuals will perceive and rate the risk as to how they have experienced it.

6.3. Social, economic and environmental impacts of the fire

The fire had severely impacted the town of Knysna. However, it was important for one to understand the fire and what kind of fire this was and also its impacts on different sectors in Knysna. In doing so, the experiences of the participants in the fire and their knowledge of the social, economic and environmental impacts of the fire in Knysna was considered.

5.3.1 Social impacts of the fire

Understanding the fire and people's experiences of the fire

In understanding what kind of fire this was, one participant from the middle and high-income households showed great knowledge of the fire by stating that …

> "*The fire was devastating and scary, but it was also strange it would burn two houses out of the three houses and it would move down to the other places. It came down the valleys, it was traveling through the valleys. It was a sinusoidal fire, as it was very selective of the houses that it burnt*" (Middle-2, 2018).

Not all participants could define or state what fire it was, but their description of the fire was similar. For instance, one participant from the informal settlement described the fire, as…

> "*A jumping fire, I didn't think it would get here. I saw it while it was far, I was shocked it to wake up to it. Look how it has burned, it burnt here but and jumped those houses. It was catching and jumping and we the unlucky ones our houses got burnt*" (Informal-2, 2018).

When one was traveling through the town, I could see what these participants were talking about. The fire did not burn an entire area. It would burn one or two to three houses and jump

to other houses and do the same. There are houses that one could identify that survived, and yet they were close to burnt houses.

From the observation of the fire trail, it was fundamental that one finds out about the experiences of the people of the fire, especially those of informal households, middle and high-income households, local businesses, and environmental consultants. In exploring the experiences of the informal households of the fire, one participant explained that…

> "*I lost everything, everything of mine burned down. I went inside the house while I saw it was burning outside as I wanted to save my fridge and other things. As I was pulling my fridge, the door caught fire, I was stuck inside, I decided to stop pulling the fridge. Amazingly, there was an opening at the door then I managed to escape. Moments after, I had escaped from the burning house the entire house collapsed. You see, my house was made out of material that could easily catch fire, it was a wooden house with cardboards and a plastic ceiling; all of these are fuel to fire*" (Informal-5, 2018).

The experience that was shared by informal settlements was articulated in a similar way as those of middle and high-income residents. For instance one of the middle and high-income residents explained her experience as…

> "*Pretty scary when you are driving out in the fierce wind in the red sky and there are embers blowing across and people getting in their cars and rushing down. Well, I have never seen so many people driving out of Knysna Heights which is a quiet place*" (Middle-3, 2018).

The participants articulated their experiences from a broader view. However, it was important that one gets to understand them from a personal basis so that one could have had a better picture of how the fire had impacted on them. In discussing how the fire had impacted on each participant personally, the participants echoed the same sentiments. For instance, a participant from the informal households stated that….

> "*I didn't burn or anything harmful didn't happen to me but at the time of the fire, my baby was only six months old. So due to the fires, my little baby inhaled a lot of smoke which affected her badly. We had to rush her to the hospital, but we were helped by Red Cross"* (Informal-5, 2018).

The possibilities of individuals relocating after a disaster are normally very high. The fire impacts amongst the informal settlement residents were so harsh, that some even considered relocating after the disaster. One of the residents from the informal households explained that…

> "*I was not okay, I was really not okay. I even thought of relocating to another place and leave Knysna*" (Informal-4, 2018).

According to the middle and high-income residents, their personal experience of the fire was also negative, in a similar way to that of informal settlement residents. For instance, one resident mentioned that "*I suppose if I have to really be honest about it. It has impacted me in a big way, I lost my house; I lost everything that I collected over 50 years"* (Middle-1, 2018).

The impacts of the fire on both poor and middle to upper income residents were devastating, as revealed in the way they have described them. From both the informal settlement residents and the middle and high-income residents, though the fire was devasting, there was a sense of support amongst the community. Hence, the middle and high-income resident further stated that….

> *I have tried to help wherever I can help in terms of help in raising money to help other people to get their lives back in order. But that is what the town does and that is what I like about the town, it is a small town and people help each other but in the big city, you can get lost in the big city*" (Middle-1, 2018).

The explanation of these residents makes it evident that the fire was very destructive as it was able to destroy participants' houses and had posed a great threat to the lives of Knysna's residents. However, it is important to note that there was great support amongst residents as well.

Perceptions of middle and high-income residents on the fire

The social impacts of any hazards or disaster are the ones that are easily identifiable after such an event has occurred as they can be observed and expressed. In discussing these impacts one of the middle and high-income residents responded that

> "*On a social level, a lot of people came together, the community centres, counselling was available, Gift of the Givers was here. There are a lot of people that lost their jobs, there are a lot of people that kept them. Like I kept my helper to work for my mom for the seven months I was busy, but a lot of people lost domestic work as a result of the houses being burnt down. Now the houses are up obviously they are*

coming back into the web but for an 8-month period suddenly you don't have a job" (Middle-1, 2018).

Informal residents attested to the information that came from the middle and high-income. According to one of the informal settlement residents

> "*Some of the people that were affected by the fires lost their jobs because the fires had also burned were they work but the fires created jobs, people were hired. People were hired to clean places that had burned down"* (Informal-1, 2018).

From the input of the informal and middle and high income residents the fire was clearly devastating as one of the municipal officials explained that

> *"I think psychologically the whole town was profoundly impacted by the fire. Some people just didn't recover, I mean the deaths after the fire were often associated with stress. So, the fire was over very few people died directly in the fire but there was collateral damage from stress-related factors"* (Muni-1, 2018).

Similarly, the other two municipal officials and one local business official had the same sentiments that the fire had negatively impacted the people of Knysna socially. People had lost their homes and others could not afford to rebuild and this has resulted in them moving out of Knysna. Also, places that were made for people to enjoy themselves like restaurants and guesthouses had burnt down and now people had lost those recreational places, so this had a negative social impact on them (Muni-2, 2018, Muni-3, 2018 and LocB-2, 2018).

Despite the fact that the fire had negative social impacts on someresidents of Knysna, it also came with benefits for others and these benefits were found amongst informal residents as well. According to one of the participants from the informal settlement, the social impacts had benefits in that

> "*Where we used to stay we were illegally connected to the electricity but since we have moved here they have given us electricity, we are also going be given proper houses with toilets, so in a way, I can say this are the social benefits to the fires"* (Informal-4, 2018).

However, not all informal settlement residents saw the social impacts of the fire as a benefit as other informal settlement residents noted that they were great costs on social cohesion and identitys. For instance, one resident argued that

> "*There are social costs because of the fire. We have even had a meeting on the fact that we as the people from new res we have a problem in sharing with other people from other townships because we do things differently. Due to our differences, this will result in war as we can't live together. There is noise and the houses are close to each other, even though we have electricity and toilets here I don't like it*" (Informal-4, 2018).

The negative social impacts of the fire were not only in the informal settlement, but they were also reported by the middle and high-income residents. For instance, one of the middle and high-income residents who forms part of the Knysna Society of Model Engineers explained that the negative social impact of the fire was that

> "*The fire was devastating, it destroyed our railway line and the whole infrastructure that has been there for 37 years, we could not get help to rebuild. We had a coal crusher which used to crush coal for the little locomotives, it got damaged by the fire. Our little station got burnt. The fires damaged our coaches, but we are repairing them. Luckily our locomotives which took thirteen years to build got saved because of where we had put them. This railway line has been around for 37 years, all the children of Knysna came to ride on the train, it had a strong history*" (Middle-2, 2018).

As I was observing I was able to see the ruins caused by the fire. The railway line was not recognisable from what it used to be. Everything was completely damaged, the only thing that survived the fire where the signs, one with a train and the other with the society's name. From the railway line, I was able to see some of the houses that got burned. In one house there were ruins of a motorbike and car left that showed that the place was once someone's garage. In the informal settlements, I was able to see where the new houses were located which housed those that lost their houses. Some of the complaints from the residents I spoke to were evident to me during my fieldwork. The houses were close to each other, one could hear people talk in the other house while sitting on the outside of another house. Those that played music, the sound could be heard by everyone. The point made by Informal-4 (2018) was valid as the distance he traveled was quite long and steep to travel each day for food.

5.3.2. Economic impacts of the fire

In unpacking the economic impacts of fires, it was important that one gets an understanding from some of the businesses in Knysna. According to one of the local business officials in Knysna had negatively impacted them, as the official explained that

"*Economically the fire had negatively affected us in the sense that not only did we lose part of our building but we also resorted to closing the business entirely until the whole rebuild process was finished and this took a year"* (LocB-2, 2018).

The fire had impacted many sectors and there were negative economic impacts across the scale, but the tourism sector was one of the sectors that was severely impacted. One of the municipal officials explained that

"So, economically we were dramatically impacted. Simply because there were guest houses and people's houses were destroyed, so the tourism industry took a knock. And right after the fires our most popular tourism event the Oyster Festival, one month after the fire and we had to put a clear message out there that it is business as usual, but it wasn't, it could have never been. " (Muni-1, 2018).

Even though the fire had negatively affected the business there were good benefits that came out of it as well as the official further stated that

"The rebuilding process was finished this year and in a way the fire has benefited us, because with the new building we got upgraded to 4 stars which was something we always wanted to do and as well, the rooms are bigger and much nicer and luxurious with better views and since then we have increased positive reviews" (LocB-2, 2018).

Another business representative also highlighted the fact that the fire economically had negatively impacted their business, but there were also benefits to it. The forestry company representative stated that the fire had a devastating impact on the forestry industry in the area:

"*the fire had negatively affected us as we have lost 20 years of timber and with the current fire things are still going to be bad. In the short term we have benefited because of the help from the insurance and the stocks that we had but the revenue we have is going to be a problem in the future because we must spread it over a period of twenty years until the trees have grown again. So, the fire economically has hit us hard"* (LocB-3, 2018).

One must note that when looking at the economic impacts of the fire it was also important to look at the economic sustainability of the town. According to one of the environmental consultants, when it comes to the impacts of the fire to the economic sustainability of Knysna …

"*there are two sides to this question, so people that were not insured we think about a third of the houses were not insured, so, there were considerable losses because of that. On the other hand, you've got those people that were paid out by their insurance they would rebuild, so what has happened there is a whole building boom that occurred in the town. In other words, the whole reinvestment that has occurred from external money largely from the insurance companies and now is coming into the town"* (Enviro-1, 2018).

Moreover, the environmental consultant also highlighted an important point that though the fires had negatively impacted the economy of Knysna but there were also benefits that also triggered to other places outside Knysna as she stated that

"I think it was about 5 billion, so lot of money has come in and has stimulated a lot of growth. So, consequently building a house is now expensive because the demand of building houses has multiplied, so we even people from the Eastern Cape and George and as far as Cape Town. " (Enviro-1, 2018).

Furthermore, the consultant also echoed the economic losses of the fire which some stated by the local business such as the forestry business. She stated that

" So, there is a building boom that has occurred on the one hand but there were losers as well. For instance, people that worked in restaurants didn't get rebuild so those are the losses. So, there were losers from certain establishments, but the builders have gained and the building companies and suppliers. The timber industry also took a knock as they were negatively affected severely. Also, the tourism industry was punished for a while because this place looked like a dessert for a good six to eight months, a lot of cancellation were made so for a good four to five months there was practically no tourism because of the fire" (Enviro-1, 2018).

While traveling in Knysna I was able to see what the environmental consultants were talking about there were a lot of houses that were rebuilt and being rebuilt. One could see construction workers busy and their cars going about town. When I conducted the interviews in the informal settlements, big construction trucks were also going in and around the township. There was a new area where they were building new houses for the victims of the fire.

Similarly, to the points made by the environmental consultants, the insurance representative, when speaking of the costs for the residents argued that

"I think it is a million-dollar question or a billion-dollar question. I heard numbers being thrown around 3 billion and 4 billion rands, but we will never be able to I guess accurately, establish exactly what the loss was for the community, for local businesses in Knysna, but its huge that I can tell you, but its billions that is true" (Insurance, 2018).

According to the insurance representative the costs of the fires were estimated to be in the billions of rands, and the informal sector whose losses are most often not accounted for also suffered significantly. When the insurance representative was asked if this includes business or businesses they have their own costs, he responded that

"*Number 1, the loss of infrastructure, the loss of jobs both in the formal but also in the informal sector whose depended on a job in the formal sector; so the gardener, the domestic worker, that laundry person, people who work in guesthouses, housekeepers at guesthouses. So those homes are gone and those jobs are gone*" (Insurance, 2018).

It must be noted that the insurance representative also reiterated what was said by both the environmental consultant and the business representative that there has been a great opportunity to Knysna though the fire had impacted some sectors negatively. As the representative explained that

"The fire brought with it, I think a new opportunity, the rebuild programme of Knysna the building sector is now blossoming, a lot of new opportunities is actually being created out of the process. The tourism sector was severely impacted and general business, those people who had a gardening business that went out to other people's gardens just to go tender the garden and clean the garden, they are losing but the builders are wining, so you could probably argue that" (Insurance, 2018)

It was established that the insurance sector had played a significant role in Knysna during the fire disasters. One needed to also establish how the insurance companies were impacted especially in terms of their costs. According to the insurance representative, it was difficult to estimate the cost, but he explained that

"*I can't give you an exact number, but we paid claims in Knysna at a gross level in excess of 800 million. Obviously, reinsurance, recoveries, etc. played a part, so the net impact of Santam was far less but the impacts that followed has made our*

reinsurance rates, premiums we now pay because of that big claim has significantly been impacted by that" (Insurance, 2018).

Despite the fact that the insurance sector had endured severe costs to the fire, there were also benefits to the insurance sector. According to the insurance representative, there are a number of lessons that were learned from the fire and these included lessons for the consumer. For instance, the representative explained that

"*I think a number of different lessons to be learned. Firstly, in terms of the client just and general insurance consumer education, understanding the importance of total loss by a disaster and how important it is to actually have insurance"* (Insurance, 2018).

Furthermore, the representative noted that despite their reputation in the industry, the fire also taught them how to better deal with their clients. By stating that

"for us as a company, although we were well prepared and probably one of the most well-prepared companies in South Africa, we still learned a lot about clients understanding of what a total loss really is, what thorough and accurate insured value should be and what content insurance should be, as people are trying to keep the cost of insurance as low as possible as clients never imagine a total loss. So, our process of helping clients understand what it is that they insure and against what it is they insured is very important" (Insurance, 2018).

The insurance representative also articulated the need for better infrastructure as municipalities are often under-capacitated to deal with such disasters. According to the insurance representative, this was a great lesson and in the fire and they saw an opportunity to give back by enhancing the municipality, as the representative explained that

"We also understood out of the process of how important loss prevention is and the effectiveness of local government and local municipalities. A great deal of the loss is because of inadequate resources, training and support by local government and local resources that led to the devastation. We have started a programme for risk and resilience, where we work with local municipalities and Knysna happens to be one of them now, where we invest a lot of money back into the communities, back into local municipalities to support them to maintain their infrastructure to teach them and to sponsor some of the programmes etc" (Insurance, 2018).

The impacts of the fire on the construction industry were well explained by most of the participants. However, it was also important to find out from one of the local construction businesses about the impacts. The information that was gathered from the participants aligned with the information from the construction company representative. According to the representative there were benefits to the construction industry from the fire. For instance, the representative remarked that

> "*I opened my businesses two months after the fire and already I have few contracts with residents who lost their houses and their sourcing out material from me. So, the business has picked up as there are now a lot of people that are rebuilding"* (LocB-1, 2018).

5.3.3 Environmental impacts of the fires

The municipal official from the environmental division provided great insight into the impacts of the fire on the environment. She stated that

> "*Environmentally the devastation was quite dramatic in terms of the loss of critically endangered vegetation types. It burnt everything from wetland vegetation to indigenous forests which have never experienced before; but it also did us a lot of favours because it burnt fynbos that should have burnt already five, ten or fifteen years ago. So, we are seeing now a year and half year after the fires increased diversity in areas that haven't burnt.* (Muni-1, 2018).

The environmental consultants views on the impacts of the fire on the environment of Knysna are important as they are experts in this field. According to one of the environmental consultants

> "*Several things occurred, one it reset many cases it burnt, it burnt a lot of vegetation that needed to be burnt, that was positive. The negative was that many of the aliens are Australian species which are triggered by the fire. So, then you have a regrowth, some places like ourselves we are focused on dealing with the regrowth, but other people haven't. So, this was a window of opportunity that was created to clear aliens, so if you have fixed standard of big trees, alien trees they all got burnt* (Envir0-1, 30-10-18).

Furthermore, there was also a great opportunity that the fire had presented to Knysna's people and the environment which is in cutting costs in addressing environmental problems in Knysna,

especially those of alien vegetation, as it was also highlighted as one of the natural hazards in Knysna. According to the environmental consultants

> *"So, the costs of managing alien vegetation were in fact really low after the fire, because you just have to pull out by hand. My wife and I and a few other we cleared our village, we have been doing it by hand with no cost. If you have to leave those trees and they get very big then you will have high costs, you look at six thousand rands to clear it. So, the more you leave it the more expansive it gets to clear. So, in many ways it provided a window of opportunity, but most people didn't take that window of opportunity"* (Enviro-1).

In support of the consultant from an observational point of view, I noticed that when driving around Knysna there were a lot of trees that were burnt down and most of the trees were alien trees such as pine trees. One could identify dead trees due to the fire up the mountain. When I visited the consultants in Brenton on Sea, the residents were busy with the alien vegetation removal which was done daily for prevention of other fires.

6.3.1. How fires have impacted different sectors in Knysna

The social economic and environmental costs and benefits are summarised in Figures 4 to Figure 5, below. In Figure 4 the middle and high-income residents, informal settlement, Knysna Society of Model Engineers and the municipality had higher social costs, than other sectors. Moreover, the sectors that were identified to have high economic costs are local businesses, informal settlement residents, the municipality, insurance sector and the Knysna society of model engineers due to the loss of assets and this is also shown in Figure 4. The figures also show that the fire had positive benefits, as it was able to burn unwanted alien vegetation and it also gave residents an opportunity to clear alien vegetation at a lower cost as shown in Figure 5. Also some of the benefits can be seen from the construction sector as it is represented in Figure 5.

The following diagram shows the social and economic costs of the fires in different sectors in Knysna.

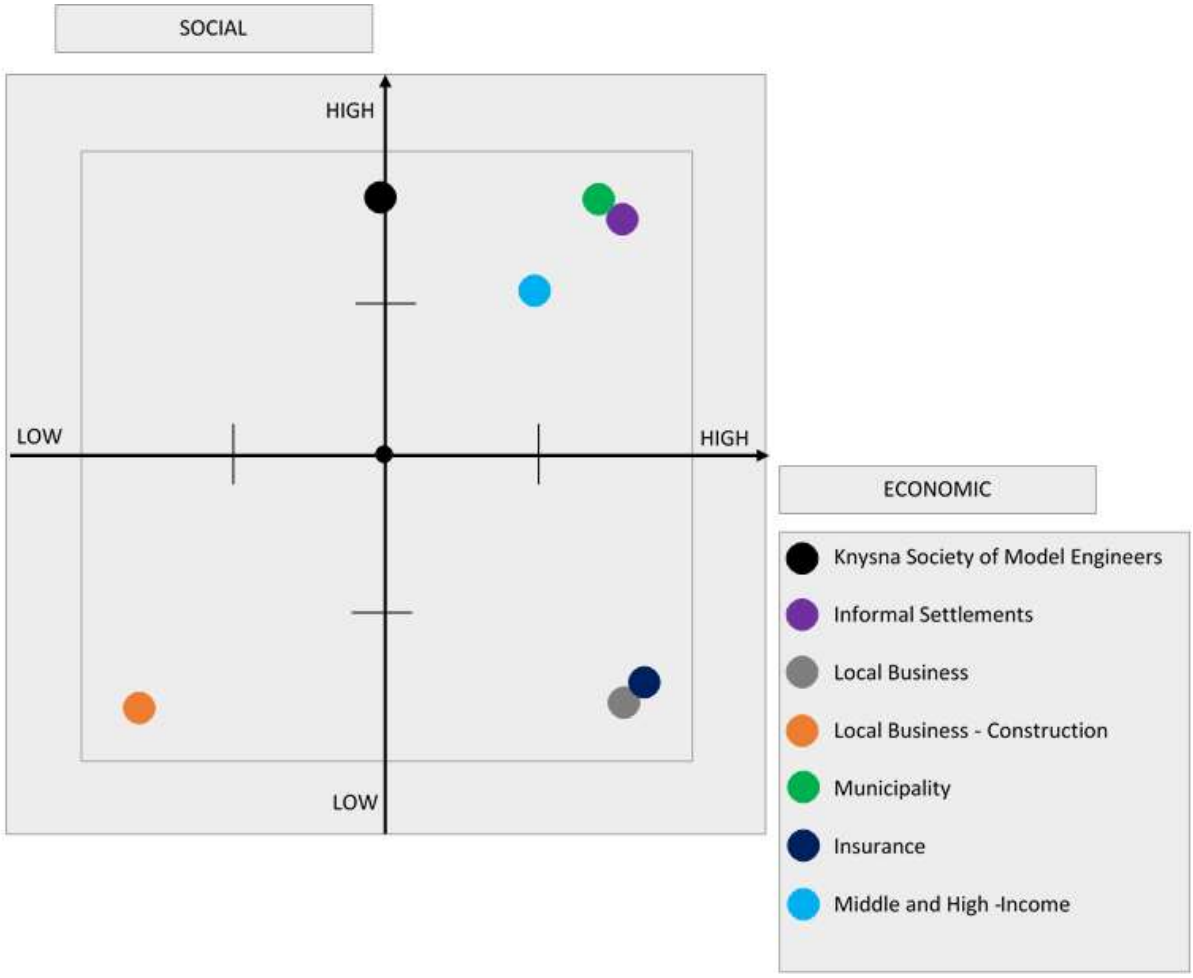

Figure 4: Social and Economic costs of Knysna fire

The following diagram shows the social and economic benefits of the fires in different sectors in Knysna. The x axes show the economic impacts and the y axes the social impacts, whether they were high or low.

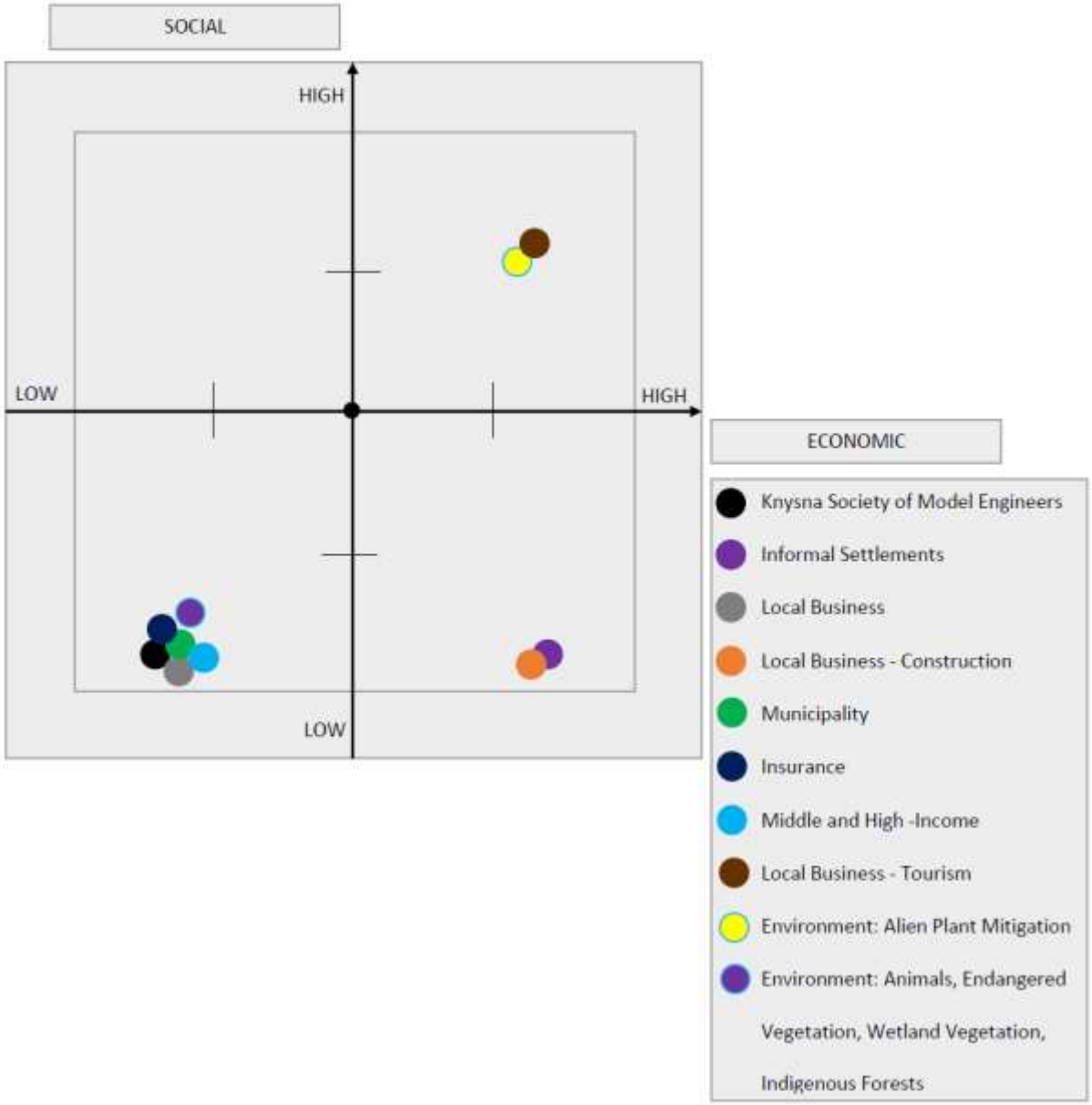

Figure 5: Social and Economic benefits

6.4.The vulnerability and coping mechanisms and support systems of the people of Knysna and their resilience.

Since natural hazards come with many risks, it is fundamental that one gets to know who are the most vulnerable to them and what coping mechanisms and support systems do they have in order to deal with these hazards, especially fire. There is a range of questions that were posed to different sectors. However, since vulnerability goes hand in hand with resilience it was also important to find out from the participants about their perceived levels of resilience and that of the town.

6.4.1. The vulnerability and coping mechanisms and support systems of the people of Knysna

Disasters such as natural hazards, leave many people in dire situations resulting in them becoming vulnerable to future shock and stresses. However, it is always better for individuals that are affected to know their vulnerability, coping mechanisms and support systems they can use. In establishing this in Knysna, a participant from the informal settlement indicated that

> "*Since last year fires, I feel vulnerable because I never thought such an incident as the fires can affect me this badly. I still feel in danger because I don't have tools to stop the fire or protect myself"* (Informal-4, 2018).

From the statement by this participant, one would assume that the information would reflect the sentiments of other informal settlement residents especially knowing that natural hazards often have the likelihood of increasing a person's vulnerability. However, one of the informal settlement residents had a different view of vulnerability as the participant stated that…

> "*I am no longer as vulnerable as I used to be, in the place I am leaving now I feel much safer. Before I was living closer to the bushes and this had made me much more vulnerable but since I have been moved to the centre and I am right at the middle, I feel much more safer and less vulnerable*" (Informal-5, 2018).

The two participants show contradicting ideas on their vulnerability. The informal settlement residents that expressed their vulnerability from an observation point of view were those that had not moved or received assistance from the municipality and were still living in the wooden structures that they had rebuilt, which were still the same as the ones that were burnt by the fires. However, those that had expressed that they never felt vulnerable are those that got help from the municipality and were moved to new structures in a new area. Though some of the structures were wooden, what made them feel safe was the fact that they had piped water and fire extinguishers close by and where located at the centre of the township. However, it must be noted that this response may not reflect the feelings and perceptions of others living at risk in Knysna.

In questioning the vulnerability of middle and high-income residents, it was evident that they also felt vulnerable like the informal settlement residents. However, to them, coping mechanisms were far more important. For example, in discussing the vulnerability and coping mechanisms to natural hazards one participant indicated that

"It is a fairly wide spectrum question, I am aware of them and yes I am vulnerable to them, everybody is vulnerable to all the hazards, it is how you cope with them and how you deal with them, when they happen" (Middle-1, 2018).

Another respondent from the middle and high-income houses mentioned that he never felt insecure or vulnerable in the house he used to live with his wife, but his wife always felt vulnerable especially to fire and always thought that if it could happen they would be badly affected (Middle-3, 2018). From the responses of the middle and high-income residents, all participants identified themselves as vulnerable to natural hazards and other risks.

The vulnerability of the local business in Knysna was expected to be different from that of residents, as businesses, assess their vulnerability to the structures and assets they operate in or have. From all the business officials responses, only two business officials identified that they were vulnerable to natural hazards. One representative identified the vulnerability of their business from mostly fire and drought, as they were a forestry business and with the fire that was in their midst during the data collection process, this had shown that fire was a disaster that was causing great vulnerability to them. On the other hand, another business representative expressed that their vulnerability was mostly from natural hazards that came from the ocean, such as strong winds and lightning, but not necessary the fire, as people are much aware than before (LocB-2, 2018; LocB-3, 2018).

According to the construction business they were not vulnerable to natural hazards. However, this was based on the location of the business as the business official indicated that

"*The location of our business favours us in terms of natural hazards. We are located in town far from the trees and bushes and also, we are far from the water. So, if a disaster would occur we would be the least affected and also, we have all the facilities here in town. The fire station is right across the road and the municipality is also here. So, I don't think that our business is that vulnerable"* (LocB-1, 2018).

In getting a clear picture on who is the most vulnerable in Knysna, it was important that one consults both environmental consultants and municipal officials as they have expert information and were going to be able to elaborate on the question of how vulnerable the people of Knysna are to natural hazards and who is the most vulnerable and why? According to environmental consultants, the poor are the most vulnerable when natural hazards occur. One environmental consultant explained that

> "*They are highly vulnerable because everyone uses water. Most hazards are associated around water and it is the poorer people that are vulnerable because they are less capable of dealing with the impacts, so everybody is exposed to the same risks. For, instance nature doesn't care if you are poor or richer or about your race, so the risk is the same but the impact, the consequences of the impact are very different. So poor people don't have insurance, they won't have the means to get in their car to go and get water. They don't have other alternatives, in most natural hazards poor people are the ones that face the greatest costs*" (Enviro-2, 2018).

One must make note that in the context of South Africa, most poor people are located in informal settlements. However, municipal officials like environmental consultants, identified informal settlements residents as the most vulnerable when it comes to natural hazards as one official mentioned that

> "*The most vulnerable are always the poorest, not necessarily in terms of the drought, I think we are all equally vulnerable when it comes to drought. But when it comes to things like flooding or fire, the poorest are certainly the most vulnerable because the access that they have when it comes to emergency services is compromised because of where they live*" (Muni-1, 2018).

Both environmental consultants and the municipal official gave a broader overview of who is the most vulnerable when it comes to natural hazards. However, it was important to get an understanding of Knysna residents vulnerability in regards to the fire disaster. However, in having a discussion about the vulnerability of Knysna's residents, one municipal official stated that

> "*This fire was non-selective. Some people have referred to it as a rich man's fire. Because it seemed to target wealthy areas. You have to look at areas in Plettenberg Bay that burnt, there were 150 homes that were destroyed in the informal settlement but there were close to two thousand homes that were either completely destroyed or damaged in the formal settlements*" (Muni-1, 2018).

Again, formal household residents were identified as the most vulnerable when another municipal official was explaining about the vulnerability of the people of Knysna when it came to the fire, as the official explained that

"*There was a lot of people impacted the biggest area was the Knysna Heights, the Brenton's but mostly the Welbedacht, the Salt River, the Knysna Heights people and 200 people in the White Location area, which is an informal settlement. At the end of the day, the number of registered disaster victims, households burned down was 1 533; households affected 560 and households destroyed 973. So those people were most vulnerable when it came to this fire and most of them live in formal households*" (Muni-2, 2018).

In contrast to this municipal official, one municipal official explored vulnerability to a further level by also elaborating on the social circumstances of the residents of Knysna, as the official explained that the most vulnerable when it came to the Knysna fire were

"*All the people in the Northern areas. Because, this fire was unique, the disaster was unique as well as more wealthy, well-established people lost their homes than poor people, but those people could in a way insulate themselves; they could easier find a friend or neighbour who still had two-bedroom rooms to sleep in for the following day or so. Lots of holiday homes got destroyed, but I still think the most vulnerable people were residents of the 150 houses that burnt down in the informal area. A lot of them got to stay in community centres up until temporary housing was established and also obviously because of money, you have lost so much that you can't rebuild*" (Muni-3, 2018).

From the discussions made by both environmental consultants and the municipal officials, it was clear that in natural hazards and risks it is mostly the poor that suffer the most. However, when it came to the Knysna fire, there were different views, as two of the municipal officials held that the middle and high-income residents, which include those that owned businesses were the most vulnerable, but the environmental consultants and one municipal official maintained that it is mostly the poor from the informal settlements that were vulnerable in the fire.

After establishing how vulnerable the people and businesses of Knysna were, it was important to understand the strategies or structures which were put in place to cope with the fires. In any disaster, it is of utmost importance that people have strategies and structures in place. In exploring these strategies and structures in Knysna, emphasis was put on both informal settlements, middle and high-income households and local businesses.

When finding out about coping mechanisms which were in place to cope with the Knysna fire, from both informal households and middle and high-income households, a participant from the informal households spoke about coping mechanisms from a joint perspective by community members as the participant indicated that

> "*I am coping by not stressing myself on what has happened as life continues. I am coping also by having prepared myself for future disaster, for instance, we have brought water pipes closer, in case another fire happens we can be able to stop it. As well we have cleared the trees and other plants closer to the house so that if there is a fire it won't be able to burn our houses. So, this is a way of preparing*" (Informal-2, 2018).

In the Knysna fires, attitude was an important factor in coping with the fires. For instance one of the residents from middle and high-income, expressed that

> "*coping with the fire? oh well you know we just do; you don't really have a choice the fire has happened and there is nothing we can do about it, we just have to be positive and continue with life*" (Middle-3, 30-10-18).

Apart from the positive attitude, other participants from middle and high-income households expressed that insurance companies had played an important role in helping them cope with the fire. If it wasn't for insurance they don't know where would they be as they had lost everything in the fire (Middle-1, 2018; Middle-4, 2018 and Middle-5, 2018). However, it must be noted that also, insurance played an important role to the local business, as two businesses mentioned that their mechanism to cope with the costs of the fires came from having insurance (LocB-2, 2018 and LocB-3, 2018).

When looking at the responses, the informal settlement residents relied on community and family support as a coping strategy and a support system. However, the middle and high-income residents and businesses had insurance which helped them greatly in coping with the disasters; family and community support also played a crucial role in them coping and improving their lives after the fire.

While doing the interviews, I was also observing if the participants I had visited in Knysna were rebuilding or not. In the informal settlement, all the participants had houses after the fire, even though some had to rebuild from scratch. Others were moved by the municipality to new houses. The houses in the informal settlement which were rebuilt were still hazardous, as they

were made from timber, and plastic material was still used. However, with the middle and high-income households, one family had moved from Knysna but had settled well in a retirement village, another participant had built a new house in a new area but was still rebuilding the damaged house, and a third participant was also busy with the rebuild and fixing his burnt farm. The participants that lost their railway line and locomotives were also busy rebuilding new railway lines and locomotives. From an observation point of view, it seemed like all the participants were coping and they had good support from friends and family members. The middle and high-income and local business also had good support from the insurance industry where they were insured. However, when it came to the local businesses, two businesses were doing well, but the forestry business was still under stress as there was a fire that they were tackling which had affected their business.

6.4.2. Understanding of resilience in Knysna

According to middle and high-income households, the fire has revealed that Knysna was resilient in the fires as people were able to go on about their lives. One participant indicated that

> "*I think it's pretty good, we produced a t-shirt 'Knysna Rises', I think that is great, that is part of the resilience, we are talking about perhaps. Also, you can see from the community it came together and when there is a disaster the people of Knysna are fantastic. I think people are resilient but there must be more awareness of this disasters so that people can be much resilient, but I think the people of Knysna have been so resilient and have done so well*" (Middle-4, 2018).

Also, the local business representatives that were interviewed stated that the Knysna fire has proven how resilient their businesses are, as they were able to open and function after the fire. The municipal officials also stated that the people of Knysna have proven to be resilient in the fire. One official mentioned that...

> "*It depends what you mean. Only seven people died in this fire, that is amazing. If you could have been here at the time you could have thought hundreds of people would die in this fire. So, from that perspective I would say that they are quite resilient; from planning for the next one six months after the event people are going about their lives in the same way they did before the fire*" (Muni-1, 24-10-18).

Though middle and high-income households and municipal officials had echoed that Knysna was resilient, there were those that were unsure of the resilence of Knysna. For instance, one informal settlement resident indicated that

> "*I can't say Knysna is resilient because it can burn anytime from now and I still feel unsafe; even the trees are growing again*" (Informal-4, 2018).

The environmental consultants also had different views on Knysna's resilience. One of the consultants when discussing the resilience of Knysna argued that

> "*To some degree, you live in the system, you are aware of certain things but for like water we've got really short rivers, low dams and like after the fire one saw thousands of jojo tanks being sold. People were doing that themselves. Things like fire, we've got like the fire protection association that is quite active. I think in some sense people were preparing for it but also everybody was thinking it's going to be one fire, a small fire. So, if we had a fire, you would expect the fire engines to come and other farmers to come. Here in terms of scale, I don't think nobody was prepared that everywhere it was going to be burning at the same time. So, I think at the small level people are resilient to fires not resilient for water* (Enviro-1, 2018)

Furthermore, the environmental consultant elaborated on how some people create resilience for themselves especially those that can afford to. The consultant also took into consideration other disasters in Knysna other than fire by mentioning that…

> *I think this thing about flooding and sea hazards and things like that happen, now you see people starting to protect the properties like in Buffalo Bay. People recognise the erosion of the sea and putting in various structures, so in Buffalo bay, they formed a small company, I think about twenty or thirty property owners raised the money to build erosion structures to protect the houses. I think you see people at the coal face being fairly resilient, but I think people in towns and informal settlements are not*" (Enviro-1, 2018).

The information from the environmental consultants was interlinked but one consultant highlighted how disparities especially those of social status play a role in the resilience of individuals in Knysna by explaining that

> "*I think you also can't answer that question with the whole of Knysna in one sentence. if you took the picture of Knysna and you've got the kind of informal settlement up in*

the top, they will have low resilience from a number of angles. First of all, they are very vulnerable because of is mostly timber, plastics, and whatever structures, so they are very vulnerable to fires, wind and big storms; they are definitely exposed but because of the poverty they are also not resilient. So, if we do have impacts from natural hazards they can't bounce back very easily" (Enviro-2, 2018).

The consultant further gave an in-depth understanding of the dynamics of Knysna when it comes to its resilience and how these dynamics play a major role in people's resilience by arguing that

"If you take Brenton on Sea, it is completely different, there are very few timber structures; there are some but mostly is brick and motar. So, they are not as exposed to wind, heavy storms and fires etc. The number of structures that would burn if you get a fire coming through would be less than when the fire burns through the informal settlement on the other side. Generally, the people will have more money, so if there is an impact or something happens, or the roof blows off; people can generally respond. So, I think one must be careful, like the resilience of the living environment will be quite different in different parts of the town. It's definitely not the same thing everywhere. It's largely linked to the poverty levels and income levels; the lower the income levels the less resilient. The settlements and the people are going to be vulnerable to hazards. The vulnerability and resilience link very closely together" (Enviro-2, 2018).

During the fire and post the fire there was a lot of work done by the insurance industry, however, it was important to hear from them on what was their thoughts on Knysna's resilience and its residents after the fire. The insurance representative had a different view by arguing that

"*I think Knysna wasn't [resilient]. We did a lot of work with Knysna Eden district around flood risk; we did some work in Eden District with fires that happened in Jefferey's Bay some years ago. We did not do enough to support local government around the awareness of veld fires, runaway fire risk and we did not do enough to date, I think in terms of supporting them to be resilient when it comes to informal ways of fighting natural disasters"* (Insurance, 2018).

Awareness of natural hazards is important in preparing individuals and in making them much moreresilient. However, the majority of the participants especially those from the informal settlement and the middle and high-income residents agreed that there was not enough awareness in Knysna on natural hazards and other risks when questioned if the municipality

was raising awareness of natural hazards in Knysna. Instead, most of them stated that the municipality started raising awareness after the fire. For instance, one informal resident indicated that…

> "*Soon after the fires there were people that came to raise awareness campaigns on fires in our communities. Even our children at schools they were taught on fires"* (Informal-5, 2018).

6.4.3. Vulnerability and perceptions at a glance

The following diagram shows how vulnerability is being perceived by people from informal settlements, middle and high-income households and local businesses when it comes to natural hazards.

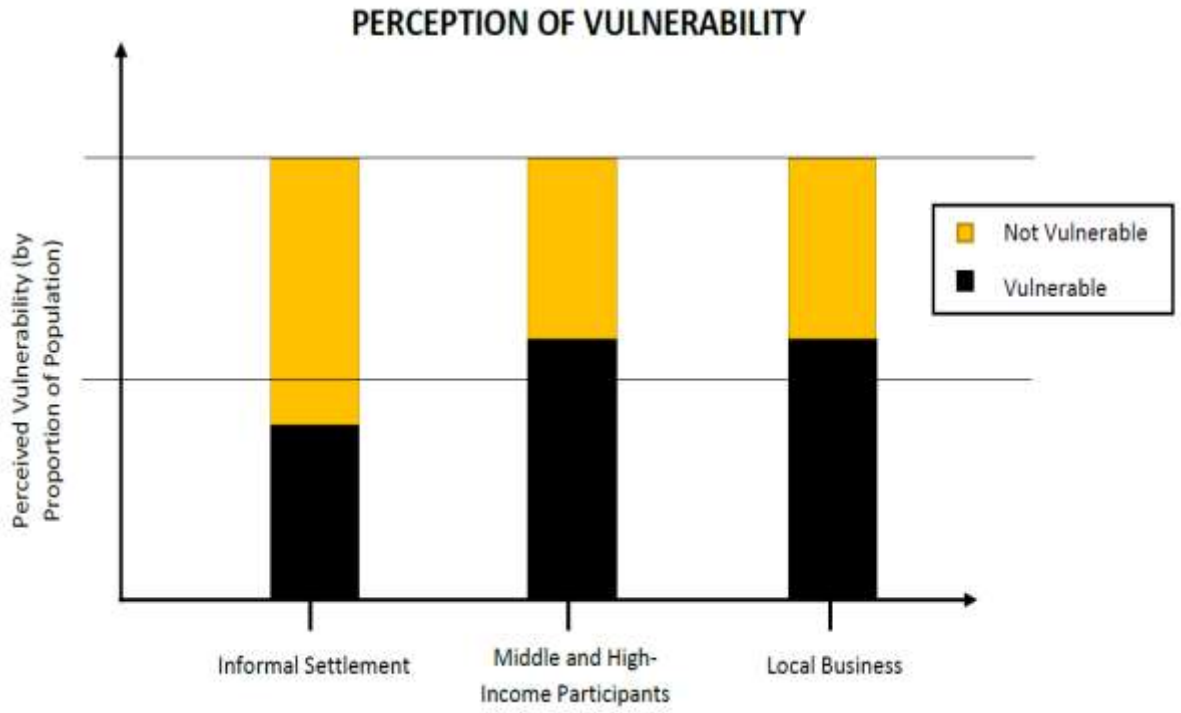

Figure 6: Vulnerability Perception

The following diagram shows who the municipal official perceives the most vulnerable due to the fire. The yellow part symbolises those that did not feel vulnerable while the black part symbolises those that felt vulnerable.

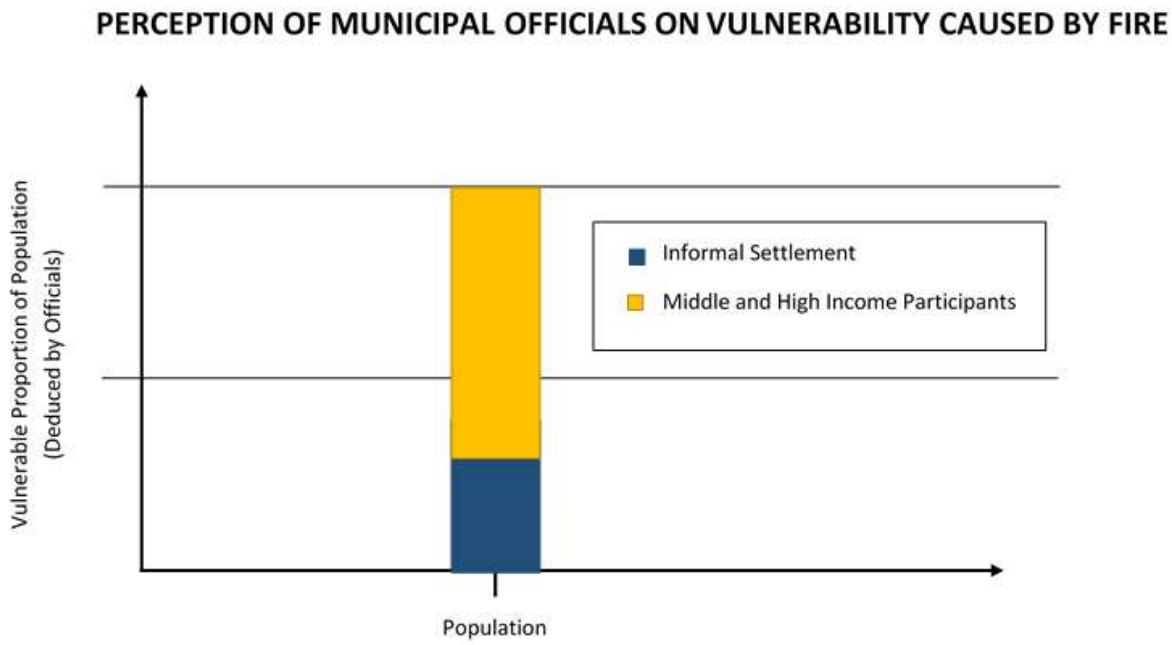

Figure 7: Knysna Fire Perception

This is according to the municipal officials that were selected for the study. The blue symbolises informal settlement residents, which according to municipal officials were the least vulnerable while the middle and high-income participants were the most vulnerable.

6.4.3.1. Who is vulnerable and what are their coping mechanisms and support systems in Knysna?

When it came to understanding how vulnerable the people of Knysna are to natural hazards, there were varying answers that came from the participants. In the informal settlement, there were those that held the view that they were still very vulnerable especially after their experience with the fire. All the residents that expressed their vulnerability were those that had not moved and had rebuilt in the same area, where their houses had burnt and they had used the same material as before which was timber and plastic mostly. Those that were moved to a new location with new houses and better services expressed that they were no longer vulnerable to natural hazards. This is shown in Figure 5, which shows that a majority of the informal settlement people felt less vulnerable to hazards.

According to participants from the informal settlement, the only natural hazard that they could think of was fire, as it is something that they have had direct experience with, so they identified their vulnerability to fire even though the question that was asked of them, was not limited only

to fire as a natural hazard or risk. The data on informal residents indicates that from informal settlement residents' perspectives, vulnerability is based on where one stays, and on what big risk they have experienced and in this case, the fire was the biggest risk. Looking at how informal residents perceived and expressed their vulnerability this agrees with what these researchers had found that direct experience with single type events such as floods and bushfire, increased perceived vulnerability and risk for these hazards by people (Gow, et al. 2008; Kellens et al. 2011).

The information that was gathered from middle and high-income households was slightly different from that collected from the informal settlement residents. The majority of the middle and high-income residents expressed that they felt vulnerable to natural hazards. This is represented in *Figure 5*. However, their vulnerability was not only limited to a single disaster but was generally on all the possible disasters that could happen. What I also found was that although the middle- and high-income residents knew of their vulnerability to different hazards and risks, what was important to them was on how they go about coping after a disaster has occurred or preparing for other disasters. This is consistent with De Silva and Kawasaki (2018) findings that non-poor people in natural hazards and disasters tare also highly vulnerable, but frequent disasters and risks make them adopt safety precautions that help them not be as vulnerable in the future. They attempt to make their lives safer using their resources. This option is not readily available for poor households, as they do not have equal resources as those from non-poor households.

Local business owners in Knysna that were interviewed, especially the two that were directly affected by the fire, expressed that their businesses were vulnerable to natural hazards. The business that expressed that it was not vulnerable to natural hazards was the construction business that was located in town. Similarly to informal settlement residents that felt least vulnerable, the representative stated that their business was in a secure place as it was central to town and close to major facilities if a disaster had to occur. The forestry business expressed its high vulnerability, and this was mostly due to the fires that were happening at the time of the data collection and these fires were once again affecting their business. Location is a critical factor in determining exposure, vulnerability and risk.

The tourism business which was closer to the ocean identified that it was highly vulnerable especially to disasters that come from the ocean, such as storm surges. In terms of what was said by the tourism officials, both the tourism and forestry sectors were highly vulnerable, but

the construction business was less vulnerable, and this is shown in *Figure 5*. This concurs with Zhang et al. (2007) that construction companies during environmental disasters are less vulnerable than other businesses, as the vulnerability in other businesses during environmental disasters occurs through capital, suppliers, labour and customers and this makes these businesses ake a longer time to revive themselves after a disaster than a construction company would do, as the construction company is often involved in rebuilding and hence this type of business benefits from natural disasters

The municipal official had different views on who was the most vulnerable in the fire; most of the officials stated people from the middle and high-income households were the most vulnerable as shown in *Figure 6*. The reason for this was of the fact that the fire destroyed more formal households than informal households, which had a few houses that were impacted. However, environmental consultants held that in any hazard or risk, the poor in the community are the ones that suffer the most and this was agreed upon by one of the municipal officials as well. There were informal settlements residents that argued that they were least impacted because they were moved to new houses by the municipality. From an observation point of view, I disagree with them as the houses that they were moved into were clustered together, so in a case of a hazard like a fire, the likelihood of the entire area catching fire was high.

Also, those that had rebuilt had used the same material as before and this was due to them not being able to afford better material. This has made them equally vulnerable as before. This is supported by Hallegatte et al. (2017) findings that poor people often live in poorer infrastructure and this is a result of low-income levels, as poor people are classified in the bottom 20 percent of income and consumption in 209 countries in the world, hence they suffer the most during natural disasters. However, the lack of not being able to afford insurance by informal settlement residents in Knysna proves that lack of resources and means of protection are the ones that are worse off in a case of a disaster (Lal et al. 2009, Walters and Gaillard, 2014). However, in considering Walter and Gaillard (2014) findings, they differ to the situation of the Knysna's middle and high-income residents, especially those that had become poorer due to the fire disaster. This is based on the fact that although some of them had resources and protection before the fire. Some became vulnerable after the fire as the resources they had were compromised. Tthey did not have adequate insurance, and their level of protection was not enough to cope with the disaster and this resulted in some people moving out of Knysna.

The research has established that when it came to coping with the fire, the majority of middle and high income-residents had insurance, yet none of the participants from the informal settlement had insurance. This has increased the already existing inequalities between the two sectors. Even among the middle and high-income residents there were inequalities that were created, as there were those without insurance. These findings agree with Howell and Elliott (2018) that natural hazards create wealth inequalities especially inequalities along the lines of socioeconomic status, race, education, and homeownership. The study has found that insurance is an effective coping mechanism, however, it also fosters marginalisation. For instance, when it came to the coping mechanism of the fire, the informal settlement residents relied on family, friends and municipal support to cope with the disaster. These researchers agree that natural hazards and disasters drive poverty and marginalisation and this can also have negative impacts on HDI, as well, as they also drive income inequality (Rodriguez-Oreggia et al. 2012; Yamamura, 2015).

6.4.3.2. The meaning of resilience

The fire was not only destructive, but it also challenged the resilience of Knysna as a town. There was a need to find out how resilient the town and people of Knysna are after the disaster had occurred. From the findings, there are different views that were stated on the resilience of the town of Knysna and its people. The middle and high-income residents found themselves and the town to be resilient after the fire disaster, as people were able to continue with their lives. The municipal official also found the town to have been resilient, especially since there were only seven people who died in the fire. Also, the two local businesses that burnt in the fire, the representatives found their businesses and the town to be resilient as they were still able to rebuild and continue to function after the disaster.

The environmental consultants argued that the town is not highly resilient as areas such as the informal settlement, where most poor people are living were identified to be less resilient and this was mostly due to income levels, but areas were middle and high-income residents were living, for instance, areas like Brenton on Sea were regarded as much more resilient due to high-income levels. There are those from the informal households that expressed their vulnerability and that they felt that they were not resilient enough to withstand another disaster, as they had felt that their lives were at risk as things like trees that triggered the fire were growing back and these residents are those that were not moved by the municipality during the fire.

As shown, the poor are the most vulnerable in society, however, it must be noted that vulnerability is well linked to resilience. The findings reveal that informal settlement residents were vulnerable during the fire and after the fire and their resilience was compromised as the majority of them were heavily reliant on the help of the municipality to make ends meet. This concurs with the findings of Hallegatte et al. (2017) that the poor's resilience is compromised during natural hazards as they are highly vulnerable, and this affects their resilience. Contrary to the informal settlement residents, some middle and high-income residents noted that they were resilient, and this was because they were assisted by insurances after the disaster and this has made the rebuilding process less stressful. These findings are consistent with the work of Atreya and Kunreuther (2016) which indicates that insurance is able to help those that are negatively affected by natural hazards or any other risks so that they can recover quickly which in turn helps with their resilience.

It must be noted that the findings show that insurance is important in natural disasters even though in the case of Knysna, it had put exclusionary measures in place as it helped certain people and not others and these are people that had resources to afford it and this contributed to others low resilience as they were not able to rebuild or rebuild as quick as those that had insurance. There were middle and upper-income households in Knysna that were also not insured, as they did not believe in investing in insurance of their properties and they also lost everything. These findings are echoed by Hallegatte et al. (2017) who pointed out that market insurance is too expensive for the poor to afford, though is a good measure to instill resilience among communities and community members. The study reveals that the town of Knysna was resilient although informal settlement residents were found less resilient. How the town has coped with the fires signifies some form of resilience. This is consistent with Beilin and Wilkinson (2015) who attest that resilience is about coping from shocks and threats to a defined system.

6.4.4. Responses to fire or interactions

In finding out how different people responded to the fires in Knysna, the informal settlement residents and middle and high-income residents were asked questions on the responses of the municipality, the community and other stakeholders on how they responded to the fire. In doing so one wanted to establish Knysna's ability to deal with hazards and risks and also to find out who is responsible for such hazards and risks and what must be done.

In any natural hazard, the unity of the community is important. In finding out the response of community members to the fire, the informal settlement residents had positive remarks about the community. According to one of the informal settlement residents…

"The community was amazing as they came to the shore when they saw the fires coming. They helped people to move out of their houses and to move their belongings out of the houses so that they don't burn. As well, the community helped in offering those that lost their houses, places to sleep, food and clothes" (Informal-1, 2018).

Middle and high-income residents shared the same sentiments as they state that the support from the community was enormous. For instance, one resident explained

"*the community responded amazingly, fantastically! I mean not only the community in Knysna but everywhere in South Africa. The things that we were given were amazing. People were fantastic. I can still remember standing in a warehouse just full of stuff that came from all over the country, you know groceries, clothes everything. So, the community response was amazing. You know I still wear clothes that I was given by various people*" (Middle-3, 2018).

The municipal official also agreed that the community responded positively. For instance, one official stated that…

"*Last year's fires, it was the first time that I ever saw that people will take hands. From all over, not just in Knysna; it didn't matter where you come from, where you stay. People really took a combined effort to help people, so I think that was good, the community got together and actually for the first time we could see people meeting people in the streets, walking past someone without hesitating to ask, 'are you okay?' 'Did your house burn?' and that started the conversation, so I think there is some good stuff that came out of it"* (Muni-2; 25-10-18).

Community members response is important in any disaster but the response of the state or municipality is critical as they have the resources and are mandated to deal with the disaster. The municipality provides services to protect people. According to the middle and high-income residents, the response of the municipality was very slow. One resident argued that

"*the municipality I don't think they knew what was going on. Because a friend of my dad's when she phoned the mayor to find out what was going on and what the municipality was doing; all she got the next day was a letter saying please pay up*

your utility bill. That's what she got from the mayor's office, I don't think they knew what was going on" (Middle-1, 2018).

Another resident from the middle and high-income households also shared the same views that the response of the municipality was slow by stating that

> "*The municipality did not respond very well frankly, not very well. They kept on sending us accounts for water and for rates etc. instead. I would say the municipal response was not good*" (Middle-3, 2018).

The disappointment in the municipality was not only expressed by the middle and high-income residents, but also by the environmental consultants. They highlighted the positive aspects of the municipality's response, but also expressed their dissatisfaction of the municipalities response to the fire. As one argued

> "*I think the municipality was fairly ineffective during the fires. I think they were quite good at having a joint operation centre, controlling activities from there and all of those things but they were completely unprepared for the scale of what happened. So, I think there is a saying that the municipality was reasonably good at coordinating things but actually implementing themselves was not good*" (Enviro-2, 2018).

The informal settlement had different views to the middle and high-income residents as some stated that the municipality has helped them greatly. For instance, one informal resident stated that

> *"the municipality responded really quickly even though their progress in stopping the fires was hindered by the fact that we don't have proper roads that come to our houses, so it was impossible for their cars to come in and access the houses.* (Informal-4, 2018).

However, in contrast to the other informal residents, one informal resident holds that the role of the municipality was ineffective. For instance, the respondent mentioned that

> "*the municipality failed in its promise to build us houses, people were moved to temporary shelters, but we were not moved, our houses we built them ourselves from scratch. We didn't even get the groceries and clothes that were given to others. Maybe it's because of our councillor, he doesn't really care about this side of the location"* (Informal-1, 2018).

According to middle and high-income households and informal settlement residents, the way the municipality addressed the Knysna fire has shown that it was ill-equipped to deal with a disaster of this scale, but in terms of what the community did in the fire, it has shown that it can withstand anything; as people came together during the fire crisis, and have shown much unity in the town.

The participants do have differing views on the response of the municipality to the fire. There was also a need to have a view from the municipal official so that one can have a better understanding of the responses to the fire. According to one municipal official the municipality

> *"We look at stuff differently since the fire has happened, we have done a risk assessment report on the top ten risks in Knysna and as a municipality, we are preparing for such risks. In terms of fire which is one of the risks, what we have done, we had to redo our IDP (Integrated Development Planning)"* (Muni-2, 2018).

The municipal official also highlighted that they got more resources so that they can be better prepared from other disasters, as he stated that

> *"We have got two fire trucks, we got one fire truck brand new big pumper but also, we were sponsored with a Unimark. So yes, definitely there was some good coming out of it as well. Some of the stuff, people can build back better now, trying to keep heads up"* (Muni-2, 2018).

After finding out how the municipality and community responded to the fire, there was a need to also find out who is responsible for natural hazards and risks that happen in Knysna and what should be done? According to the insurance representative

> "*I think the ultimately responsibility lies with government, we have government, then provincial, then local authorities obviously in the form of municipalities.* (Insurance, 2018).

Both informal and middle-income residents also felt that it was the municipality's responsibility to take care of natural hazards or risks that happen in Knysna. However, since Knysna is a small towm and the municipality is also small, it was important to establish in such a disaster did the municipality receive any assistance from other spheres of government. According to municipal officials, there were interventions from other spheres of government such as the Department of Agriculture, Department of Environmental Affairs (DEA) and South Africa National Defence Force. One municipal official explained that

> "*Big time! national government certainly came to the party. Treasury was very slow, because we asked for disaster relief funding, over and above what DEA gave us. Because DEA only gave us materials, we need money for labour, we need money for army of people out there doing work repairing the landscape. Disaster management was extremely slow to respond but DEA responded immediatelY"* (Muni-1, 2018).

In disasters, the private sector often plays a very important role. However, one needed to establish if things were any different in Knysna. The information that was gathered showed that participant had positive remarks to say about the private sector. According to middle and high-income residents the response that came from private companies was phenomenal as they had helped in many donations which helped them greatly. For example, one resident mentioned that

> "*there were a lot of donations that were made by private companies, they really helped with easing the burden for the municipality. I can't imagine what would the people of Knysna have done without their help*" (Middle-2, 2018).

The tables below provide an overview of how different sectors responded to the fire according to participants from different groups.

Table: 5 Responses to the fire by different stakeholders

Sector perceptions	Private Sector	Community based	Municipal/Provincial/National government
Middle and high-income residents	Immediate/ effective	Immediate/ effective	Not immediate/ineffective
Informal settlement residents	Immediate/ effective	Immediate/ effective	• Immediate and effective (2 participants) • Not immediate and ineffective (3 participants)
Environmental Consultants	Immediate/effective	Immediate/ effective	Not immediate/ ineffective
Municipal Official	Immediate/ effective	Immediate/ effective	Immediate except treasury

Table 6 shows Knysna's ability to deal with natural hazards and risks and also shows who is responsible for taking care of natural hazards and risks according to informal settlement residents, middle and high-income residents, insurance representative and the municipality and environmental consultants.

Table: 6 Preparedness and responsibility to the Knysna fire

Sector	Knysna ability to deal with natural hazards and risks	Responsible for natural hazards and risks
Informal settlements	Not prepared	Municipality
Middle and high-income residents	Not prepared	Municipality
Municipality Officials	Better prepared	Government and municipality
Insurance representative	-	Government
Environmental Consultants	Not prepared	Municipality

6.4.5. Expanding on responses and responsibilities of the fire.

When looking at the interactions and responses to the fire, there are different views that arose and this can be shown in both *Tables 5 and 6*. The study found that the community member's response to the fire was immediate, as there was a sense of belonging amongst community members. What was also found is that the South African community including humanitarian aid agencies responded to the fire immediately as there were many donations and aid that came from them. The insurance sector was also found to have responded immediately, For instance, one of the participants, when asked of the responses of his insurance, he noted that he got a message from them asking if he was fine immediately after the destruction by the fire. The importance of community participation and other external support is emphasised by Thornley, Ball et al. (2014) as this is a way that can better community's well-being and their resilience, as it was the case with the Canterbury earthquakes.

The study found that in terms of the municipality, the response to the fire was not immediate and effective and to a large extent this has shown that the municipality is not prepared to deal

with natural hazards and risks at this scale, as it is inadequately resourced to deal with major disasters such as the fire. This concurs with the findings of Mehiriz and Gosselin (2016) that preparedness is largely influenced by the capacity of the municipality as often municipalities that are smaller have low capacity and their disasters risk management is ineffective in dealing with weather hazards, as was in the case with Quebec. The study also found that in terms of the municipality, the heavy reliance on other spheres of government to step in has contributed to the ineffectiveness of the municipality in addressing the fire disaster.

This is due to the fact that the national government departments often address the same problem in isolation and this was the case in the Knysna fire. However, this isolation makes the local municipalities look incompetent as local municipalities are the first line of interaction to residents. Moreover, it was found that the budget for risk management in the case of Knysna Municipality was constrained to deal with such a disaster, hence there was an urgent need from other spheres of government to help. These findings align with Munzhelele (2011) findings that budgetary constraints at the municipal level for those that have a primary and secondary or supportive role in disaster risk management hinders the implementation policy and legislative requirements and also the lack of including disaster risk reduction activities and this contributes to many problems at the local level.

6.5. Summary of the chapter

This chapter has analysed the data and presented the findings of this study. It did this by identifying four themes which are people's understanding and notions of risks and hazards; the vulnerability and coping mechanism and support system of the people of Knysna and their resilience; the social, economic and environmental impacts of the fire and responses to fire or interactions. The findings of the research were also presented in this chapter according to the themes. It was found that the majority of the people of Knysna are aware of natural hazards and risks as they were able to identify them. The findings also show that people felt that the most common natural hazard or risk to Knysna is fire, although there were other risks that are also present in Knysna such as storm surges, alien vegetation and drought. From the themes it also emerged that the poor or those that live in informal settlements are the most vulnerable and this was the case in the fire, which has made them the least resilient. However, although most of the people were found to vulnerable the findings show that Knysna was resilient. The chapter has also given a detailed view of the negative social, economic and environmental impacts of the fire and the benefits. It also gave an overview of the responses to the fire and it was found that the municipality was ineffective according to participants perceptions.

Chapter Six: Conclusion

6.1. Introduction

This chapter presents an overview of the social, economic and environmental impacts of the fire in Knysna. It reflects on the resilience in Knysna and its challenges and how it can be better improved, especially in contributing to the sustainability of the town. It also provides an overview of the research on what it has achieved, and it also suggests further studies that can be conducted.

6.2. Concluding remarks

The fires in Knysna mark one of the most tragic and devastating events that have happened in South Africa in terms of fire hazard, as fires of this magnitude seldom occur. There were many losses and great costs, but also many great lessons that were learned from this natural disaster. This fire was devasting to an extent that residents found it difficult to define the fire, as some termed it as a 'jumping fire", but the best description of it that was given was that the fire was a 'sinusoidal fire' due to its selectiveness when it was burning. From the study, there was a common agreement by participants that the fires had severely affected everyone negatively especially those that had direct contact with it, as many of them had lost their houses and their entire belongings to the fire. There are various social, economic and environmental impacts of the fire the majority of which are negative.

In most disasters, the costs often outweigh the benefits, and this was the case in the Knysna fire. The social and economic costs of middle and high-income residents, informal settlement, Knysna Society of Model Engineers and the municipality were higher than in other sectors. It was found from the municipal officials that there are seven people in the fire that died and also people were not the same after the fire as there was collateral damage from stress-related factors, which has resulted in deaths and out-migration. This was also seen from other participants as they had expressed that they were still stressed and had thought of moving out of Knysna. This is common in natural hazards and disasters, as there is always post-traumatic stress disorder after a disaster, which is contributed to by pre-existing vulnerabilities, displacement from home and serious injury or death.

The social impacts of both informal settlement residents and middle and high-income residents were also found to be high. From the study, what has caused this was the fact that majority of the residents had lost their homes, their health was impacted, some were forced to relocate to new places and also recreational facilities, such as restaurants were affected. This is common

in many global disasters, especially in natural hazards such as earthquakes and bushfires. Many people are left displaced or dead and this was the same with Waldo Canyon fire and Hurricane Katrina.

In showing an understanding of these social impacts on community members, the Knysna Society of Model Engineers was also included as shown in the diagram (Figure 7); as it was a hobby for one of the participants. When assessing the social impacts specifically on the Knysna Society of Model Engineers the findings aligned with those of informal settlement residents and middle and high-income household residents as the study found that the fire had negative impacts on the society, due to the complete destruction of their railway line and locomotives and a complete destruction to their 37 years history of the club. This is also common in natural hazards as they destroy infrastructure but also erode social assets such as social groups, neighbourhoods, kinships and relationships in a community. The municipality was also found to have high social costs mostly related to tourism as some events were canceled or postponed.

The economic costs of the Knysna fire have shown to be high for most of the sectors. The sectors that were identified to have high economic costs are local businesses, informal settlement residents, the municipality and the insurance sector. The reason that the informal settlement residents economic costs were high was because the majority of them work in the formal sector, and they had lost their jobs due to the loss of infrastructure of their workplaces. In natural hazard disasters, there are high economic impacts, especially to jobs, as people lose their jobs and this can be seen with what has happened with Hurricane Katrina. As noted, the economic impacts of the fire were also high for the insurance sector, although there were many without insurance, the insurance sector also took the financial brunt of the disaster. From the findings, it was found that one of the insurance companies paid over 800 million rands in claims which is a lot of money from a single insurance company without consideration of how much other companies had paid. However, this is common with fires as their destruction can increase claims which results in insurance companies paying more. This was found to be the case with North Bay fires and the Southern California fires.

The local businesses also had high economic costs apart from the construction business. For instance, the tourism business that was part of the study had to close down for a year for the rebuild period and during this period it was not generating any income. The forestry business was also severly impacted due to the loss of their 20-year supply of timber and this is predicted to have long-term effects on the timber industry in Knysna. So, from both the businesses, it can

be seen that the economic costs are both short and long-term.. Natural hazards can have impacts on the economy, be it short or long term and millions, if not billions, can be lost, as they affect commercial and public infrastructure and in most cases, the tourism industry often takes a huge knock, as was in the case with the Knysna fire. Moreover, when looking at the economic costs of the municipality they were also high, and this was due to the destruction of infrastructure and loss of revenue from tourism and unplanned expenditure due to the fire disaster.

The fires in Knysna also had positive aspects as there were benefits to some of the sectors in Knysna. Some of the sectors that benefited from the fire are the local businesses, especially the construction and tourism businesses. The construction sector which was struggling after the recession of 2008 experienced a sudden boom. When it came to the tourism sector, those that had lost their infrastructure had rebuilt better buildings with better services. For, instance the local tourism business representative identified that they had rebuilt better and their facility was upgraded to four stars which saw them have more clients and better reviews about their establishment. However, this can be taken as a good example of short and long term benefits to some of the businesses in Knysna due to the fire. These benefits also trickled down to the informal sector, hence it was shown that there were high economic benefits to the informal sector and this was due to the jobs created most of which were in the construction sector and in people cleaning up after the fires

There were also environmental impacts from the fire. From the study, it was gathered that though there was significant damage to the natural environment as animals, critically endangered vegetation, wetland vegetation and indigenous forests were destroyed, the fire also had positive benefits, as it was able to burn unwanted alien vegetation and it also gave residents an opportunity to clear alien vegetation at a lower cost. For instance, this can be seen from how the residents of the Brenton on Sea community were removing the alien vegetation without any machinery and this saved them a lot of costs.

The impacts of the fire was a great test to the resilience to the town of Knysna, as a disaster of this magnitude can result in total failure of an area. The town of Knysna in these fires proved to be resilient as the town was able to cope after the disasters. However, though the town had proven to be resilient; when looking at the resilience from an individual level this presents a different story, because not everyone was resilient. The fire hazard resulted in a loss of life and damage to infrastructure and this is an indication that Knysna town and its assets are vulnerable to disasters. However, it is important to look closely at the disaster risk component of Knysna.

The majority of the people that suffered in the fire were impacted because of their location. The geographical area where they had settled played a critical role, even at the microscale due to the sinusoidal fire, in terms of them being victims to the fire. For instance, Knysna is rich in fauna and most of the valuable infrastructure is close to this, hence it was easy for most houses to burn especially those that were close to plants species that are enriched with alien vegetation that fuelled the fire. For most people especially the middle and high-income households, it is out of choice but for those in the informal settlement this was influenced by the availability of space and other factors and this was the case in this study. However, it must be noted that this has caused and increased poverty and vulnerability amongst the informal settlement. The lack of infrastructure and capacity by the Knysna municipality had also contributed to the vulnerability of the people of Knysna, as this had increased their disaster risk factor and this had affected their resilience.

These elements should be taken into consideration in making Knysna more resilient to future disaster, as there are many hazards that already occur in the area. If these elements are not taken into account and the resilience of Knysna and its people is compromised this also compromises the sustainable development of the town, as challenges of poverty will persist due to the risks that may occur. Also, sustainable development of the town is compromised as continuity of such disasters affect the economy badly and for a small town such as Knysna this can have long term implications, especially looking at the sectors such as the forestry and tourism which contributes greatly to the economy of the town.

This research focused on the social, economic and environmental impacts of the fire. However, through it, the aim and the objectives of the study were achieved. The research was also able to identify gaps that future research can be worked on and this is covered below. When looking at the vulnerability of the people of Knysna, geographical placing plays a role in their vulnerability especially in the informal settlement, as many individuals stay in areas that can trigger a disaster due to hazards. The fire made the existing inequalities much more stark and evident, as there are those that were left far worse off and those that greatly benefited especially in monetary terms. There is a need for a study on the inequalities that natural hazards create especially in a country like South Africa which is struggling with high poverty and inequality rates. To add, it is highly recommended that a study is conducted on the post-fire impacts including the psychosocial impacts. There was a shortfall to this study as the study could not establish how many people left Knysna due to the fire. It is of utmost importance that a study is conducted on migration patterns enforced by natural hazards in the context of South Africa.

When looking at the social, economic and environmental impacts of the fire, there are a few gaps that need to be covered that the study could not cover. One is that in literature often the impacts are on the social and economic impacts. However, in regards to the social impacts, the concentration is on the larger costs to insurance companies and large industries; so more research is needed to establish the impacts of natural hazards like fire on small businesses, as they play a crucial role in poverty alleviation in a country. Also, there is a gap in how natural hazards such as fires affect the natural environment over the longer term. There are more studies needed in this regard, as countries like South Africa are rich with natural species that are fundamental to the environment. When looking at the responses of the fires, it was clear that the municipality was unable to handle the fire on its own. However, from the municipal responses to the fire, it was clear that there are interventions that are needed in disaster risk management in South Africa.

The National Disaster Management Act and the National Disaster Management Framework should be used to guide responses and the way which they can be implemented must be well understood. There was a gap in the implementation of this policy in the case of Knysna, it is important that it is understood at municipal level. There are delays when municipalities consult with the national government and matters cannot be resolved speedily, as was the case with the Knysna fire. Also, there should be more disaster centres that are built in the country as natural hazards such as fires are a phenomenon that will continuously happen with the climate changing. The study also identified that there is little awareness on natural hazards and risk, so it is recommended that there should be a policy which must be linked to educational processes on raising awareness on people's disaster risks, vulnerability and exposure, as these are linked to making places, systems and individuals resilient. The fire in Knysna was indeed a devastating ordeal which will remain as one of the greatest disaster risks in the history of South Africa.

Reference List

Adam, E. and Heiduk, S. F. (2015) Hazy Days: Forest Fires and the Politics of Environmental Security in Indonesia. *Journal of Current Southeast Asian Affairs.* 34 (3). pp. 65–94. [Online] Available from: https://journals.sub.uni-hamburg.de/giga/jsaa/article/view/906. [Accessed: 18 September 2018]

Alberta Government (2016) Home Again Recovery after the Wood Buffalo Wildfire. [Online] Available from: https://www.alberta.ca/documents/Wildfire-Home-Again-Report.pdf. [Accessed: 18 June 2016]

Alexandre, P. M., Mockrin, M. H., Stewart, S. I., Hammer, R. B., Radeloff , V. C. (2015) Rebuilding and new housing development after wildfire. *International Journal of Wildland Fire.* 24 (1). pp. 138-149. [Online] Available from: http://www.publish.csiro.au/WF/WF13197.

Amul, G. G. (2013) *Haze and Air Pollution: The Potential Health Crisis*. [Online] Available from: https://dr.ntu.edu.sg/bitstream/handle/10220/20088/RSIS1222013.pdf?sequence=1&isAllowed=y. [Accessed: 18 September 2018]

Athukorala, P. and Resosudarmo, B. P. (2015) The Indian Ocean Tsunami: Economic Impact, Disaster Management, and Lessons. *Asian Economic Papers.* 4 (1). pp. 1-39. [Online] Available from: https://www.mitpressjournals.org/doi/pdf/10.1162/asep.2005.4.1.1. [Accessed: 12 June 2018]

Atreya, A. and Kunreuther, H. (2016*) Measuring Community Resilience: The Role of the Community Rating System (CRS)*. [Online] Available from: http://opim.wharton.upenn.edu/risk/library/WP201607_Measuring-Community-Resilience-CRS.pdf. [Accessed: 13 October 2018]

Barnes, A. and Shippey, K. (2017*) Provincial drought update & impacts*. [Online] Available from: http://www.wcpdf.co.za/workshops/western_cape_water_crisis/Provincial%20drought%20update%20and%20impacts.pdf. [Accessed: 10 August 2018]

Béné, C., Wood, R. G., Newsham, A. and Davies M. (2012) Resilience: New Utopia or New Tyranny?. [Online] Available from: https://www.ids.ac.uk/publication/resilience-new-utopia-or-new-tyranny. [Accessed: 14 May 2018]

Beilin, R. and Wilkinson, C. (2015) Introduction: Governing for urban resilience. *SAGE Journals.* 52 (7). pp. 1205–1217. [Online] Available from: http://journals.sagepub.com/doi/abs/10.1177/0042098015574955. [Accessed: 14 May 2018]

Besset, M., Anthony, E. J., Dussoulillez, P. and Goichot, M. (2017) The impact of Cyclone Nargis on the Ayeyarwady (Irrawaddy) River delta shoreline and near shorezone (Myanmar) : Towards degraded delta resilience?. Comptes Rendus Geoscience. 349 (6-7). pp. 238-247. [Online] Available from: https://www.sciencedirect.com/science/article/pii/S1631071317301074. [Accessed: 17 August 2018]

Bhamra, A. (2015) *Resilience Framework For Measuring Development.* [Online] Available from: https://sustainabledevelopment.un.org/content/documents/642997-Bhamra-Resilience%20Framework%20For%20Measuring%20Development.pdf. [Accessed: 5 October 2018]

Briske D. D., Illius A. W., Anderies J. M. (2017) Nonequilibrium Ecology and Resilience Theory 'in' Briske, D. D. (ed) *Rangeland Systems Processes, Management and Challenges*. Springer: Switzerland

Bromet, Atwoli and Kawakami (2017) Post-traumatic stress disorder associated with natural and human-made disasters in the World Mental Health Surveys. *Psychol Med*. 47 (2). pp. 227-241. [Online] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5432967/. [Accessed: 27 November 2018]

Brown, K. (2014) Global environmental change I: A social turn for resilience?. *SAGE*. 38(1). [Online] Available from: http://journals.sagepub.com/doi/pdf/10.1177/0309132513498837. [Accessed: 9 March 2018]

Brunkard, J. Namulanda, G. and Ratard, R. (2008) Hurricane Katrina Deaths, Louisiana, 2005. *Cambridge Core*. 2 (4). pp. 215-223. [Online] Available from: https://www.cambridge.org/core/journals/disaster-medicine-and-public-health-preparedness/article/hurricane-katrina-deaths-louisiana-2005/8A4BA6D478C4EB4C3308D7DD48DEB9AB. [Accessed: 30 August 2018]

Chasi, V., de Waal, J., Fortune, G., Holloway, A.J. and Zweig, P. (2012)S. *Eden & Central Karoo drought disaster 2009–2011:"The scramble for water"*. Disaster Mitigation for Sustainable Livelihoods Programme (DiMP).

Cote, M. and Nightingale, A.J. (2012). Resilience thinking meets social theory: situating social change in socio-ecological systems (SES) research. *Progress in Human Geography*. 36 (4), pp. 475-489. [Online] Available from: https://journals.sagepub.com/doi/abs/10.1177/0309132511425708. [Accessed: 9 September 2019]

Creswell, J. W. (2014) *Research Design Qualitative, Quantitative and Mixed Methods Approaches.* SAGE: London

CSIR (2018) *The Elandskraal Fire, Knysna A data driven analysis.* [Online] Available from: https://www.csir.co.za/sites/default/files/Documents/CSIR%20Knysna%20Report%202018.pdf. [Accessed: 4 October 2018]

De Silva, M. M. G. T. and Kawasaki, K. (2018) Socioeconomic Vulnerability to Disaster Risk: A Case Study of Flood and Drought Impact in a Rural Sri Lankan Community. *Ecological Economics.* [Online] Available from: https://www.sciencedirect.com/science/article/pii/S092180091731604X. [Accessed: 18 November 2017]

Dolfman, M. L., Wasser, S. F. and Bergman, B. (2007) *The effects of Hurricane Katrina on the New Orleans economy*. [Online] Available from: https://www.bls.gov/opub/mlr/2007/06/art1full.pdf. [Accessed: 7 June 2018]

Energy & Climate Change Intelligence Unit (2017) *Heavy Weather Tracking the fingerprints of climate change, two years after the Paris summit*. [Online] Available from: https://eciu.net/assets/Reports/ECIU_Climate_Attribution-report-Dec-2017.pdf. [Accessed: 4 October 2018]

Engel, T., Fink, A. H., Knippertz, P., Pante, G. and Bliefernicht, J. (2017) Extreme Precipitation in the West African Cities of Dakar and Ouagadougou: Atmospheric Dynamics and Implications for Flood Risk Assessments. *Journal of Hydrometeorology*. 18. pp. 2937-2957. [Online] Available from: https://journals.ametsoc.org/doi/pdf/10.1175/JHM-D-16-0218.1. [Accessed: 4 October 2014]

FAO (2007) *An overview of the impact of the tsunami on selected coastal fisheries resources in Sri Lanka and Indonesia*. [Online] Available from: http://www.fao.org/3/a-ai000e.pdf. [Accessed: 13 August 2018]

Faulkner, S., Barrow, W., Couvillion, B., Conner, W., Randall, L. and Baldwin, M. (2007) Impacts of Hurricane Katrina on Floodplain Forests of the Pearl River. in Farris, G. S., Smith, G. J., Crane, M. P., Demas, C. R., Robbins, L. L. and Lavoie D. L. (eds) *Science and the Storms: the USGS Response to the Hurricanes of 2005*, pp. 124-130

Feinstein International Center (2014) *Lessons Learned from the Somalia Famine and the Greater Horn of Africa Crisis 2011–2012*. [Online] Available from: http://fic.tufts.edu/assets/Desk-Review-Somalia-GHA-Crisis-2011-2012.pdf. [Accessed: 10 August 2018]

Ferris, E., Petz, D. and Stark, C. (2012) *The Year Of Recurring Disasters: A Review Of Natural Disasters In 2012*. [Online] Available from: https://www.brookings.edu/wp-content/uploads/2016/06/Brookings_Review_Natural_Disasters_2012-2.pdf. [Accessed: 5 September 2018]

Földi, L. and Kuti, R. (2017) Characteristics of Forest Fires and their Impact on the Environment. *Academic and Applied Research in Military Science*. 15 (1). [Online] Available from: https://folyoiratok.uni-nke.hu/document/uni-nke-hu/aarms-2016-1-foldi.original.pdf. [Accessed: 27 November 2018]

Forsyth, G. G., Kruger F. J. and Maitre, D. C. (2010) *National Veldfire Risk Assessment: Analysis of Exposure of Social, Economic and Environmental Assessts to Veldfire Hazards in South Africa*. [Online] Available from: https://www.westerncape.gov.za/assets/departments/local-government/Fire_Brigade_Services/For_the_fire_service/veldfire_risk_report_v11_0.pdf. [Accessed: 25 August 2018]

Forsyth, G., Le Maitre, D., van den Dool, R., Walls, R., Pharoah, R. and Fortune, G. (2019) THE KNYSNA FIRES OF 2017: LEARNING FROM THIS DISASTER.

Garber, M., Unger, L., White, J. and Wohlford, L. (2006) *Hurricane Katrina's effects on industry employment and wages*. [Online] Available from: https://www.bls.gov/opub/mlr/2006/08/art3full.pdf. [Accessed: 7 June 2018]

Greater Houston Partnership Research (2017) Houston in Perspective. [Online] Available from: http://www.houston.org/pdf/comm/Hurricane-Harvey-Statistics.pdf. [Accessed: 10 June 2018]

Gow K, Pritchard F, Chant D. (2008) How close do you have to be to learn the lesson? Fire burns! *Australian Journal of Disaster and Trauma Studies*. 2. pp. 1–19. [Online] Available from: https://www.massey.ac.nz/~trauma/issues/2008-2/gow.htm. [Accessed: 13 October 2018]

Hallegatte, S., Vogt-Schilb, A., Bangalore, M. and Rozenberg, J. (2017) *Unbreakable Building the Resilience of the Poor in the Face of Natural Disasters*. [Online] Available from: https://openknowledge.worldbank.org/bitstream/handle/10986/25335/211003ovEN.pdf?fbclid=IwAR369OfPFYV857HyIWxMyAxtjvQlHdcUHVMi_CS49JvQrQExXn8DS-EViKo. [Accessed 13 October 2018]

Heil, A. (2007) *Indonesian Forest and Peat Fires: Emissions, Air Quality, and Human Health*. [Online] Available from: http://pubman.mpdl.mpg.de/pubman/item/escidoc:994286/component/escidoc:994285/BzE_50.pdf. [Accessed: 18 September 2018]

Holling, C. S. (1973) Resilience and Stability of Ecological Systems. *Annual Review of Ecology and Systematics*. 4. pp. 1-23. [Online] Available from: https://www.annualreviews.org/doi/abs/10.1146/annurev.es.04.110173.000245. [Accessed: 8 March 2018]

Howell, J. and Elliott, J. R. (2018) Damages Done: The Longitudinal Impacts of Natural Hazards on Wealth Inequality in the United States. *Social Problems*. spy016. [Online] Available from: https://academic.oup.com/socpro/advance-article/doi/10.1093/socpro/spy016/5074453. [Accessed: 14 October 2018]

Howes, N. C., FitzGerald, D. M., Hughes, Z. J., Georgiou, I. J., Kulp, M. A., Miner, M. D., Smith, J. M. and Barras, J. A. (2010) Hurricane-induced failure of low salinity wetlands. *PNAS*. 107 (32). pp. 14014–14019. [Online] Available from: http://www.pnas.org/content/107/32/14014.short. [Accessed: 11 August 2018]

Hrabrin, B. (2011) *Socio-economic and environmental impacts of Match 2011 earthquake, tsunami and Fukushima nuclear accident in Japan*. [Online] Available from: https://mpra.ub.uni-muenchen.de/60661/. [Accessed: 18 September 2018]

Hunter, I., Stander, J. and de Coning, E. (2006) *The Storm Surge of 19 March 2006 – East coast of South Africa Ian Hunter, Jannie Stander, Estelle de Coning South African Weather Service.* [Online] Available from: http://oiswww.eumetsat.org/WEBOPS/iotm/iotm/20070318_storm/20070319_report_saws.pdf. [Accessed: 4 October 2018]

IFRC, (2011) *Drought in the Horn of Africa Preventing the next disaster*. [Online] Available from: https://www.ifrc.org/PageFiles/90410/1203800-Drought%20in%20the%20Horn%20of%20Africa-Preventing%20the%20next%20disaster-EN-LR.pdf. [Accessed: 19 September 2018]

Institute of Disaster Management (2013*) Uttarakhand Disaster 2013*. [Online] Available from: http://nidm.gov.in/pdf/pubs/ukd-p1.pdf. [Accessed: 4 August 2018]

International Federation's Disaster Relief Emergency Fund (2011) South Africa: Floods. [Online] Available from: http://www.ifrc.org/docs/appeals/11/MDRZA005.pdf. [Accessed: 4 October 2018]

Japan International Cooperation Agency (2015) *Country Report Indonesia*. [Online] Available from: http://open_jicareport.jica.go.jp/pdf/1000023394.pdf. [Accessed: 12 June 2018]

Jonkman, S. N., Godfroy, M., Sebastian, A. and Kolen, B. (2018) Brief communication: Loss of life due to Hurricane Harvey. *Natural Hazards and Earth System Science.* 18. pp. 1073–1078. [Online] Available from: https://www.nat-hazards-earth-syst-sci.net/18/1073/2018/nhess-18-1073-2018.pdf. [Accessed: 31 August 2018]

Karya, D., Hasan, H., Kadir, E. A. (2017) Impact of Forest Fires to Economic and Environment in Riua Province in Indonesia. *International Business Management.* 11 (2). 474-477. [Online] Available from: http://docsdrive.com/pdfs/medwelljournals/ibm/2017/474-477.pdf. [Accessed: 22 August 2018]

Kellens,W., Zaalberg, R. Neutens, T., Vanneuville, W. Maeyer, P. D. (2011) An analysis of the public perception of flood risk on the Belgian coast. *Risk Analysis*. **31** (7). pp. 1055–1068. [Online] Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1539-6924.2010.01571.x. [Accessed: 13 October 2018]

Keller, E., DeVecchio, D. (2014). *Natural Hazards*. Routledge: New York

King, S. (2017) ‘Climate change evident in Cape storm and Knysna fires’, Mail & Guardian, 14 June Knysna Municipality (2017) *Knysna will rise again, stronger than before*. [Online] Available from: http://www.knysna.gov.za/wp-content/uploads/2012/12/Knysna-will-rise-again-stronger-than-before.pdf. [Accessed: 23 October 2017]

Knysna Municipality (2017) *Socio-Economic Profile.* [Online] Available from: https://www.westerncape.gov.za/general-publication/socio-economic-profile-municipalities-2017. [Accessed: 9 October 2018]

Kung, Y-W. and Chen, S-H. (2012) Perception of Earthquake Risk in Taiwan: Effects of Gender and Past Earthquake Experience. *Risk Analysis An International Journal.* 9 (32). pp. 1535-1546. [Online] Available from: https://onlinelibrary.wiley.com/doi/full/10.1111/j.1539-6924.2011.01760.x. [Accessed: 13 October 2018]

Lal, P. N., Singh, R. and Holland, P. (2009) *Relationship between Natural Disasters and Poverty: A Fiji Case Study.* [Online] Available from: https://www.preventionweb.net/files/11851_11851R25PovertyAFijiCaseStudylowres.pdf. [Accessed: 11 September 2019]

Landis, M. S, Edgerton, E. S, White, E. M., Wentworth, G. R., Sullivane, A. P. and Dillner, A. M. (2018) The impact of the 2016 Fort McMurray Horse River Wildfire on ambient air pollution levels in the Athabasca Oil Sands Region, Alberta, Canada. *Science of The Total Environment.* 618. pp. 1665-1676. [Online] Available from: https://www.sciencedirect.com/science/article/pii/S0048969717326955. [Accessed: 12 August 2018]

Lavell, A., M. Oppenheimer, C. Diop, J. Hess, R. Lempert, J. Li, R. Muir-Wood, and S. Myeong, 2012: Climate change: new dimensions in disaster risk, exposure, vulnerability, and resilience. In: *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation* [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)]. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (IPCC). Cambridge University Press, Cambridge, UK, and New York, NY, USA, pp. 25-64.

Lin, Y., Wijedasa, L. S. and Chisholm, R. A. (2017) Singapore's willingness to pay for mitigation of transboundary forest-fire haze from Indonesia. *Environmental Research Letters*.

12 (2). pp. 1-8. [Online] Available from: http://iopscience.iop.org/article/10.1088/1748-9326/aa5cf6. [Accessed: 7 August 2018]

Littell, J. S. Peterson, D. L., Riley, K. L., Liu, Y. and Luce, C. H. (2016) Fire and Drought in Vose, J. M., Clark, J. S., Luce, C. H. and Patel-Weynand, T. (eds) Effects of Drought on Forests and Rangelands in the United States: A Comprehensive Science Synthesis. United States Department of Agriculture: Texas, pp. 136-154

Loveline, E. C. (2015) Impacts of Wetland Degaradation in Niger Delta Nigeria and Its Significance in Flood Control. *International Journal of Environment.* 4 (30. pp. 177-184. [Online] Available from: https://www.nepjol.info/index.php/IJE/article/view/13244. [Accessed: 23 August 2018]

Lyu, H., Xu, Y. Cheng, W. and Arulrajah, A. (2018) *Flooding Hazards across Southern China and Prospective Sustainability Measures*. [Online] Available from: http://www.mdpi.com/2071-1050/10/5/1682. [Accessed: 10 August 2017]

Makhoul, I. (2014) *Recovery and return after typhoon Haiyan/Yolanda Environmental displacement in the Philippines*. [Online] Available from: http://labos.ulg.ac.be/hugo/wp-content/uploads/sites/38/2017/11/The-State-of-Environmental-Migration-2014-13-30.pdf. [Accessed: 18 September 2018]

Manning and Goldblatt (2012) *Plants of The Greater Cape Florist Region 1: The Core Cape Flora, Strelitzia 29.* South African National Biodiversity Institute: Pretoria.

Markus, K., Min, H. and James, P. S. (2018) *Meandering to recovery : post-nargis social impacts monitoring ten years after.* [Online] Available from: http://documents.worldbank.org/curated/en/970811524649784589/Meandering-to-recovery-post-nargis-social-impacts-monitoring-ten-years-after. [Accessed: 3 August 2018]

Martin, D., Tomida, M. and Meacham, B. (2016) Environmental impact of fire. *Science Reviews*. 5 (5). pp. 1-21. [Online] Available from: https://pdfs.semanticscholar.org/f050/745b31af918a4de5ef77068efbe5a267d503.pdf. [Accessed: 12 August 2018]

Martin-Breen, P. and Anderies, J. M. (2011) *The Bellagio Initiative The Future of Philanthropy and Development in the Pursuit of Human Wellbeing*. [Online] Available from:

https://opendocs.ids.ac.uk/opendocs/bitstream/handle/123456789/3692/Bellagio-Rockefeller%20bp.pdf?sequence. [Accessed: 14 May 2018]

Masante, D., McCormick, N., Vogt, J., Carmona-Moreno, C., Cordano, E. and Ameztoy, I. (2018) *Drought and Water Crisis in Southern Africa*. [Online] Available from: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC111596/drought_water_crisis_in_southern_africa2018_doi_isbn.pdf. [Accessed: 10 August 2018]

Mather, A. and Theron, A. (2011) *Recent extreme events along the coast of South Africa*. [Online] Available from: http://www.cfoo.co.za/docs/stormsurge/Item%203%20Extreme%20events%20AM%20et%20al%20revised.pdf. [Accessed: 23 October 2017]

Mccaffrey, S. (2004) Thinking of Wildfire as a Natural Hazard. *Society & Natural Resources.* 17 (6). pp. [Online] Available from: https://www.tandfonline.com/doi/abs/10.1080/08941920490452445. [Accessed: 15 March 2018]

Mehiriz, K. and Gosselin, P. (2016) Municipalities' Preparedness for Weather Hazards and Response to Weather Warnings. *Plos One.* 11 (19). [Online] Available from: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0163390. [Accessed: 27 November 2018]

Mitchell, D. (2000) *Cultural geography: A critical introduction.* Oxford: Blackwell.

Munzhelele, M. M. (2011) "An evaluation of the implementation of the institutional capacity for Disaster Risk Reduction (DRR): The Case of Capricorn District Municipality'. Masters Thesis. North-West University

Nature Conservation Bureau, Ministry of the Environment and Biodiversity Center of Japan (2013) *Impact of the Great East Japan Earthquake on the Natural Environment in Tohoku Coastal Regions*. [Online] Available from: https://www.env.go.jp/press/files/jp/23311.pdf. [Accessed: 13 August 2018]

Nauslar, N. J., Abatzoglou, J. T. and Marsh, P. T. (2017) *The 2017 North Bay and Southern California Fires: A 2 Case Study*. [Online] Available from: https://www.preprints.org/manuscript/201804.0194/v1. [Accessed: 17 June]

Nel,J. L, Maitre, D. C. L., Nel, D. C., Reyers, B., Archibald, S., van Wilgen, B. W. Forsyth, G. G., Theron, A. K., O'Farrell, P. J., Kahinda, J. M., Engelbrecht, F. A., Kapangaziwiri, E., Niekerk, L. and Barwell, L. (2014) Natural Hazards in a Changing World: A Case for Ecosystem-Based Management. *Plos One.* 9 (5). [Online] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4012988/. [Accessed: 25 August 2018]

OCHA (2013) *Typhoon Bopha (Pablo) Humanitarian Handbook*. [Online] Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/TY%20Bopha%20Humanitarian%20Handbook%20DavOr%20Final%2003Oct2013.pdf. [Accessed: 18 September 2018]

Olsson, L., Jerneck, A., Thoren, H., Persson, J and O'Byrne, B. (2015). *Why resilience is unappealing to social science: Theoretical and empirical investigations of the scientific use of resilience.* [Online] Available from: http://advances.sciencemag.org/content/advances/1/4/e1400217.full.pdf. [Accessed: 5 October 2018]

Opere, A. (2013) Floods in Kenya. in Paron, p., Olago, D. O. nd Omuto, C. T. (eds) *Kenya a Natural Outlook Geo-environmental Resources and Hazards,* pp. 315-330

Pauw, K. and Thurlow, J. (2009) *Economic losses and poverty effects of droughts and floods in Malawi*. [Online] Available from: http://www.ifpri.org/publication/economic-losses-and-poverty-effects-droughts-and-floods-malawi. [Accessed: 10 August 2018]

Picou, J. S. and Marshall, B. K. (2007) Social Impacts of Hurricane Katrina on Displaced K-12 Students and Educational Institutions in Coastal Alabama Counties: Some Preliminary Observation. *Taylor & Francis Group*. 27. pp. 767–780. [Online] Available from: https://pdfs.semanticscholar.org/2aa1/b759fc642254e4f73e748f3d75e83e9f59a6.pdf. [Accessed: 30 August 2018]

Rodriguez, H., Kendra, J. and Trainor, J. (2005) A snapshot of the 2004 Indian Ocean tsunami: societal impacts and consequences. Disaster Prevention and Management: An International Journal. 15 (1). pp. 163-177. [Online] Available from: https://doi.org/10.1108/09653560610654310. [Accessed: 18 September 2018]

Rodriguez-Oreggia, E., De La Fuente, A., De La Torre, R. and Moreno, H. A. (2012) Natural Disasters, Human Development and Poverty at the Municipal Level in Mexico. *The Journal of Development Studies*. 49 (3). pp. 442-445. [Online] Available from:

https://www.tandfonline.com/doi/abs/10.1080/00220388.2012.700398. [Accessed: 13 October 2018]

Rahman, S. U. R. (2014) 'Impacts of flood on the lives and livelihood of people in Bangaladesh: A case case study of a village in Manikganj district'. Master thesis. Brac University.

RoomsForAfrica (n.d) Map of Knysna accommodation, photograph, accessed October 2018, https://www.roomsforafrica.com/dest/south-africa/western-cape/knysna.jsp?tab=3.

Rufat, S., Tate, E., Burton, C. G. and Maroof, A. S. (2015) Social vulnerability to floods: Review of case studies and implications for measurement. *International Journal of Disaster Risk Reduction*. 14 (4). pp. 470-486. [Online] Available from: https://www.sciencedirect.com/science/article/pii/S2212420915300935. [Accessed: 13 October 2018]

Sastry, N. (2010) Tracing the Effects of Hurricane Katrina on the Population of New Orleans: The Displaced New Orleans Residents Pilot Study. *PMC*. 38 (1). pp. 171–196. [Online] Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2747749/. [Accessed: 30 August 2018]

Shaw, A., Hashemi, M. R., Spaulding, M., Oakley, B. and Baxter, C. (2016) Effect of Coastal Erosion on Storm Surge: A Case Study in the Southern Coast of Rhode Island. *Journal of Marine Science and Engineering*. 4 (4). pp. 85. [Online] Available from: https://www.mdpi.com/2077-1312/4/4/85. [Accessed: 12 September 2019]

Sheikh, P. A. (2006) *The Impact of Hurricane Katrina on Biological Resources*. [Online] Available from: https://digital.library.unt.edu/ark:/67531/metacrs8477/m1/1/high_res_d/RL33117_2006Feb22.pdf. [Accessed: 11 August 2018]

Smith, A. M., Guastella, L. A, Bundy, S.C. and Mather, A. A. (2007) Combined marine storm and Saros spring high tide erosion events along the KwaZulu-Natal coast in March 2007. *South African Journal of Science.* (103). pp. 7-8. [Online] Available from: http://www.scielo.org.za/scielo.php?script=sci_arttext&pid=S0038-23532007000400001. [Accessed: 21 April 2018]

Sørensen, J., Vedeld, T. and Haug, M., 2006. Natural Hazards and Disasters: Drawing on the International Experiences from Disaster Reduction in Developing Countries. Norwegian Institute for Urban and Regional Research (NIBR), pp.16-17.

Srinivas, S. (2015) *The Indian Ocean Tsunami and its Environmental Impacts*. [Online] Available from: https://www.gdrc.org/uem/disasters/disenvi/tsunami.html. [Accessed: 13 August 2018]

Statistics Canada (2016) Fort McMurray 2016 Wildfire Economic Impact. [Online] Available from: https://www150.statcan.gc.ca/n1/pub/11-627-m/11-627-m2017007-eng.pdf. [Accessed: 18 June 2018]

Stupak, J. M. (2017) *Economic Impact of Hurricanes Harvey and Irma*. [Online] Available from: https://fas.org/sgp/crs/misc/IN10793.pdf. [Accessed: 10 June 2018]

Sutherland, C. (2016) 'Society, Space and Environment: "Environmental Spaces" In Knysna, Southern Cape, South Africa', PhD thesis, University of KwaZulu-Natal, Durban.

Sutherland, C., Roberts, D. and Douwes, J. (2019) Constructing resilience at three scales: The 100 Resilient Cities programme, Durban's resilience journey and water resilience in the Palmiet Catchment. *A New Radical Journal.* 12 (1). [Online] Available from: https://hugeog.com/constructing-resilience-at-three-scales-the-100-resilient-cities-programme-durbans-resilience-journey-and-water-resilience-in-the-palmiet-catchment/. [Accessed: 9 September 2019]

Sutherland, C., Sim, V., Buthelezi, S., and Khumalo, D. 2016. Social constructions of environmental services in a rapidly densifying peri-urban area under dual governance in Durban, South Africa. *African Biodiversity and Conservation*, 46(2), 1-12. [Online] Available from: http://www.scielo.org.za/pdf/babc/v46n2/04.pdf. [Accessed: 11 September 2019]

Tempelhoff, J., van Niekerk, D., van Eeden, E., Gouws, I., Botha, K. and Wurige, R. (2009) The December 2004-January 2005 floods in the Garden Route region of the Southern Cape, South Africa. *Journal of Disaster Risk Studies.* 2 (2). pp. 93-111. [0nline] Available from: https://jamba.org.za/index.php/jamba/article/download/18/18. [Accessed: 13 October 2018]

Terrell, D. and Terrell, L. (2016) *The Economic Impact of The August 2016 Floods On The State Of Louisiana.* [Online] Available from:

http://gov.louisiana.gov/assets/docs/RestoreLA/SupportingDocs/Meeting-9-28-16/2016-August-Flood-Economic-Impact-Report_09-01-16.pdf. [Accessed: 31 August 2018]

Tessler , N. (2012) *Documentation and analysis of wildfire regimes on Mount Carmel and the Jerusalem hills*. [Online] Available from: https://www.jstor.org/stable/23718589?seq=1#page_scan_tab_contents. [Accessed: 22 August 2018]

The World Bank (2016) *The Cost of Fire An Economic Analysis of Indonesia's 2015 Fire Crisis*. [Online] Available from: http://pubdocs.worldbank.org/en/643781465442350600/Indonesia-forest-fire-notes.pdf. [Accessed: 20 April 2018]

The World Bank (2011) *The Drought and Food Crisis in the Horn of Africa: Impacts and Proposed Policy Responses for Kenya*. [Online] Available from: https://pdfs.semanticscholar.org/e7d0/caa6f0c76583d552ab60349d6af975279c76.pdf. [Accessed: 10 August 2018]

Theron, A. and Rossouw, M. (2008) *Analysis of potential coastal zone climate change impacts and possible response options in the southern African region*. [Online] Available from: https://researchspace.csir.co.za/dspace/bitstream/handle/10204/2561/Theron_P_2008.pdf?sequence=3&isAllowed=y. [Accessed: 29 October 2018]

Thomas, K., Hardy, R.D., Lazrus, H., Mendez, M., Orlove, B., Rivera-Collazo, I., Roberts, J.T., Rockman, M., Warner, B.P. and Winthrop, R. (2019) Explaining differential vulnerability to climate change: A social science review. *Wiley Interdisciplinary Reviews: Climate Change*. 10 (2). [Online] Available from: https://onlinelibrary.wiley.com/doi/full/10.1002/wcc.565. [Accessed: 1 September 2019]

Thornley, L., Ball, J., Signal, L., Lawson-Te Aho, E. and Rawson, E. (2014) Building community resilience: learning from the Canterbury earthquakes. *Kōtuitui: New Zealand Journal of Social Sciences Online*. 10 (1). pp. 23-35. [Online] Available from: https://www.tandfonline.com/doi/full/10.1080/1177083X.2014.934846. [Accessed: 27 November 2018]

Tripartite Core Group (2008) *Post-Nargis Joint Assessment*. [Online] Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/C675C571D9F845A7C125748D0046C5A3-Full_Report.pdf. [Accessed: 3 August 2018]

Tripartite Core Group (2010) *Post-Nargis Social Impacts Monitoring: April 2010.* [Online] Available from: https://emref.org/sites/emref.org/files/publication-docs/sim_3_english_version.pdf. [Accessed: 4 August 2018]

United Nations (2015*) Disasters in Asia and the Pacific: 2015 Year in Review*. [Online] Available from: https://www.unescap.org/sites/default/files/2015_Year%20in%20Review_final_PDF_0.pdf. [Accessed: 4 August 2018]

United Nations (2017*) Mozambique: Cyclone DINEO*. [Online] Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/Sitrep_Template_RC_EN_0.pdf. [Accessed: 21 April 2018]

UNEP (2009) *Learning from Cyclone Nargis Investing in the environment for livelihoods and disaster risk reduction*. [Online] Available from: https://wedocs.unep.org/bitstream/handle/20.500.11822/14116/myanmar_cyclonenargis_case_study.pdf?sequence=1&isAllowed=y. [Accessed: 17 August 2018]

United Nations Office for Disaster Risk Reduction (2017) *Words into Action Guidelines National Disaster Risk Assessment*. [Online] Available from: https://www.unisdr.org/files/52828_nationaldisasterriskassessmentwiagu.pdf. [Accessed: 5 September 2019]

USGCRP (2017) *Climate Science Special Report: Fourth National Climate Assessment, Volume I.* [Online[Available from: https://science2017.globalchange.gov/. [Accessed: 15 March 2018]

Vromans, D. C., Maree, K. S., Holness, S., Job, N. and Brown, A. E. (2010) *The Garden Route Biodiversity Sector Plan 2010 for the George, Knysna and Bitou Municipalities.* [Online] Available from: https://scholar.google.co.za/scholar?hl=en&as_sdt=0%2C5&q=The+garden+route+biodiversity&oq=The+garden+route+biodi#d=gs_qabs&p=&u=%23p%3DbzJs4jBbxP0J. [Accessed: 13 October 2018]

Wachinger, G., Renn, O., Begg, C. and Kuhlicke, C. (2012) The Risk Perception Paradox—Implications for Governance and Communication of Natural Hazards. *Risk Analysis.* 33 (6). pp. 1049-1065. [Online] Available from:

https://onlinelibrary.wiley.com/doi/full/10.1111/j.1539-6924.2012.01942.x. [Accessed 13 October 2018]

Walters, V. and Gaillard, J. C. (2014) Disaster risk at the margins: Homelessness, vulnerability and hazards. *Habitat International*. 44. pp. 211-219. [Online] Available from: https://www.sciencedirect.com/science/article/pii/S0197397514000824. [Accessed: 13 October 2018]

Wang, S-Y. S., Zhao, L., Yoon, J., Klotzbach, P. and Gillies, R. R. (2018) *Quantitative attribution of climate effects on Hurricane Harvey's extreme rainfall in Texas. Environmental Research Letter*. 13. pp. 1-10. [Online] Available from: http://iopscience.iop.org/article/10.1088/1748-9326/aabb85/pdf. [Accessed: 31 August 2018]

Western Cape Government (2017) *Socio-Economic Profile.* [Online] Available from: https://www.westerncape.gov.za/general-publication/socio-economic-profile-municipalities-2017. [Accessed: 9 October 2018]

WHO (2009) *West Africa Floods Situation Report*. [Online] Available from: https://reliefweb.int/sites/reliefweb.int/files/resources/4C6BC8DE80B23277C125764200347F95-Full_Report.pdf. [Accessed: 4 October 2018]

World Bank (2013) *India: Uttarakhand Disaster Recovery (In preparation)*. [Online] Available from: http://siteresources.worldbank.org/INTSOUTHASIA/Resources/223497-1378327471830/SASDC_PB_IN_UDRP.pdf. [Accessed: 4 August 2018]

Yamamura, E. (2015) The Impact of Natural Disasters on Income Inequality: Analysis using Panel Data during the Period 1970 to 2004. *International Economic Journal*. 29 (3). pp. 359-374. [Online] Available from: https://www.tandfonline.com/doi/abs/10.1080/10168737.2015.1020323. [Accessed: 7 December 2018]

Yin, R. K. (2014) *Case Study Research Design and Methods.* SAGE: New York

Zainal, Z. (2007) *Case study as a research method.* [Online] Available from: http://psyking.net/htmlobj-3837/case_study_as_a_research_method.pdf. [Accessed: 26 August 2016]

Zhang, Y., Carla, M. K., Prater, S. P. (2007) *Vulnerability of community businesses to environmental disasters*. [Online] Available from:

https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-7717.2008.01061.x. [Accessed: 18 November 2018]

Zhou, F. and Botzen, W. J. W. (2017) The Impact of Natural Disasters on Firm Growth in Vietnam: Interaction with Financial Constraints. [Online] Available from: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3095539. [Accessed: 4 December 2018]