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VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY OF THE LIMPOPO PROVINCE

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A thesis submitted to the Faculty of Science, University of the Witwatersrand. Johannesburg, in fulfillment of the requirements for Doctor of Philosophy in Geography and Environmental Studies

SUPERVISOR: PROF. MULALA DANNY SIMATELE

DECLARATION

I Daniel Takalani Makananisa, declare that this thesis is my own work, unaided work. It is being submitted for the Degree of Doctor of Philosophy at the University of the Witwatersrand, Johannesburg. The thesis has not been submitted before for any degree or examination at any other University.



22 APRIL 2021

(Signature of Candidate) **(Date)**

ABSTRACT

One of the precursors in large fire response is the adequate supply of resources. Previous research suggests that fire management paradigm which comprises: (1) protection of critical facilities (ii) prevention of fire spread beyond spatially defined boundaries (iii) minimized exposure to hazard and (iv) desired containment and control period are important elements in fire management. A litany of literature focuses on Veldfire risk reduction and prevention whereas response readiness is largely unexplored. This study attempted to interrogate the readiness to respond to Veldfires by the District Disaster Management Centres of the Limpopo province. To achieve this aim, the study analyzed the management of Veldfire incidences within Mopani and Capricorn Districts, and assessed the effectiveness or lack thereof of interagency collaboration in tackling Veldfires by different stakeholders. In addition, the study examined the adequacy of Veldfire response mechanisms.

In addressing the thematic focus of the study, data collection was achieved through the deployment of research tools inspired by the tradition of participatory research methods. These tools included field observations, questionnaires, focus group discussions with key informants and fire management experts as well as community members. In addition, document review was also used to source out information required for the study.

The key findings of the study suggest that the districts of the Limpopo province are exposed to a litany of legislative and policy frameworks which create an enabling environment for land and Veldfire management. However, several reasons, such as lack of financial resources, misalignment of policies and inefficient strategies are hampering emergency institutions to deliver effective and sustainable Veldfire management systems and process. Other factors exacerbating the situation include the non-compliance to municipal bi-laws, lack of trust between communities and fire services, and poor communication among stakeholders.

It was also established that both the Disaster Management Centres and the Umbrella Fire Protection Associations experience fundamental coordination impediments associated with power relations and dysfunctionality especially in the space of the fire warning systems. Thus, the Veldfire response challenges are far from over if the early warning information is not made available to all the Veldfire management stakeholders. In view of this, it is recommended in this study that the current trajectory of

Veldfire management in South Africa can be improved through the provision of resources as such as those relating to budgeting, skilled personnel development, and capital investments in the Veldfire management infrastructure. If this is not achieved, the impact of Veldfires will continue to reverse the development gains made over the past years and retard progress for sustainable development.

Key words: Veldfires; disaster management; environmental management; environmental sustainability and South Africa.

DEDICATION

This thesis is dedicated to my wife Phumudzo and our children Andy, Takalani and Tshedza. You were my source of strength and motivation. I also dedicate this thesis to every youth who believe that through perseverance and hard work, it is possible to reach the highest goal in life.

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"In all your ways submit to Him, and he will make your paths straight" (Proverbs 3:6).

Thank you, Jesus, son of David.

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LIST OF ABBREVIATIONS AND ACRONYMS

IPCC: Intergovernmental Panel on Climate Change

COP: Conference of the Parties

EMS: Emergency Management Service

UNISDR: United Nations Office for Disaster RISK Reduction

IFRC: International Federation of Red Cross and Red Crescent Societies

EOC: Emergency Operational Centre

DALRRD: Department of Agriculture, Land Reform and Rural Development

FAO: Food Allied Organizations

NRC: National Research Council

EMA: Emergency Management Authority

IA: Initial Attack

CFO: Chief Fire Officer

FPO: Fire Protection Officer

WoF: Working on Fire

HoDMC: Head of Disaster Management Centre

FPA: Fire Protection Association

FBS: Fire Brigade Service

GFMC: Global Fire Management Centre

ACIA: Arctic Climate Impact Assessment

CFFWIS: Canadian Forest Fire Weather Index System

CRCM: Canadian Regional Climate Model

GFMC: Global Fire Monitoring Centre

NAFFC: National Aerial Forest Fire Centre

EWS: Early Warning Systems

EUCPM: European Union Civil Protection Mechanisms

CRM: Crew Resource Management

FEMA: Federal Emergency Management

EMC: Emergency Management Council

ICS: Incident Command System

JRC:EU: Joint Research Centre of European Union

SADEC: South African Development Community

EMA: Environmental Management Authority

NEFP: Namibian Finland Forestry Program

IFFM: Integrated Forest Fire Management

CBFiM: Community Based Fire Management

TFS: Tanzania Forest Service

COP: Conference of Parties

NVFFA: National Veld and Forest Fire Act

NVFIS: National Veldfire Information System

CSIR: Council for Scientific and Industrial Relations

SAWS: South African Weather Services

StatsSA: Statistics South Africa

NDP: National Development Plan

DEFF: Department of Environment, Forestry and Fisheries

EPWP: Expanded Public Works Program

NEMA: National Environmental Management Act

TCA: Thematic Content Analysis

DWA: Department of Water Affairs

COVID-19: Corona Virus Disease

DMISA: Disaster Management Institute for Southern Africa

SANRAL: South African National Road Agency Limited

PRASA: Passenger Rail Agency South Africa

COGHSTA: Cooperative Governance, Human Settlement and Traditional Affairs

DO: Divisional Officer

UFPO: Umbrella Fire Protection Association

DMAF: Disaster Management Advisory Forum

CPA: Communal Property Association

NFDRS: National Fire Danger Rating Systems

FDR: Fire Danger Rating

FDI: Fire Danger Index

EADRCC: Euro-Atlantic Disaster Response Coordination Centre

CRM: Crew Resource Management

FERAP: Fire Emergency Response Action Plan

DMA: Disaster Management Act

NDMF: National Disaster Management Framework

MHEWS: Multi Hazard Early Warning System

UNISDR: United Nation International Strategy for Disaster Risk Reduction

IFMH: Integrated Fire Management Handbook

INFPS: Integrated National Forest Protection Strategy

TRANSNET: Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation

ESKOM: Electricity Supply Commission

CHAPTER 1
THE FRAMES OF REFERENCE

1.1 INTRODUCTION

Climate change is arguably one of the highest-ranking factors contributing to unacceptable levels of Veldfire frequency in South Africa and around the world. It is putting the world under pressure to find long and short-term solutions to Veldfire risk growth trajectory. According to Lesolle (2017), South Africa should begin to address climate change seriously as it cannot cope with its devastating effects. Climate change is already affecting Veldfire frequency by altering the key factors that control fire, temperature, precipitation, humidity, wind, ignition, biomass, dead organic matter, vegetation species composition and structure, and soil moisture (Intergovernmental Panel on Climate Change (IPCC), 2001).

The frequent occurrences of Veldfire have put the world on alert, putting Emergency Management Service (EMS) under the spotlight. Berke (1995) and Mileti (1999) argue that the importance of emergency management services lies in the tasks they perform. The significance is appreciated by communities, government, and private sectors. With the expectation for government to ensure adequate resource allocation and monitoring, protection of infrastructure has become a development priority. Noji (1997) is of the view that even if people were able to recognize their exposure levels, only few understood the need for a systematic program of protection due to lack of appreciation and awareness on the magnitude of threats. He further argues that many losses to disasters may not be entirely recovered (ibid). It is therefore, important for communities to know what to do if Veldfires occur.

The definition of disaster management by Fritz (1961:655), states that it is "an event, concentrated in time and space, in which a society or a relatively self-sufficient subdivision of a society undergoes severe danger and incurs such losses to its members and physical appurtenances that the social structure is disrupted and the fulfillment of all or some of essential functions of the society is prevented." It is also defined as a "serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability and capacity, leading to one or more of the following: human, material, economic and environmental losses and impacts" (United Nations International Strategy for Disaster Reduction (UNISDR), 2017:13). The widely used definition from the International Federation of Red Cross and Red Crescent Societies (IFRRC) (2018:3) is that a "disaster is

a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community's or society's ability to cope using its own resources, though often caused by nature, disasters can have human origins."

Total prevention of disasters is arguably impossible, and therefore readiness to respond to disasters could make a difference in saving lives, provided early detection is made and warning effectively communicated. Lindell and Perry (1996) contend that although there are Veldfire disasters from which protection of human lives cannot be guaranteed, it remains important to ensure that reasonable planning, streamlining resources and response readiness form an integral part of Veldfire management approaches. Perry and Hirose (1982) reveal that emergency response should be coordinated by an organized structure, which has rich knowledge of hazard from diverse groups of stakeholders. They further argue that a well-coordinated response action saves lives and protect infrastructure. Additionally, they argue that effective response can be successfully accomplished when skilled firefighters together with emergency service personnel from various government departments such as Transport and Public Works work together.

1.2 STATEMENT OF THE PROBLEM

In 2012, the Department of Agriculture Land Reform and Rural Development (DALRD) reported to the Portfolio Committee of Parliament of the Republic of South Africa that Veldfires have become a regular feature across the country mostly between July to October and November to January annually. The report reveals that Veldfires are exacerbated by the dry and windy conditions, fuel load and poor veld management. The shows that elements are conducive to development and spread of runaway fires. Additionally, the report argues that in some provinces, arson is also a major contributor to Veldfire occurrence, however the South African Police Service (SAPS) has not been able to lead successful prosecution of the suspects. Lastly, the report pointed out that enforcement of the law in the fire sector is increasingly frustrating landowners particularly in largely rural provinces such as Kwa-Zulu Natal, Mpumalanga, Northern Cape, and Limpopo (Report, 2012).

The coordination of major role players such as Department of Agriculture, Land Reform and Rural Development (DALRRD), Department of Environment, Forestry and Fisheries, (DEFF), Local government Fire Brigade Services, the Fire Protection Association, Working on Fire and other parastatals such as (Electricity Supply Commission) ESKOM and Traveler Response Architecture using Novel Signaling for Network Efficiency in Transportation (TRANSNET) by Disaster Management Centre (DMC) has been a challenge for the past ten years. The Disaster Management Advisory Forums (DMAFs)

have been reduced to committees without institutional powers. The report concludes by indicating that these issues have created enough grounds for further investigations on the capacity required by Disaster Centres to fulfil their roles and mandates.

Lindell and Perry (1996) argue that Veldfire occurrence is as old as mankind. They observe that this notion is supposed to mean that meaningful levels of knowledge of Veldfire management should exist (ibid). However, living in a climate troubled world with high frequency of Veldfires comes with array of response challenges mostly to vulnerable communities. According to Quarantelli (1998) most businesses have incorporated fire management into their disaster risk management to ensure allocation of resources and response efficiency. He further argues that government and organized business are lagging in adopting integrated approach that ensures meaningful levels of participation in decision making procession for Veldfire management. Lindell and Perry (1998) argue that involvement of organized businesses, governments, and community structures in Veldfire management ensures ownership and sustainability, though it is a difficult balance act.

According to Low and Rebelo (1996), the north-eastern parts of the Mopani District in Limpopo Province contribute to the high incidence of Veldfires. The Veldfire risk in these regions is exacerbated by similar vegetation found in the Kruger National Park. Kruger, et al. (2006) and van Wilgen, et al. (2010) argue that grass vegetation in Capricorn has put the district at 72% risk level for Veldfire occurrence.

Goldammer (2001), argues that between 1980s and 1990s, Veldfire research in South Africa gradually declined. This had impacted negatively on Agricultural and Forestry sector development. Dynes (2004: 2) states “Indeed, the lack of research on Veldfire risk management is such a great challenge, it perhaps makes our current research an example of trivial pursuits.” Nkhensani (2011) is of the view that as Veldfire occurrence increases response readiness becomes an issue of great concern. The view is supported by de Rhonde (2008) who pointed out that South Africa lost thousands of hectares of commercial timber plantations to uncontrollable Veldfires, especially between 2005 and 2009. For the past 25 years, an estimated 14 000 ha was lost to Veldfires. This loss had far reaching implications to timber and sawmilling processing plants which experienced increased operational costs, as timber resources diminished setting manufacturing plants to a grinding halt (Kruger et al, 2000). Numerous sawmilling companies in Limpopo province experienced sudden closure due to log shortage caused by Veldfires. The Livubu sawmilling situated along the Punda Maria road to Tshakhuma and Tshifhere

sawmilling in Makhado bare testimony to once upon a time thriving sawmilling industries. The closure of these sawmilling industries had affected local communities socially and economically.

The Visser Report (2019) presented in the 6th National Fire Prevention Indaba reveals that Fire Services are increasingly facing shortages of resource allocation, which include the following:

(i) lack of qualified personnel
(ii) Interference with appointments of firefighters.
(iii) Lack of replacement strategy
(iv) Lack of maintenance strategy for vehicles, equipment, and buildings.
(v) Lack of support for training and skills development.
(vi) Budget is not sustainable.

The Visser (2019) report further points out that Fire Services in Limpopo continue to face a bleak future due to conspicuous lack of budgetary support from National Government. Additionally, the report states that lack of political will is a major factor contributing to poor Veldfire response readiness. The issues raised in the Visser report provide a glimpse into troubled Emergency Fire Service and Disaster Management in the districts of Limpopo province. It is within the context of these challenges that the current study sought to investigate how veldfires are managed in South Africa, taking the Province of Limpopo as a case study.

1.3 RESEARCH QUESTIONS

In view of the above observations, the following questions guided the research process: -

(a) What institutional and policy framework exist within which the management of Veldfires can be pursued in Mopani and Capricorn district?
(b) What kinds of collaborations exist among the stakeholders responsible of Veldfire management within Mopani and Capricorn district?
(c) In what ways do the District Disaster Management Centres coordinate the Veldfires response preparedness?
(d) What forms of early warning systems exist within which to detect Veldfires in the districts of Limpopo province?

(e) What implications result from the study findings in a wider context, particularly in Southern Africa?

1.4 AIM AND OBJECTIVES OF THE STUDY

The aim of this study was to investigate readiness to respond to Veldfires by the District Disaster Management Centres of the Limpopo province. To realize this aim, the following were the objectives set for the study:

(a) To analyze Veldfire dispensation within the Mopani and Capricorn Districts.
(b) Determine interagency collaboration approach that exists among the Veldfire stakeholders in Mopani and Capricorn districts.
(c) Determine Veldfire response mechanisms in Mopani and Capricorn districts.
(d) Establish the extent to which Veldfire early warning information reaches landowners.

1.5 OVERVIEW OF LITERATURE

1.5.1 Socio-economic impact of Veldfires

Van Mantgem, et al., (2009) are of the view that Veldfires are generally destroying forests which are crucial for the well-being of humanity and ecosystem balance. They observe that Veldfires have had huge impact on the world's socioeconomic issues resulting in reversing gains which have been attained over a lengthy period and that reconstruction is virtually impossible. This view is supported by De Ronde (2008) who is of the view that reconstruction does not guarantee restoration to the former glory. The Republic of Ghana has become one of the leading exporters of timber in Africa, making timber a big contributor to the country's economic advancements. The country however, lost an estimated 4 million hectares (Mha) of timber plantation to Veldfires between 1982 and 1983 resulting in the loss of 3% of the country 's Gross Domestic Product (GDP). During the same period, Indonesia, a country well known for earthquakes and tsunamis, lost 9.5 Mha of forest land to Veldfires. Between 1995 and 2000, Brazil lost 3.5 Mha of land, of which 1.5 Mha was rainforest. Mexico lost approximately 1.5 Mha, while the United States of America lost 5 Mha, and Russia lost 2 Mha of forest land to Wildfires during the same period (Rowell and More, 2000).

Ronald (2006) argues that globally more than 250 million Mha of forest are destroyed by Wildfire annually. The impact of Veldfire is felt in the Amazon where many different species of the forest continue

to die at close to 36% due to Veldfire occurrence. These developments have impacted the timber producing factories negatively adding to a significant loss of jobs especially in developing countries.

1.5.2 Causes of Veldfires

Goldammer (2007) opines that the increase of global Veldfires have aggravated the state of the forest ecosystem and functionality. This increase has been associated with human activities driven by economic endeavors as well as natural processes such as climate change. According to Daniels et al., (2011) and Rego (2011), they argue that there is a relationship between wildfires and climate change. They further argue that this position is widely accepted in Northern America, South Western British Columbia, and Europe. Calvin and Wettlaufer (2000); Goldammer (2000) argue that for the past ten years Veldfire in South Africa is exacerbated by persistent hot/dry conditions from the effect of global warming. The other additional factors, identified by Van Mantgem, at al., (2009), include the oily rags from wood finishing or polishing and the accumulation of organic materials facilitate the development of Veldfire in South Africa. They argue that these factors create conducive environment for increasing fuel levels in the forest ecosystem, putting it at risk (ibid). However, in the savannah, most, if not all Veldfires occur because of human activities (Food and Agriculture Organization (FAO), 2003).

The severity of Veldfires may be reduced if fires are spotted early and reported directly to the responsible authorities. Teie (2005) is of the opinion that to effectively prevent Veldfires, fire breaks are most important tools. Without fire breaks, or lack of it thereof, Veldfire incidents are likely to stretch capacity required to bring about proportional response to reduce the impact. The Intergovernmental Panel on Climate Change (IPCC) (2001) report indicates that climate change has created conducive environment for Veldfire occurrence. Experts who attended one of the IPCC workshops submitted a list of factors including temperature and wind arguing that these factors are functions of climate change that contribute to environmental degradation (Hassan et al., 2005; and Turner et al., 1997). Quarantelli and Dynes, (2002) expound that human activities contribute towards the frequency of Veldfire occurrence.

1.5.3 Building resilience to vulnerable communities

Ariyabandu & Wickramasinghe (2003) argue that it is necessary to build the adaptive capacity and resilience of communities at risk to Veldfires to reduce the degree of exposure or level of vulnerability. They are of the view that communities are often deprived of resources and finances to boost their capacity to manage Veldfires (ibid). Quarantelli and Dynes, (2002) are of the view that the impoverishment which

many poor people are subjected to, make them to engage in livelihood strategies which may be detrimental to the environment and give rise to disasters which are difficult to manage. This view is supported by Drabek (1991:17) who argues that fire management is not as easy as it seems especially if it occurs in vulnerable and poor spaces with infrastructure maybe lacking. The National Research Council (NRC) (2007) reports that to help communities in the management of Veldfires, the best would be to educate them on available modern approaches to improve Veldfire emergency response. They point out that the only way to reduce the impact of Veldfire is to ensure that information is provided to the public.

A study by Kreps (1991) revealed that the increase of Veldfire incidents in Zimbabwe was because of newly resettled smallholder famers who had no access to any form of infrastructures. Furthermore, the Zimbabwe Environmental Management Authority (ZEMA) report states that Veldfires are diminishing the role played by forests, among which include that of regulating climate and water resources and providing habitat for both plants and animals (ZEMA, 2011). It is further argued that Veldfires are impacting negatively on the indigenous cultural practices such as spiritual renewal, recreation, and animal food, fodder, and medicine resources dependent on the availability of forests (ZEMA, 2011).

According to Kreps (1991), s/he argues that the foundations of effective emergency management involve improvisation and preparedness. This demonstrates how the strategic approach to emergency preparedness can improve the quality of disaster response. Drabeck (1990) argues that when disaster threatens, demand for emergency response increases rapidly. For this reasons, Veldfire response agencies need to change approaches to meet the demand for service by seeking involvement of multi-emergency agency. Ammo and Brown (1991) are of the opinion that in each single response mission, the greater challenge is that each fire presents unique characteristics. Fire response requires mechanisms to provide aggressive suppression as universally accepted approach (Calkin, 2015).

Drabek (1990) on the other hand argues that response strategy promote support. It also mergers the agenda and enhances control, co-optation and use of outside experts or similar approaches to effective and efficient fire management systems. Rogers et al., (1982) and Gillespie (1991) argue that coordination is an overarching element of the response strategy. It eliminates gaps and duplication of services while enhancing efficient use of resources. The need for integrated and well-coordinated emergency response services will remain an ideal in the world that is facing global warming. Veldfire coordination characterizes an Operational Response Models (ORM) that provide effective Veldfire control (Duff and

Tolhurst, 2015). Vast majority of Veldfire response agencies rely on Initial attack (IA) as a fire prevention measure, despite the highly contested IA views which purports that all large fires are preventable (Dunn, et al., 2017) but this position may work to contribute to negatively reducing the adaptive and resilience of those communities most at risk to disasters such as veldfires.

1.6 SIGNIFICANCE OF THE STUDY

Many studies, such as Hessburg et al., (2007); Nacify et al., (2010); Hass et al., (2013); Stephens et al., (2014); Jolly et al., (2015), reveal that in recent decades increasing incidences of Veldfires are alarming. According to Allen et al., (2010) and Stephenson et al., (2013), Veldfire has more than ever become an economic destruction we have come to know. The increase of fire incidents continues to cause intense destruction in the forest and threatens sustainability of forestry in certain region. This has put disaster response services around the world on a spotlight.

To date, every part of the world has in one way or the other been affected by Veldfires. Veldfire disasters are now more than ever associated with losses of properties, lives, and economic gains. According to Mileti (2003) numerous factors namely population density, encroachment to protected areas have increased the levels of Veldfire frequency. There is a notable level of impact of Veldfire in different parts of the world. Bond and Mercer (2013) observe that to lessen the impact on the environment and human lives, authorities should ensure that effective Veldfire hazard-mitigation, and response strategies are financially supported. In South Africa, many studies have covered wide range of Veldfire management issues, such as risk assessment, and risk reduction. However, a lot of work still needs to be done to reveal how Veldfire is being responded to, particularly within Limpopo province.

This study therefore is potentially going to contribute towards the solutions needed to address Veldfire challenges facing the districts of Limpopo province in South Africa, and perhaps the world at large. To the extent that the study examines the legislative and policy framework, it is going to impact on how government of South Africa runs the business of managing Veldfire whereby proposals for policy change are made, even more crucial is that the study contributes to change of attitude and course of direction in the implementation of existing interagency policies sought to strengthen institutions responsible for Veldfire management in the districts of Limpopo province. The study furthers addresses crucial issues of early warnings systems, thereby bringing to the attention of local authorities that the significance of access to early warning information reduces the impacts of Veldfires onto the local economy development and

that government should intensify programs and projects aimed at raising levels of resilience of the residents of the districts against impacts of Veldfires.

1.7 SUMMARY OF METHODOLOGICAL CONSIDERATIONS

This section presents a summary of the methodologies used in this study. Comprehensive methodological discussions are provided for in Chapter 3 of the study, detailing the approaches applied during data collection. Qualitative methodology was adopted in this study and provided for the use of a judgmental sampling technique in the selection of participants from both Mopani and Capricorn district study sites. Etikan and Bala (2017) argue that judgment sampling is mainly dominated by the researcher's decision on who should be the key informants and from whom the right information can be obtained. All members of the Disaster Management Advisory Forums in the two districts including the Chief Fire Officers, the Head of the Disaster Management Centers, the Response Team Members from the Fire Brigade Services, Working on Fire and Fire Protection Association constituted the study population. Other participants were selected from Government departments responsible for the disaster management. In additional to this Traditional Leaders, whose role in Veldfire management cannot be over emphasized were also identified and selected using a purpose sampling technique. The Snowball technique was also used in conjunction with judgment sampling to select specific people with the relevant information as research participants. The researcher also made use of observation to supplement the data in the research sites. Strauss and Cobi (1990) argue that when a researcher uses snowball sampling technique, he relies on the experiences of other people to direct or identify other participants since the researcher in this case knows little about the organization or a group to the study.

In this study, participant's observation was used together with structured, semi-structured, and unstructured interviews to collect the primary data while secondary data was collected from government policy documents, electronic and hard copies of reports and other government reports.

1.8 THE RESEARCH SCOPE

This study was limited to interrogating the readiness to respond to Veldfires by District Disaster Management Centres of the Limpopo province. While the study has implications for Veldfire management in South Africa, its key focus on to draw lessons from some of the spatial locations in Limpopo which are highly vulnerable to veldfires. These included the Mopani and Capricorn districts of Limpopo province. It is important to note that the critical part of the scope of this study was to assess the effectiveness or lack thereof of interagency collaboration needed in the management of Veldfires by different stakeholders within the study districts. Furthermore, an attempt to investigate and assess the adequacy of Veldfires response mechanisms was embarked on and this was also limited to the two study sites.

1.9 ETHICAL CONSIDERATIONS

According to Robson (1993) when embarking on any study, research ethics is an important step to consider. Involvement of human and animals in a study requires protection of rights, which validates the processes of research (Page and Mayer, 2006). The classification of this research project in terms of the risk factor is of great significant. It is for this and other reasons that the research was subjected to ethic committee review. The data collection of the study kick started soon after the ethics committee expressed their opinion. According to Drew, Hardman and Hosp, (2008), ethics in research is a moral obligation of what is deemed proper to ensure that practices that will not hurt, infringe, or invade the privacy of participants are upheld. Howel (2004), observes that based on deep trust a member may share intimate secrets with the field researchers alone. This does not give a researcher any form of authority to divulge either the information or the source. Page and Meyer (2006) argue that researchers ought to respect participants and study sites to highlight the need to seek informed consent from participants. It is a measure which ensures that no rights of participants are violated, while at the same time providing participants authority to voluntarily participate and withdraw in any given circumstances during the research process (Creswell, 2003).

The researcher embarked on the lengthy process for ethical clearance prescribed by the University of the Witwatersrand Ethics Committee and the following protocol identity number H20/05/18 (See Appendix M) was issued to certify that this study has successfully met the university ethics clearance standards.

1.10 THESIS STRUCTURE

The first chapter of the study presents the introduction, the problem statement, the study aims and objectives, including the research questions, literature overview, significance of the study, methodological and ethical considerations form the last part of the study. Chapter 2 presents a theoretical perspective of the study. Chapter 3 describes the research methodologies adopted in the study, also detailing the study locations where in-depth data was collected. Chapter 4 provides for the empirical evidence of policy documents, questionnaire surveys and elaborate interviews conducted with different focus groups and individuals. Chapter 5 presents the discussions and analysis of findings from the two districts in the Limpopo province. Finally, Chapter 6 presents conclusions and recommendations from the study.

CHAPTER TWO

THEORETICAL CONSIDERATIONS AND LITERATURE REVIEW

2.1 INTRODUCTION

The review of existing literature on Veldfire management and topics of a similar nature characterizes this chapter. To enrich this part of the study, we engage with historical and contemporary arguments pertinent to the research topic. According to Newman (2011:125), for example, he argues that literature review links a specific study to a larger body of knowledge. He further argues that integrative literature review, on the other hand, presents a summarized current state of knowledge, on the other, it provides highlights for or against specific discourse of study.

To accomplish this task, the work of the chapter is divided into four different subsections. The first subsection is dedicated to giving the prevalence and impacts of Veldfires within a global context. It is in this section where a brief history of Veldfires is given, specifically highlighting policy integration. The second subsection focuses on dynamics of the Veldfires in the context of sub-Saharan African countries. It is in this section where impacts of the Veldfires in the region are contextualized. The third subsection discusses capacity issues at play in the management of Veldfires by emergency agencies. The final subsection pieces together the global, regional, and local contexts that converges into knowledge gaps, which may further contribute to fire management field of study.

2.2 CONTEXTUALIZING VELDFIRE MANAGEMENT: A GLOBAL PERSPECTIVE

Veldfire management has become one of the noticeable challenges attributed to rising temperatures in and around the world. It knows no boundaries. Both developing and developed countries alike are socially, economically, and environmentally impacted upon. This problem is compounded by fire uses which are destructive to extensive tracts of forests and grasslands, resulting in the poor biodiversity and loss of human life (Russell-Smith et al., 2003; Bond and Keeley, 2005). Randerson et al., (2005) and Lavorel et al., (2007) as well as Giglio et al., (2010), contend that wildfires operate globally in all continents consuming on average 5% of net annual territorial primary production. They further argue that wildfires are estimated to burn more that 30 million hectares (Mha) worldwide annually.

The Food and Agriculture Organization (FAO) (2006) shows that the current estimates of the quantity of biomass burned globally each year from all sources is about 92 million tons, while overall global wildfires consume 51 million tons, 42 percent of which burned in Africa (including fires associated with deforestation). This burning releases about 34 million tons of C_2O as well as significant quantities of emissions.

Previous studies have revealed that an estimated of 27–68 million tons of plant carbon are consumed annually through the burning of savanna vegetation and by wildfires in shifting agriculture (Gillett et al., 2004 and Duffy et al., 2005). Goldammer and de Ronde (2004) point out that approximately 168 million hectares burn annually in the South of the equator, while nearly 17% of a total land base of 10 million hectares, accounting for 37% of the dry matter are burned globally. Figure 2.1 shows megafires burning through the Krasnoyarsk region of Siberia in Russia.



Figure 2.1: Forest fire in Siberia, Russia
Source: Greenpeace International (2020)

According to the Greenpeace International (2020) report, more than 10. 9 million hectares of forest land were destroyed by Wildfires between 2000 and 2021. The damages were estimated to an approximately one billion USA dollars. To date, wildfires are reported to have caused enormous economic, social, and environmental damages of enormous proportion. According to Bond et al., (2005); Pausas and Paula, (2012), they argue that there are contradictions that belies the use of fire in environmental management. Fire is used to regulate fuel accumulations, regeneration of vegetation, removing fungi and

microorganisms, disease, and insect control. Fire should be recognized as an important ecological process used for maintaining healthy ecosystems in plantation areas (Pereira et al., 2012).

Veldfire related deaths (in terms of statistics) in different parts of the world show average increased tendency. The World Bank Report (2014) reveals that in the year 2010, New Zealand experienced the highest death rate in the southern hemisphere, where 74 death per were caused by Veldfire. It was followed by Australia with 53 deaths. Daniel (2011), for example, argue that Veldfire related deaths for every 100 000 people in the national populations between 2005 and 2007 increased dramatically. In that particular year, Finland was the highest with 194 deaths, followed by Hungry, Japan and Poland with 184, 168, and 153, respectively. The least recoded death rate in that period was 13 deaths in Portugal. Goldammer et al., (2012) observe that the 2010 Global Wildlands Fire Fatalities Statistics (WFFS) released by Global Fire Monitoring Centre (GFMC) reveals that in western Russia, 345, 374, 279 and 130 people were killed directly by wildfires in 2008, 2009, 2010, and 2011, respectively. He is of the view that this number was high notwithstanding that the statistics was not inclusive of deaths caused by heat and smoke pollution.

The economic impact of Veldfire is also felt at a global scale. The World Bank Report (2014) for example, reveals that Wildfires cost Indonesia at least United State Dollar (USD) 16.1 billion an equivalent of Indonesian Rupia (IDR) 221 trillion. The report further shows that Austria and New Zealand had the highest loss of 0.3% and 0.1% of their Gross Domestic Product (GDP) directly due to Veldfire damages on livelihood assets. Other affected countries were Belgium, Switzerland, and Norway with losses of 0.2%, 0.3% and 0.2% of their GDPs, respectively. The Global Veldfire Fatalities Statistics (GVFS) (2017) also reveals that around the world, a great number of countries have their GDPs affected from the cost of direct fire loss. These proportion of damage are clear indications of the extent of Wildfire problem, which are far from over. Anderson (2003) is of the opinion the United States of America (USA) and around the globe, are experiencing raising temperatures. Forests have become dryer than usual, presenting increasing chances for more severe Veldfires to occur. Heberle and Ladru (2001) are of the view that Wildfire activities are in the increase in places such as Patagonia, the northwestern USA, and northeastern Canada, Australia, and Papua New Guinea.

The Arctic Climate Impact Assessment (ACIA) (2013) report that the boreal forest and the north are warming up rapidly destroying the ecosystem balance. The rising temperatures put the world at risk from Veldfire occurrences that potentially threatens economic activities (International Panel of Climate Change (IPCC), 2017). Flannigan et al., (2012) argue that Veldfire occurrence will phenomenally increase in future. This is exacerbated by the notion that fire management will continue to face difficult challenges in the future (Payne, 2013).

Historically, global debates have revealed that during world wars, countries such as North America, Germany, Greece, and Japan had in the past used fire to ignite wild forest to distract military operations using balloon-carried incendiary devices carried by high-altitude jet stream (Peebles, 1991; Xanthopoulos, 2010; Webber, 1975; Muller 1992). Pyne (1995) argues that in the past, conflicts in the society and political rivalry contributed immensely to major fires. According to Kasischke et al., (2002) and Turetsky (2006) the history of Wildfires in the North America (Canada, Maxico and USA) boreal forest is such that, the Veldfire occurrence in the boreal forest from 1960s – 1990s tripled, largely due to rising temperatures.

Drever et al., (2009) and Krawchuck et al., (2009) observe that on average, 51 Mha of boreal forests of Siberia, Canada, and Alaska, burn annually. Balshi et al., (2008) agree, that the Canadian Forest Fire Weather Index System (CFFWIS) data used by the Canadian Regional Climate Model (CRCM) reveals that towards the end of the 21st century the decadal burned in Canadian boreal will double between 2041 and 2050. To support this position, Amiro et al., (2009) predicted a 1.2 to 8 times increase in Veldfire occurrence by the year 2050.

Held (2005) argues that high proportion of emissions from biomass burning results in an estimated 92 million metric tons burned. They have shown that the estimates of quantity of biomass burned globally each year are approximately 92 million metric tons (mt) of the 52 million mt global wildfire, 42 percent is burned in Africa. These fires in Africa release about 34 million of Carbon Dioxide (C_2O). These assertions are in tandem with the debates in Conference of the Parties (COP) 25 in Madrid, Spain which stated that carbon emission is setting the world in a state of emergency, putting enormous pressure for the world to find alternative energy source (Amiro et al., 2009).

Stocks and Flannigan (2009) argue that the rising fire suppression costs are increasing because fire equipment has become very expensive as the heat is persistent during fire seasons. They further point out that Canada continues to experience extreme fires due to high ignition levels which caused 334 homes, 10

businesses destroyed, and 45 000 people evacuated leaving fire suppression capabilities consistently overwhelmed. Harden et al. (2010) calculate loss on tourism alone excluding costs on air and water quality in the Okanagan region, it costed the country an estimated Canadian Dollar (Can$) 80 million. Filmon (2014) argue that in 2009 alone, fire suppression costs Canada more than Can$400 million and yet the damage to timber, forest productivity, homes and infrastructure far exceeded that value. Weber and Stocks (1998) and Kura et al., (1995) support that the policy of modified suppression adopted by Canada, which allows for fire to operate naturally in the lower priority areas, has cost the provinces such as British Columbia, Ontario, Alberta, and Quebec from Can$700 million to Can$1billion in extreme Wildfire seasons annually.

Payne (2005) argues that between 2000 and 2004, Mexico Wildland fires burn 197 hectares (ha) on all lands. In 2003 alone Maxico lost US$337,03 million worth of wood in Wildland fires, US$57 million worth of firewood and US$39.17 million to deforestation. Figure 2, 2 illustrates the statistical a, 8853 km² size of land is burned by wildfires, setting the trend to 5% increase (An equivalent of 10-year average: 8853 km²) area burned by wildfires (National Interagency Fire Center Statistics, 2016).

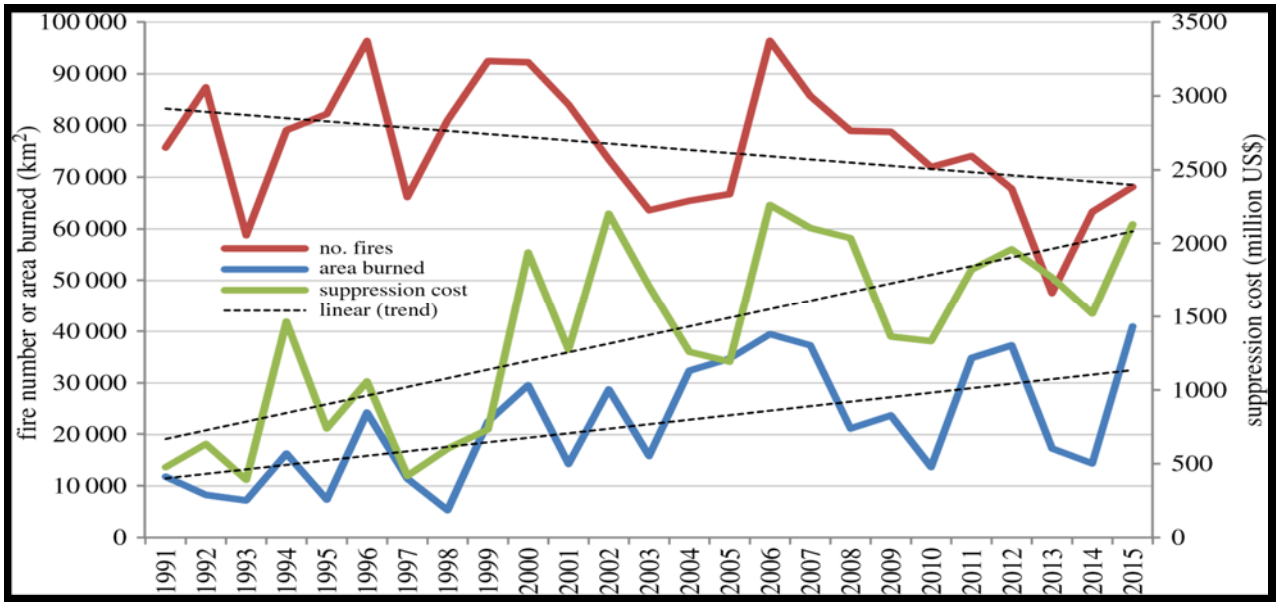


Figure 2.2: Area burned per suppression costs (inflation adjusted to 2016 equivalent) for the USA with linear trend lines (1991 – 2015).
Source: NIFC. 2016 National Interagency Fire Center

Figure 2.2 illustrates the existence of linear relationship between suppression cost and the number of fires. The linear trends revealed that an equilibrium point between the number of fires and suppression cost was reached between 2013, when the number of fires had decreased substantially. Furthermore, in 1997, 1999

and 2005 equilibrium points were reached between suppression cost and the area burned when suppression costs decreased. Van Wilgen et al (2010:217) point out that huge forest plantations have been hard hit by Veldfires occurrences in the past few months with statistics supporting that in a period of 30 years economic activities from timber production will decrease by 40% to 75%.

Caitlin (2008) and Komarek (2010) argue that in 1997-2008 United States Department of Agriculture Forest Service spent $US 11.5 billion on fire suppression alone, on Wildfire that burned 26 million hectares of forest land, and that the figure runs into hundreds of billions if four other federal states included. Anderson (2010) argues that in the same period, United States of America experiences an average of about 7500 Wildfire burns approximately 1.5 million acres of Forests and Grasslands each year.

FAO (2006) states that in the USA, during the year 2000 more than 2.8 Mha burned making it the worst burnt season in the history of Wildfire occurrence in more than two decades. This was followed by more than 2.8 Mha of forest and rangeland destroyed by Wildfires soon after the year 2004. A total of 3640 homes and 33 commercial building were lost to Wildland fires in Los Angeles. In San Diego, in 2005 over 3.48 Mha were destroyed by Wildfire. All these damages were sustained despite the fire suppression policy in place, special firefighting training, and revised qualifications for firefighting to make for a finest fire force. FAO report shows that the Fire Wise community awareness program 'Smokey the Bear' came under severe criticism, as it was seen to have not made any substantial contribution. The report concluded by showing that the USA had to seek assistance from GFMC through which resources were coordinated from different member states bringing 1200 specialist fighters from Canada, Australia, New Zealand and Mexico. As a result of the partnership fostered through GFMC, USA continues to work together with Australia and New Zealand.

Barbasa and Fearnside (2000) as well as Shimabukuru (2000) argue that Brazil has also experienced Wildfires of massive proportion and has continued to suffer from recurrent burning in recent years. In 1998, USA approximately 11 million to 14 million ha of undisturbed forest was destroyed by Wildfire during 1998 (UNEP, 2002). Cochrane et al., (1999) and Cochrane (2003) point out that once Wildfire becomes established in Brazil Amazon Wildlands, it takes forever to put it down. Mostacedo et al., (1998), (1999) and Musse (1999) argue that fires in Bolivia destroyed huge forest land in 1993 and 1994. Gregoire et al., (1998) posit that, in Alaska, the total burned area between 2000 and 2009 was twice the total burned area in 1970-1999.

Stocks et al., (2009) are of a view that the Union of Soviet Socialist Republic (USSR) also experienced Wildfires just like other boreal countries. Stocks and Jin (1998) as well as Cahoon et al., (1991), (1994) argue that the 1987 mega fires burn 13 million hectares in the Northeast of China, while 10 million hectares burned in Eastern Siberia. Many studies (see Shastakovich, 1925; Lutz, 1956; Kurbatskii, 1975; Korovin, 1996; Goldammer and Furyaev, 1996) reveal that regions commonly known for extensive fire activities in Russia particularly Siberia are mostly characterized by boreal, sub-boreal forest, grasslands, and agricultural land.

Sikhinin et al., (2004) are of the view that in the past, USSR did not have comprehensive or reliable statistics to quantify the problem of the magnitude of Veldfires. Soja et al., (2004), (2007) argue that the data from Independent Russia Academy (IRA) Sukacher Institute for Forest, Krasnoyarsk (SIFK) reveals that official records fail to reflect all the areas burned in Siberia. Huang et al., (2009) and Goldammer (2010), posit that after Russia, abolished the National Advanced Forest Fire Centre (NAFFC) specialized forest firefighters' units, the result was that Wildfires killed 63 people, 9 villages were destroyed. A further total of 300 homes and infrastructure were burned, including other asserts such as military fighting equipment.

San-Miguel and Camia, (2009) point out that Veldfire in the Mediterranean are caused by humans, either accidentally or intentionally. These fires cause larger impacts for example, in Southern Europe 3% of fires destroy an area larger than 59 hectares of Forestland which account for 76% of the area burned. Moreno et al., (2010) and Vallejo (1990) point out that in Spain, 10% of the burned are occur in the remote areas which are also managed through first fire attack. According to Vega-Garcia and Chuvienco (2006) Wildfires in Spain are associated with extreme weather conditions of dry thunderstorm and strong winds, making Aerial Extinction Resource (AER) difficult if not impossible to use. Goldammer (2012) argues that it is critical to put wildfire response mechanisms in place at the detection point because once wildfire spreads, it could prove difficult to manage.

According to Sorensen (2000), Early Warning Systems (EWS) use technology which varies according to the type of hazard exposure. The extent to which early warning could be effective depends on variety of factors for example, plans for response, preparedness, the jurisdiction size, and the time taken to warn communities at risk. He further opines that most communities may not afford or able to use technologically inclined systems to obtain warning readings. Brunacini (2001) and Kramer and Bahme (1992) argue that Tsunamis warning are issued on time through technologically inclined systems that relay accurate warning

information to the local community, however majority of the people either do not understand it or ignore it to their own peril. According to Lautze and Bell (2012), much of the literature on Early Warning System (EWS) assume that effective response depends on the prediction and distribution of accurate warning information to vulnerable communities (Alinovi and Russo, 2012).

Goldammer (2006) and Gillet et al., (2004) argue that in Central Asia, the change in climate exacerbated the Widfire situation. Contrary to this belief that every part of the world is experiencing increased incidences of Veldfires, Dimitrakopoulos and Mitsopoulas (2006) argue that most parts of the Mediterranean Sea and the Peninsula of the Anatolian experience limited incidents of fires. In support to the contrary view, Vazquez et al., (2002) argue that fire climatic conditions do not necessarily induce high fire frequency. However, many studies using the output from research on Wildfire conducted in Spain in 1994 and Portugal in 2003 and 2005 also in Greece in 2007 strongly argue that there is correlations between the fire size, frequency and the weather severity. Some studies further show that, climatic conditions such as drought and heat waves are more likely to induce Wildfire (Boer et al., 2008).

Velez (2008) argues that during fire seasons the Mediterranean countries ensure that firefighting capacity is in place. They ensure that more than 400 aircrafts are required to provide support for fire suppression and that expenditure in prevention and suppression amount to 60% while the remaining proportion goes to personnel operation and fire prevention leaving the government constrained on unforeseen catastrophic eventualities. San-Miguel and Camia (2009) argue that increment in firefighting capacity has on average tendency to stabilize the mean of large fires. This position was challenged by Pukka (2007) who is of the view that increase in firefighting capacity does not guarantee stabilization of average mean size of large fires as in some areas, large fire frequency increases.

Williams et al., (2011) and Liu et al., (2009) reveal that the 2007 Veldfire disasters which claimed 84 lives in Greece, saw the activation of the European Union Civil Protection Mechanism (EUCPM) meant to exchange request for assistance and offer response and rescue resources by GFMC. They further argued that as a result, EUCPM provided a new capacity for coordination which played a central part in firefighting coordination at European Union (EU) level for countries such as Iceland, Norway, Croatia, Yogoslavia and Republic of Macedonia etc.

Russell-Smith et al (2003) is of a view that the history of Australia shows that the Australian aborigines who for many decades lived in the northern tip of Australia forests, used fires for cultural events such as marriage and initiation ceremonies. According to Bradstock et al., (2002) the 2009 catastrophic fires that took place in Victoria burned 430 000 ha of wild land and destroyed over 2000 homes and 173 lives were lost. It was referred to as Australia's worst disaster. Russel-Smith et al., (2019) state that the second half of 2018, Australia was hit by numerous bushfires that caught the attention of the world. According to the Australia Fire Management (2006) report, Australia is one of the countries with well-developed risk reduction strategies incorporated into their education system. These strategies are aimed at changing human behavior towards fire and are applied in every part of the country. The report reveals further that Australia uses Crew Resource Management (CRM) strategy which over the years was seen to have improved not only communication but coordination of Veldfire stakeholder teams.

According to Godwin and Kobziar (2006), the CRM model enhances teamwork. It produced results that show improvement on interpersonal skills among Australian firefighters. Goldammer (2004) is of the view that team leaders must ensure that a fire staging area illustrate by Figure 2.3, should be demarcated with a flag, plastic tape, or any other agreed clearly visible marking. They are valuable resources for keeping any other additional equipment needed to fight Veldfire. They further argue that trained personnel with special skills on fire combat should be placed at the fire front and the other one on the lookout for the intensity of fires. The constant monitoring is required for sending alert messages on any changes in fire behaviour as the team working at the head of the fire may fail to notice changes due to smoke and heat (Goldammer (2008).

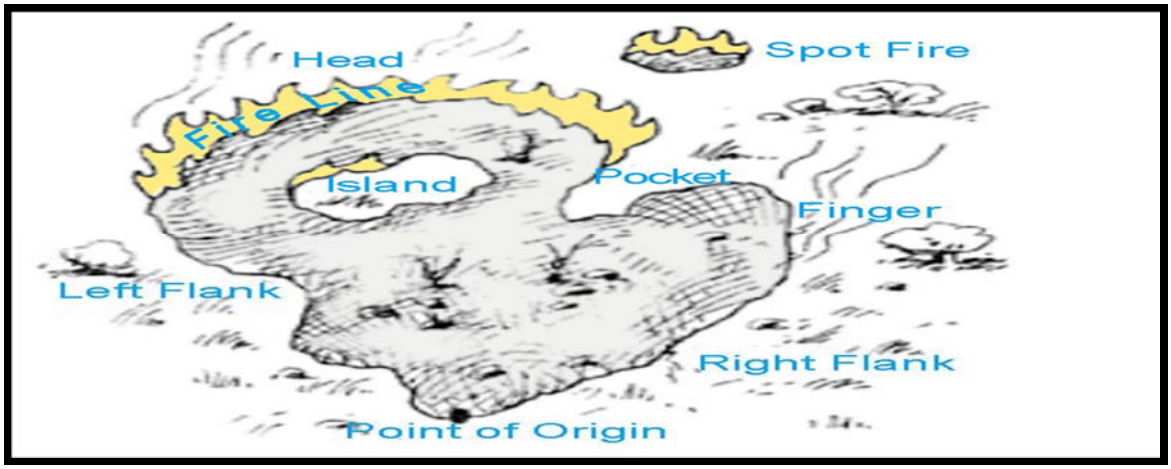


Figure 2.3: Veldfire fighting theory
Source: Goldammer (2004)

The Veldfire theory illustrated in Figure 2.3 shows that fire has a complex structure, which can only be handled by skillful firefighters. Fighting fire requires that firefighters be able to determine the amount of fuel that is causing burn speed and the head which is responsible for direction and the manifestation of flanks into the right side and the left side of the fire structure. It is further argued that when firefighters have the necessary knowledge about the fire, they stand a good chance to make informed decision on how to attack effectively and efficiently. Trollope (2004) emphasizes that the fire theory requires that skilled firefighters should be placed in different strategic location and that not everyone should be at the fire front or on the lookout, in that the more hazardous the situation, the specialized fire skills are required. The lookout alerts the team to any changes in fire behavior while the team working at the head of the fire in the smoke and heat should communicate correct messages effectively to reduce chances for failing to notice changes which mostly results in maximum damage (Goldammer, 2004).

Lindell and Perry (1998) argue that to manage mega fires, for example, a recognized specialized training and developed Emergency Management System (EMS) are required. The professional associations which provide Veldfire expert training and incident management should provide accreditations for firefighter skills training courses. They further argue that this will ensures that Veldfire fighting is not only professionalized but is accredited to meet world standards.

Studies done before by Fleming and McCartha, (2015); have shown that responding to large-scale wildfire, requires involvement of stakeholders from diverse jurisdiction. This enables each one to provide unique sets of expertise needed in tackling large fires. Provan et al (2007) are of the opinion that the only way to successfully respond to large fires, would be to have integrated frontline network of local and federal. This array of actors can collectively provide a strong network which stands them a chance to win together or at the very worse loose together (Sydow, 2007).

Comfort (2007) and Kapucu (2006) argue that the scope of disaster incident response is always far too wide and complex, that no single organization can handle it. The coordination, integration and cooperation are all what is needed to build capacity against the impact of huge fire disasters (Faas and Colleagues, 2016). Steelman et al (2014) argue that the local communities are important group of responders who also need to be equipped with the knowledge of Veldfire. According to Perry and Hirose (1982), the respond list of agencies includes among others, all the EMS local services, state and private firefighters, Public Works, Police and Transport departments.

Mener (2007) argues that in America, after Three Mile Ireland nuclear disasters the then President Richard Nixon, instituted a commission of inquiry to address America's readiness to respond to disasters. He further states that failure to respond to nuclear disaster was due to failure to maintain approved disaster plan. The noticeable absence of evacuation plan, and communication system to communicate with the media and surrounding communities was one of the startling findings of the enquiry. Subsequently, President Richard M. Nixon established Federal Disaster Management to commit the country to the course for fighting disasters (Blanchard, 1986). Mener (2007) argues, that after 2000 Veldfire disasters in America, it was noted that performance of the emergency response services was substandard. He further states that President Bill Clinton, much like his predecessor, responded by appointing a commission of inquiry to investigate best ways to respond to Wildland fires. According to Witt (1997), the commission revealed that issues on disaster plans were not part of the institutional culture, neither were they reviewed over time.

Williams et al., (2011) is of the view that America had responded to many disasters in the past, and still failed on several occasions to effectively do so. He further argues that federal governments have created numerous large bureaucracies and congressional panels, which lead to inefficiencies and consistent failure of the system under different personal leadership. They are of the view that the establishment of the Federal Emergency Management Agency (FEMA) and the Emergency Management Council (EMC) helped to ensure that administrative structure to manage disaster responses and preparedness in the United State of America is at work. The response system for Canada and Australia are considered the best among others and that they had completely depolarized their operations whereby most if not all disasters are declared without political debate which often led to not only problematic but irrational lenient disaster declarations (Perry and Hirose, 1982)

Irwin (1989) argues that countries should establish Incident Command System (ICS) for them to deal with large-scale wildfire events. This coordination body uses management teams that lead response structures which command a pool of resources needed to deal with disasters. Nowell and Steelman et al., (2014) argue that while Incident Command System are helpful, they target mainly response but not preparedness and not recovery. They are of the opinion that it needs to be noted that developed countries have had serious challenges for response readiness in spite having resources and response strategies at their disposal.

Miskel (2007) argues that though the United State of America (USA) had responded to thousands of disasters and numerous terrorist attacks, the federal state and at local level are exceedingly unprepared to handle the immediate effects of disasters. He further points that government still fails to respond despite notices issued on time for impending disasters, nor possession of appropriate respond guidelines and equipment.

2.3 VELDFIRE MANAGEMENT AND SUSTAINABILITY: A SUB-SAHARAN AFRICAN PERSPECTIVE

Africa is viewed as a fire continent. It is believed that the continent experiences high frequency of unwanted Wildland fires (Food, Agriculture and Natural Resources Directorate (FANRD), 2010). De Ronde et al (2004) argue that much of sub-Saharan Africa constitute vast landscape of tropical and subtropical fire-prone savannas, fire-influenced woodlands and shrub lands that have been shaped by the longest history of human involvement with fire in the Africa. Pyne et al., (2004) argues that these unwanted fires change species composition, vegetation structure and composition and as a result, soil properties are degraded while soil productivity in both commercial and natural setting decreases.

According to de Ronde (1992), they argue that most parts of the Sub- Saharan African countries such as Mozambique, Tanzania, Uganda, Zambia, and Sudan have significant scales of industrial plantations established on savanna grassland. This makes them more susceptible to huge losses attributed to the effect of total fire protection policy (De Ronde et al., (2004). Komarek (1971) argues that sub-Saharan Africa is vulnerable to Veldfires which result from lightning. The country also has an ideal fire climate comprising of dry and wet periods. Sub-Saharan Africa has the most extensive area of tropical savanna in the world which is characterized by grassy understory that becomes extremely inflammable during the dry season (Held, 2005).

Many studies have examined trends in burned area and concluded that over the last century, Veldfires in sub-Saharan Africa were caused by man. They also stressed that land-use practices, and increased temperature in the region have increasingly contributed to Veldfire (Mouillot and Field, 2005; Schults et al., 2008). The sub-Saharan Africa has its fair share of challenges because of Veldfire impact on social, economic and environmental development. Held (2005) argues that sub-Saharan Africa have a distinctive wet and dry season which together favour regular occurrence of Wildland fires. He is of the opinion that

there is increased fire danger due to extreme fire weather conditions. These extreme fire weather conditions impact on the poor, particularly the rural poor, majority of whom constitute a sizable proportion of village populations in the sub-Saharan Africa (De Ronde et al., 2004).

The report from the National Space Agency, Moderate Resolution Imaging Spectoradiometer (NASA MODIS) Sensor (2004) states that Terra and Aqua satellite data detected the 2.3 million km sq. active 7fires of an equivalent of 8 % of Africa‘s land area burning. An estimated 54 percent of the world burned area are in Africa (Payne, 2004). The social and economic damage from wildfire in Africa should be investigated carefully around all aspects of fire management aiming at empowering the affected populations with information on how to reduce Veldfire risks (Barbosa et al., (1999). It is for these reasons that South African Development Community (SADEC) region and neighboring countries have adopted a policy referred to as “let’s burn” to ensure that fire is used in the safest way possible (Goldammer, 2009).

Tsiko (2006) argues, for example that in Zimbabwe, Veldfires have impacted immensely on the economic activities and cause the country widespread ecological disturbances. He further argues that forests and plantations under Border Timber Limited, were burned down resulting in a loss estimated to an undisclosed amount of money. According to Goldammer (2013), the Manicaland Integrated Fire Management Strategy 2009 – 2011 is an adaptation of the existing fire management approach centered upon the Plantation Timber Industry and the Caprivi Strategy 2007 – 2011 focusing on fire prevention and suppression of fires within areas of the Province. Meyers (2006) posit that Namibia developed the Caprivi Region Integrated Fire Management Program (CRIFMP) which commenced in 2006. The program was mainly to represents an ecosystem-based fire disaster risk reduction program and in general to enhance Veldfire management. Jurvelius (2000) observed that Namibia fights Veldfire through the Integrated Forest Fire Management (IFFM) program funded by the Namibian-Finland Forestry Programme (NFFP). The IFFM entails awareness campaigns, roadside billboards, news on local radio, village meetings and drama presentations to enlighten communities particularly school children about control of Veldfires.

The Namibia Finland Forestry Program (NFFP) (2003) report reveals that approximately 900 000 ha burned in a single day. Burkina Faso lacks the resources and skills to fight fire. It further shows that there are serious budget allocation issues one of which is that 80-90 percent goes to suppression while 10-20% into prevention, unless a country has foreign-funded fire management programme which emphasizes

prevention and preparedness. Only a few countries attach those programmes to their national strategy but still lack adequate financial support (Held, 2005).

According to Hoffman (2013) communities should control when, where and how fires occur to minimize negative effects while maximizing the benefits of fire without costly machinery or resources. He further observes that by using fire behaviour, local knowledge of the area and strategic implementation of safe and efficient controlled burning is achieved with minimal equipment (matches / drip torch / fire beater). Archibald et al., (2009) argue that the economic impact of Veldfire is devastating to rural farming communities as depicted in Figure 2.4. Dube (2013) is of the opinion that in Botswana, Veldfire destroyed approximately 34% of the land burned from 2000 to 2008. The Khama Rhino Sanctuary Trust (KRST) project facilitator developed the 2010 / 2011 Khama Rhino Sanctuary Integrated Fire Management Strategy (KRSIFMS) which includes involvement of communities and neighboring countries to ensure that the Khama Rhino Sanctuary IFM excels in the management and operational capabilities implement a CBFiM initiative.



Figure 2.4: Livestock destroyed by Veldfire in Southern Africa
Source: 6th National Fire Prevention Seminar Visser report 2019

Figure 2.4 above illustrates that Veldfire can cause substantial economic and environmental damage. Visser (2020) argues that huge scale loss of livestock causes many farmers to take property insurance against Veldfires. He further points out that without insurance, famers will take longer to recover from damage such as this, because farming is costly, and without insurance longer to rehabilitate and

reconstruct their damaged farming infrastructure and properties. Dube, (2009); Batisani and Yarnal (2010) point out that Botswana has a climate with distinct characteristics conducive for Wildfires. Held (2006) argues that this makes the Botswana Government to prepare 12000km of fire breaks spending a total of US$ 5 million on firebreak maintenance every year. Goldammer (2013) opines that extension of fire management by the Botswana government to the community has typically involved awareness campaigns on fire prevention, employing communities to construct and maintain cutline and mobilizing community workforces to extinguish wildfires. He further argues that though Fire management ownership rests firmly within the Government and communities of Botswana. It is largely driven by external decisions and resources (Dube, 2009).

Meyers (2003) argues that in recent years, Tanzania, faced serious challenges of managing Veldfires. The country government employs the services of the Tanzania Forest Services (TFS) Agency tasked to implement a broader and more comprehensive approach in Public Fire Management. He is of the opinion that the country's Integrated Fire Management (IFM) strategy has archived significant goals land management in the country. Hoffman (2012) observes that in 2011 the "Working on Fire" programme of South Africa adopted from the United State of American FireWise model was customized in Tanzania to include collection of information, prevention, preparedness and suppression. According to Hoffman (2013), the Ministry of Natural Resources and Tourism in the country facilitated different training events on forest management and conservation as part of the Public Fire Management (PFM) with remarkable success. The success of every government program lies not in the designing but in the implementation (Meyers, 2003).

Goldammer (2013) argues that Community Based Fire Management (CBFiM) proved to be a success story in Sub Saharan Africa. He points out that it is much to the surprise of everyone that CBFiM has not yet been applied to communities living adjacent to forests, while in countries such as Tanzania and South Africa, CBFiM is even supported by German Cooperation (GIZ). CBFiM is the fire management project coordinated in Sub-Saharan Africa countries to enhance integrated fire management at national and local levels. Its major part is training of community members on ways to mitigate the negative impacts of the unwanted fire incidents, there by educating them on the use of fire as a tool for natural resource management. FireWise South Africa (SA) model was customized into Tanzania context and environment with multiple stage process involving stakeholders from various land management agencies (Forestry,

Wildlife, Agriculture and Livestock, Universities, NGOs) to cater for the rural context of Tanzania (Hoffman, 2013).

Payne, (2004) argues that it is ironic that Africa lacks records for Veldfire statistics, and yet it is a burning continent. He further contends that the politics and lack of resources in south of the Sahara Desert resulted in high frequencies of wildfire burn and unreliable statistics. Figure 2.5 illustrates disaster events related to climate change in Southern Africa during the period from 1990 to 2016. According to FAO (2006) report, fire suppression equipment's in sub-Sahara Africa are in urban municipalities, capital or bigger cities making it difficult for rural communities to response to wildfires as it is difficult if not impossible for urban equipment to reach the far-flung rural areas.

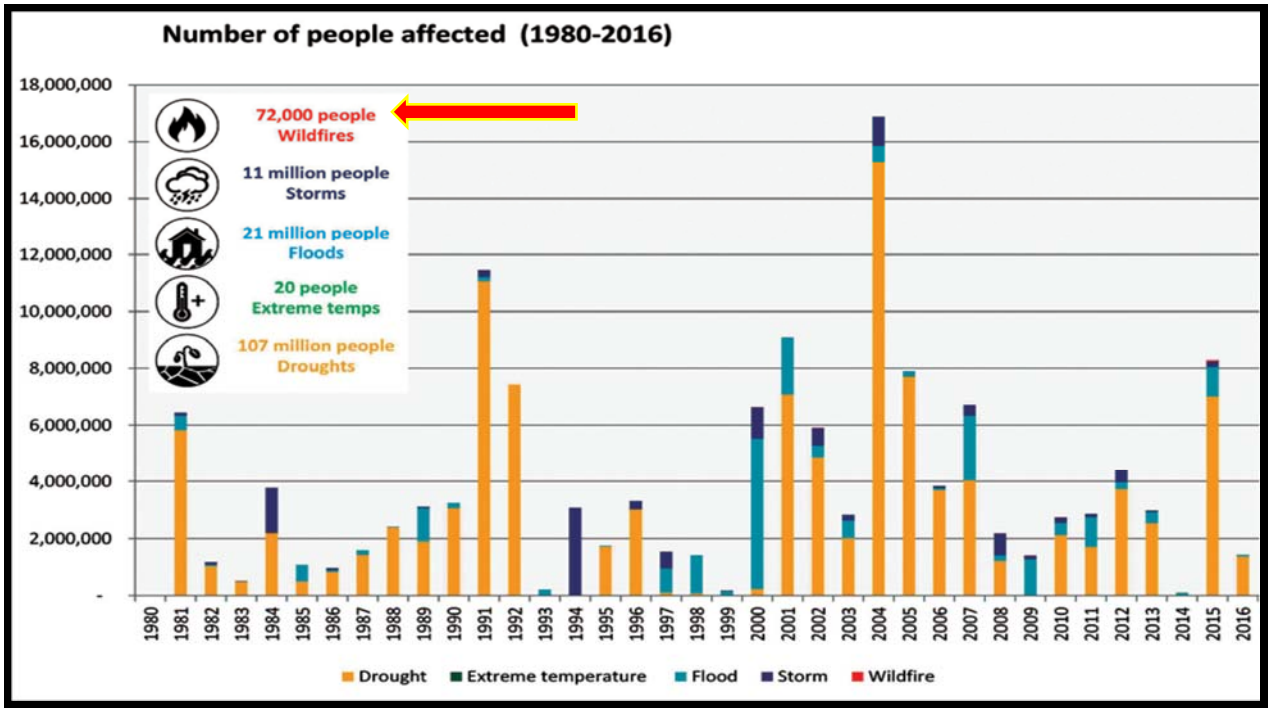


Figure 2.5: Number of people affected by Wildfire. (20 million people instead of 20 people were affected by extreme temperatures)
Source: EM-DAT CRED (2016).

Figure 2.5 illustrates disaster events related to climate change in Southern Africa in the period from 1990 to 2016. This figure shows various hazards that have impacted lives. It is observed that Veldfire was the least to impact on people's lives as compared to all the other hazards namely drought, heat, floods, and storms. Forsyth et al., (2010) argue that there exists a relationship between fire frequency and temperatures. Although lightning is the natural cause of Veldfire, today however, up to 90% of fires are caused by people themselves (Kruger, 2000).

According to Stocks et al., (1998) the effects of climate change will be felt for many years to come. Flannigan at al., (2009) argue that the sub-Saharan countries barely afford fire suppression due to increasing rate of Veldfire occurrence. They point out that Wildfires are in the increase and will continue to do so unless something drastic is done about it. The CBFiM has provided the much-needed hope as the one approach that must bring the desired change both in Veldfire and land management in sub-Sahara Africa and perhaps the entire continent. Held (2004) opines CMFiM is the last hope of sub-Sahara Africa. Burkina Faso, Mozambique, and Namibia it is the turning point at which to re-assign responsibility for fire management back to communities and their traditional leaders.

The arguments made by Goldammer (2012) show that in sub-Saharan Africa traditional leaders have authority over the use of fire, particularly during initiation schools and hunting ceremonies. It was until after the colonialization that detribalized African leaders began to follow dictates of laws of their masters rather than their cultural practices. Held (2004) opines that sub-Saharan countries had institutions which promoted indigenous knowledge on the management of fires. These knowledge systems were built from experience of over thousands of years, until unfortunately disrupted by the knowledge of the colonial masters.

De Ronde (2004) argues that sub- Saharan countries, recognize that fire management should be a concerted effort by all stakeholders including governments, private sectors and communities. He further opines that the regional fire management frameworks should address trans-boundary fire management issues. The turning point for effective Veldfire management will be reached when countries begin to collect and analyze fire related data through generalized standards and acceptable procedures (Goldammer et al., 2002).

FAO (2009) stresses that countries need to formulate flexible fire management policies that take account of prevailing land use practices, with realistic implementation plans based on clear objectives. Furthermore, the policies should involve every stakeholder to effectively address fire prevention in sub-Saharan Africa. FAO (2002) reveals that to address sub-Saharan Africa fire management challenges ensure that both human resources and equipment are adequately allocated. Develop regional and international cooperation on forest fires management, foster inter-country and international agreements and most of all the development of database frameworks for the management of forest fires should be in place.

2.4 VELDFIRE MANAGEMENT AND SUSTAINABILITY: A SOUTH AFRICAN PERSPECTIVE

South Africa, the fynbos vegetation kingdom, has for the past decade been increasingly experiencing disturbing trends of Veldfires which cost the country millions of hectares of vegetation each year (de Ronde, 1982). Kruger et al., (2000) argues that like many other countries in the region, uncontrolled fires have caused South Africa noticeable levels of human safety, health, economic and environmental uncertainly. They further indicate that South Africa has a complex population trends in rural areas due to influx from neighboring countries resulting in denser rural settlements, especially in Limpopo and Mpumalanga province. De Ronde (1982) argues that land management standards and commercial farming have declined due to land claims.

Williams et al., (2009) argue that Wildfire is one of the major hazards affecting the economy of the country. Most burned areas in South Africa result mainly from the interaction of flammable vegetation (fuel) that can support combustion and the prevalence of hot, dry spells or seasons which predispose these landscapes to burn whenever there is a source of ignition (Moreno, 2014). According to Russell-Smith et al. (2003) South Africa has complex population trends in both villages and cities due to influx of foreigners from neighboring countries, resulting in denser rural settlements, especially in Limpopo and Mpumalanga province. This increases chances for Veldfire occurrences due to human encroachment (Bond and Keeley, 2005).

Low and Rebelo (1996) argue that Sour Grassland and Moist Woodland constitute major fire-ecology of the Drakensberg escarpment. This ecology type contributes to numerous Veldfire outbreaks that take place in the Eastern Cape, Mpumalanga, and Limpopo province. Based on Figure 2.6, Spracklen et al., (2009) argue that this type of fire ecology maximizes Veldfire risk in these provinces, with the mean fire incidence of > 0.50 pixel. An example of calculations carried through this estimation is as follows 4.5 pixels on the horizontal side, 3.0 on the vertical size gives a total of 13.5 mega pixel. Figure 2.6 is a graphical illustration of how those average mean temperature anomalies are generated at weather stations.

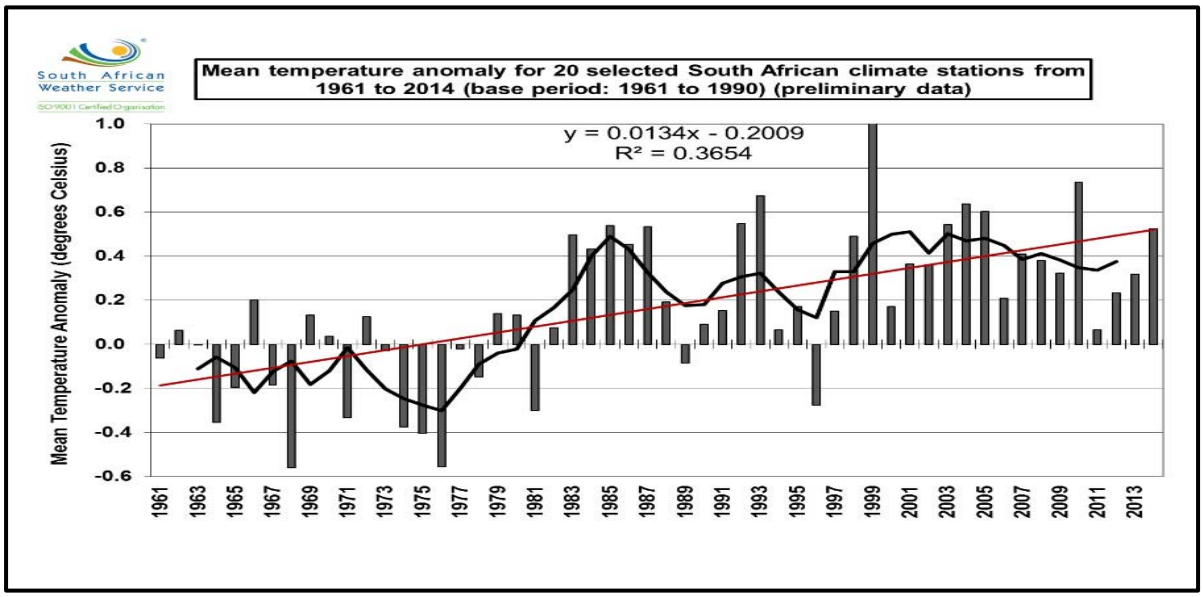


Figure 2.6: Annual mean temperature anomalies[1]
Source: SAWS, 2015.

Figure 2.6 above illustrates that the mean average temperature calculated from 20 selected weather stations in South Africa was in a constant steep increase from -0.2°C in 1961 to just above 2°C for the past 50 years. During 1975 and 1976 the average temperature was 0°C. One of the resolutions of COP meetings which took place in Paris 2015 was that the world should embark on a monitored programe to reduce Carbon emission in order to slow down the rise of the average world temperature, thereby keeping the temperatures well below 2°C. The reluctance displayed by large economy countries to adhere to the PARIS Conference of the Parties (COP) 21 resolutions had seen the world failing to reduce the amount of heat radiated to the earth from the sun causing the mercury to rise sharply (Kruger et al., 2006).

Bond et al. (2004) argue that in complex-fuel vegetation, Veldfire burn with intensity harming biodiversity particularly those situated at near-by settlements. Bond et al., (2003) is of the opinion that, most of the Veldfires are caused by prescribed burning that went wrong. Low and Rebelo (1996) are of the view that most of the Veldfire incidence in both Mopani and Limpopo province are vegetation types also found mostly within the Kruger National Park. The Park experienced numerous fires as results of prescribed burning and altered Veldfire management practices (De Ronde, 2004).

[1] Annual mean temperature anomalies (base period 1961-1990) of 20 climate stations in South Africa for the period 1961-2014, with the red line indicating the linear trend and the black line the 5-year moving average)

The Western Cape Province had responded to several serious fires for the past five years and had ultimately put in place a grand plan which ensures that the province is ready to respond to Veldfires. All the district Disaster Management Centers in the province have adopted a Veldfire response strategy to ensure coordinated response to Veldfires. The Veldfire response strategy entails activation of aircraft with 2500 litre of water load capacity to attack fire at the soonest after it had begun. This strategy allows for the spotter to be deployed simultaneously during the first hour in which the fire started. The strategy works best if fire is detected soon after it had started (Western Cape Disaster Management Report 20011).

According to Bond et al., (2003) generating fuel should be managed as most fires in the Northern Cape, and North-West provinces occur from prescribed burning after annual harvest. The study by Williams et al., (2009) reveals that fire regimes across South Africa are different because of variations in four key drivers namely the rate of growth, the dry fuel rates, the weather spread conditions and the ignition potential. The four key drivers are differentially sensitive to climate change and are responsible for influencing risk assessment used to generate the Fire Danger Rating illustrated in Figure 2.7.

Kruger et al., (2006) argues that South Africa risk assessment per province shows that 31% of the country experiences Extreme Veldfire Risk (EVR). They point out that such areas should at all times take precautions to safeguard lives, livelihoods, property, and the environment. According to Potgieter et al., (2000), KwaZulu/Natal experiences EVR of up to 84%, followed by Mpumalanga at 71%. The Northern Cape is the province with the lowest EVR at 57%. Even the lowest EVR reading, implies above average Veldfire frequencies (Potgieter et al., 2000). More than 90% of certain District Councils (DC) have an EVR. The Alfred Nzo DC in the Eastern Cape has 100% chance of Veldfire risk. Thabo Mofutsanyane DC in Free State has 98% Veldfire risk. Metsweding DC in Gauteng has 93%. In KwaZulu/Natal, Umgungundlovu DC has 99% Veldfire risk, Uthukela DC has 97%, Amajuba DC has 100%, Zululand DC has 91% and Sisonke DC has 100% (100%), Greater Sekhukhune DC in Limpopo has 93% (CSIR, 2010). Fire Danger Index FDI shown in Figure 2.7 provides critical information to warn the landowners about the possible run-away fires. This information is critically important to the FPAs wh have the authority for issuing the burning.

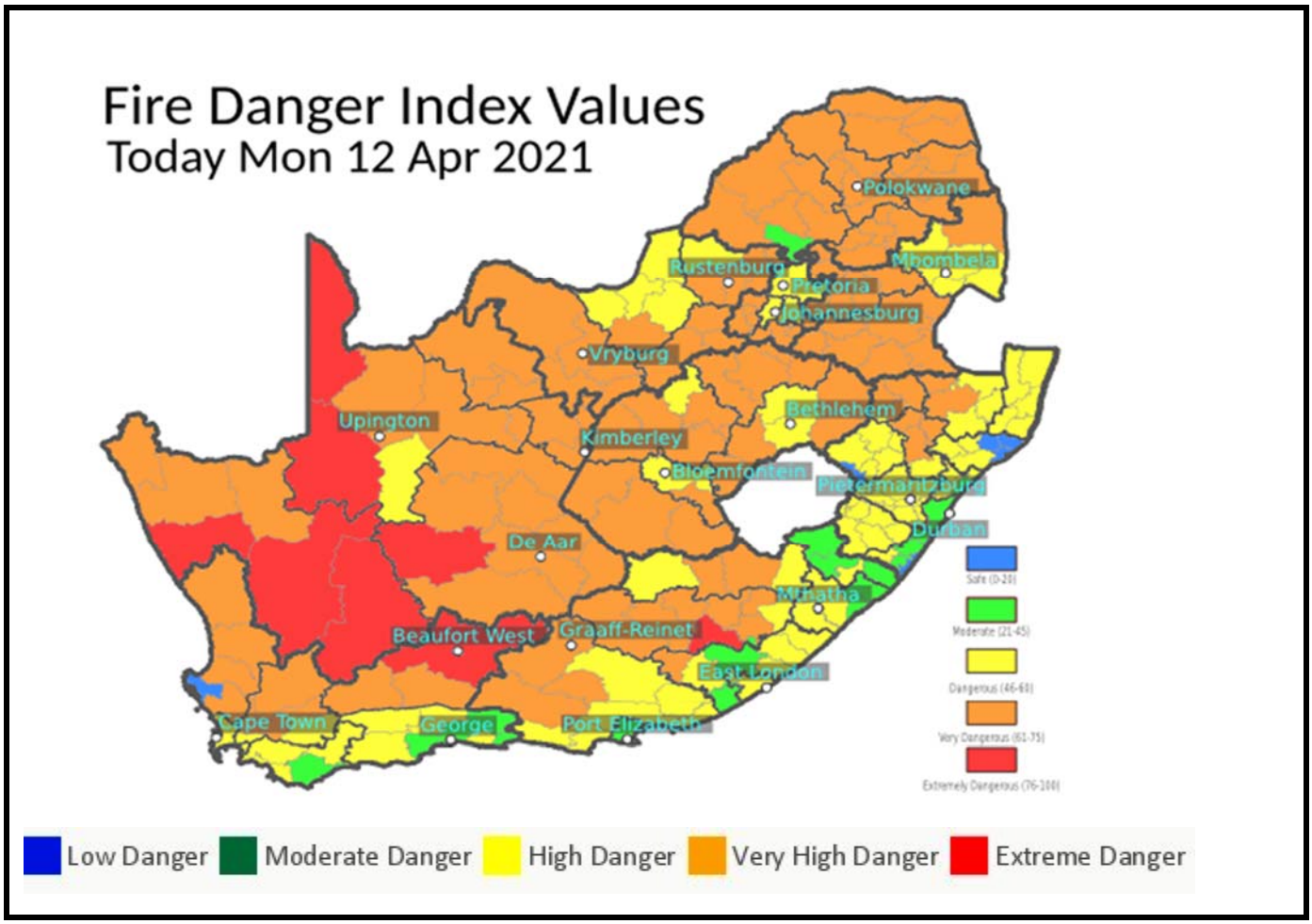


Figure. 2.7: Fire Danger Rating Index in South Africa.
Source: Department of Agriculture, Land Reform and Rural Development: Thematic Booklet 14

Figure 2.7 shows that the Extreme Danger rating is experienced in western part of the Republic of South Arica. The Polokwane area situated in the district of research focus area is profiled at second highest (Very High Danger). The map shows a total of five Fire Danger Index rating. There are sporadic moderate areas and only one area with low Fire Danger Index rating. The Fire Danger Rating Index mapping shockingly reveals that most places of South Africa experience Very High Fire Danger Index rating.

According to Van Wilgen et al., (2010) the Fire Danger Index in Limpopo is very high across all the five districts in the province. In these regions of the province, management of Veldfire should be taken seriously as the impact of fires in these regions have resulted in devastating effects, some of which landowners have not recovered. Trollope (2004) argues that the National Veldfire Risk Assessment is done using qualitative measures derived from the consequences of specific fire risk scenarios. Further shows that scenarios are described by the levels of asserts damaged and their respective degree of

vulnerability to fires. Elements such as fire behavior and the potential consequences for those assets also form part of the risk assessment scenarios (Trollope, 2004).

The UNDP (2013) report reveals that using FPAs fire management programs, tremendous, sizable number of hectors of land have been saved (UNDP, 2013). Archibald, et al., (2013) state that the effective ways to manage Veldfire risks are among others to build capacity in all the community structures providing knowledge about the risk categories discussed in Table 2.1.

Initiate the FPA formation

i. Adoption of Integrated Fire Management (IFM) strategy by all district municipality
ii. Provide resources, staff, funding, and training to all FPAs.
iii. Improve the use of advanced Veldfire detection technology.
iv. Veldfire risk mapping produce before every fire season.
v. Build capacity of the Veldfire vulnerable communities.
vi. Consequential management on failure to approve or implementation of IFM.

Table 2.1: Veldfire categories and levels of consequence

Level of consequence		**Consequence end points**		
		Social consequence criteria	**Economic consequence criteria**	**Environmental and ecological consequence criteria**
Damaging fires	**Catastrophic**	Death of one or more persons in the scenario	Depressed economy of the Municipality. Extensive and widespread loss of assets. Major impact across a large part of the community. Long-term external assistance required to recover.	Permanent loss of species or habitats within the area or of water catchment values and other ecosystem services (and not assessed as an economic consequence).
	Major	Extensive injuries to people in the scenario, requiring emergency hospitalization and affecting work capacity; or, evacuation required.	Serious financial loss, affecting a significant portion of the community. Requires external funding. (e.g. from Disaster Management funds) to recover.	Habitat destruction, temporary loss of species, or temporary loss of catchment values and other ecosystem services requiring many years to recover.
	Moderate	Medical treatment required but full recovery possible.	Localized damage to property. Short-term external assistance required to recover.	Serious impact on the environment that will take a few years to recover.
No damaging fires	**Minor**	Minor injuries only – first aid treatment required.	Minor financial loss. Short-term damage to individual assets. No external assistance required to recover.	Discernable environmental impact. Assets recover rapidly.
	Insignificant	No injuries	Inconsequential or no damage to property	Minor impact on the environment

Source: UNDP Project UNDP GEF PIMS 3947 UNDP Atlas Proposal ID 60783, Project ID 76680 GEF Project ID 3934; 2013

The able 2.1 illustrates Veldfire Matrix which enable communities to differentiate and link categories of fires with possible social, economic, and environmental impact. Van Wilgen, et al., (2010) observe that during the last decade and more, fires have destroyed the forest sector resulting in extensive economic losses. They point out that in KZN, 3% of the total forest plantation was destroyed by fire, whereas in Mpumalanga the same year 10% of the forest plantation was destroyed by fires. This Veldfire incidence took place between January and August of 2007. The impact of Veldfires in South Africa is such that in 2009 South Africa lost an estimated US$ 150 million Veldfire that burned timber and vineyard plantation along the Heidelberg Mountain in Cape Town. In 2012, an estimated loss to Veldfire in South Africa was approximately $US 7.16 million (Goldammer, 2012). ForestrySA (2010) Report reveals that in 2007 South Africa lost an estimated R1, 33bn of standing timber to Veldfires, and that the effect of such disaster will be felt for the longest time because many manufacturing companies closed causing unemployment and many other adverse effects.

De Ronde et al., (2004) argue that in 2008 an estimated 25 000ha of forest regions of industrial pine plantations in the Sabie district was destroyed by Veldfire. From this incidence, more attention was focused on the analysis that were in favour of prescribed burning against fuel protection policy, by companies involved in plantation industry. Figure 2.8 illustrates burned area (BA) vary annually and across different seasons. From 2007–2016, the largest BA is observed during between December, January and February (DJF). June, July and August (JJA), and September, October and November (SON) seasons in different regions of sub-Saharan Africa. The lowest BA is observed during the March, April and May (MAM) season.

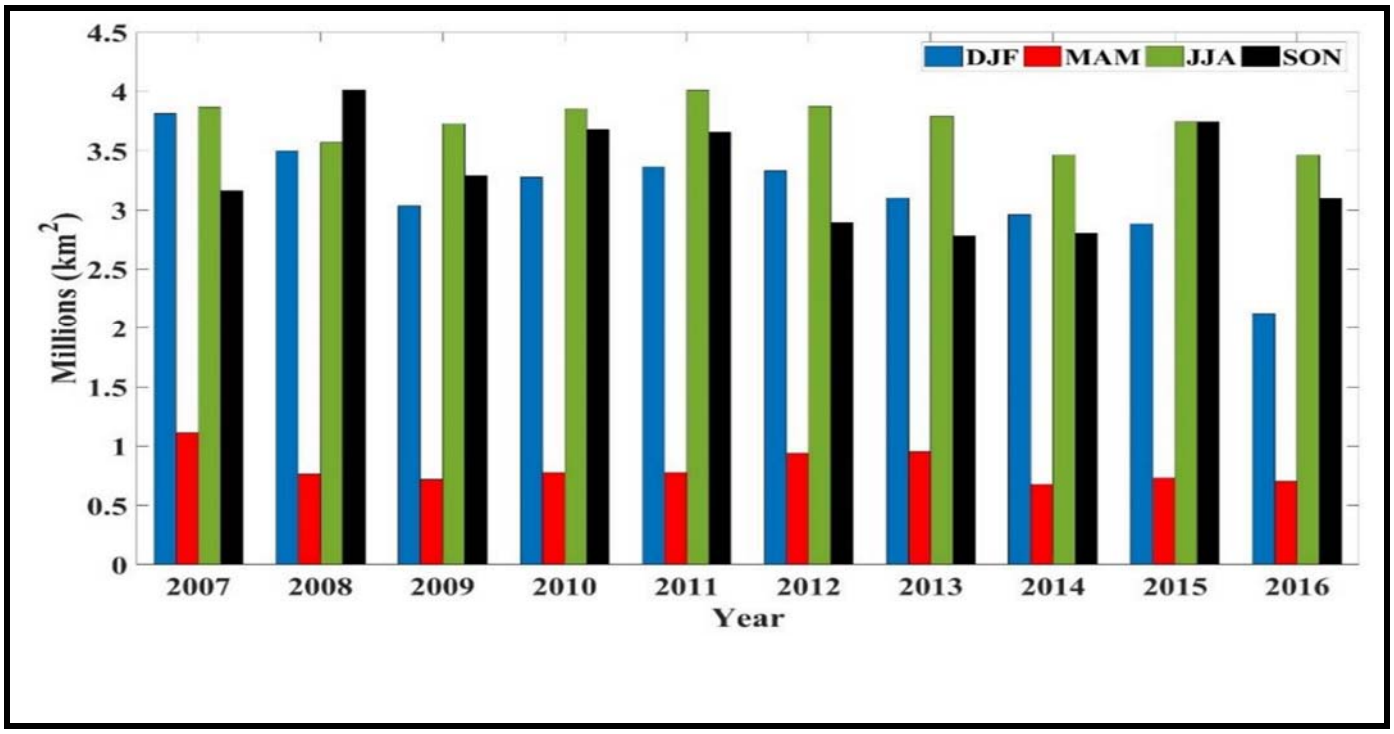


Figure 2.8: Seasonal Effects of Wildfires on Land Surface Dynamics in Sub Saharan Africa
Source: Kganyago and Shikwambana (2019)

According to de Ronde et al. (2004), the South African pine and eucalypt comprises more than 1.35 million of the entire plantations in the country. These pines and eucalypt are a fire hazard. They put the forest land in the country more at risk of Veldfire due to high content of biomass accumulation levels. The SatsSA (2007) report suggests that a total of 19 people died in a Veldfire in the Kruger National Park, and 25 died in a Veldfires in the Eastern Cape and KwaZulu-Natal, Veldfire will continue to impact on the social welfare of RSA citizens. According to Forestry SA (2007), more social impact from these fires was felt as manufacturing companies closed resulting in massive job loss for rural communities.

Bond and Keeley (2005) posit that accurate statistics are not recorded despite the use of Advanced Fire Information System (AFIS). Landowners can benefit immensely from the use of AFIS Veldfire readings. Without these tools, there is no critical fire warning information to warn landowners beforehand. Forsyth et al, (2008) argue that social, economic and environmental impact of Veldfire management in the Republic of South Africa (RSA) remains a challenge due to poor distribution of information regarding weather conditions. They are of the opinion that the only statistics available on Veldfire occurrence is from Forestry South Africa (ForestrySA), and often it is not available.

The Annual Fire Protection Association (2009) report reveals that the Department of Agriculture Land Reform and Rural Development (DALRRD) has initiated systems that will ensure that Veldfire statistics is made available. Working on Fire (WoF), Disaster Management Centres, Government and FPAs should also collect and record Veldfire statistics. The report further purports that strengthening the use of AFIS will enrich Veldfire data needed to analyse Veldfire risk profile and reduction programme.

Van Wilgen et al., (2010) argue that South Africa has done well as compared to many other countries when it comes to Veldfire management. This is partly due to the cooperation between the Fire Brigade Service, Working on Fire (WoF) and Fire Protection Association (FPA). The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998) provides for any voluntary association or organisation to form part of the FPA. The following is the list summaries the kinds of association that can form part of the FPA.

i) The Section 4.8 of the NVFFA, provided the study with information on the registration of the FPAs.

ii) Any organization established in line with provincial ordinance for nature conservation.

iii) A fire protection committee established under section 7 of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

v) Any voluntary association in existence at the time of the promulgation of the NVFFA, which has as one of its objectives the prevention and combating of wildfires, or any committee of such an association.

The Council for Scientific and Industrial Research (CSIR) (2010) reports that Veldfire is a major challenge in South Africa. The report also reveals that veldfire reporting systems are not operational nor are there methods to quantify Veldfire in the country. Furthermore, the council reports that there are no consequence management on failure to approved or implement IFM. Archibald et al., (2009) argues that current land reform legislations have complex effects to commercial farming, because new farm owners have no knowledge of meaningful faming, nor Veldfire management skills. Steenkamp et al. (2009) and Griffiths (2009) argue that gentrification both in South Africa and Australia has caused serious alienation of neighboring communities to take responsibility of the nearby farmland and resort areas situated nearby.

The FPA (2010) Annual Report states that government departments, municipalities, and other State-Owned Entities, for example Eskom South African National Road Agency (SANRAL), Spoornet, Telkom, etc. are not complying with the NVFFA. This non-adherence to the policy frameworks, is punching holes on the efforts of government that attempts to foster collaborations and cooperation in the fight against Veldfires. Van Wilgen et al., (2011:213) state that: "The incidences of fires in forest plantations have increased markedly compared to the past few years, probably due to less effective fire protection and additional sources of ignition. They further argued that the preliminary model suggests that, where trees are grown on a 30-year rotation, timber yields will decline by between 40% and 75% and plantations area subjected to burn will range between 3 to 7% on average each year."

Steenkamp et al., (2009) argue that, arson is identified as the main cause of fires in rural areas. It is mainly attributed to land claims conflicts among community members and poor land management skills. Van Wilgen, Forsyth and Khuluse (2008) indicate that human activity is a major contributor to Veldfire both in South Africa and Australia. Archibald et al., (2009) observe that the informal settlements have experienced more fires which not only destroyed property but impacted socially and environmentally. This calls for educational programs targeted at rural communities to improve their level of access to information.

McFerren (2010) is of the view that effective dissemination of information to warn communities is still a big challenge. The three organizations namely the Disaster Management, Weather Services, and media and communication companies should join venture to ensure that early warning information is disseminated to communities. The lack of early warning at local communities and awareness information on how to respond to these warnings is unacceptable (Du Plessis, 2004). The early warning information should be easy to understand what it represents. The use of colour codes is demonstrated in Table 2.2 is a way to ensure that messages are easily and correctly interpretation by all users. Stigler et al., (2005) argue that there is a challenge on the interpretation and translation of climate information and warnings at the local level. The existence of traditional and indigenous knowledge alongside scientific knowledge provides a strength that could bring about innovation on the world to resolve the challenges for Veldfire response preparedness (Shaw et al., 2009).

Table 2.2: The Severe Weather Alerts

No Alert	Advisory	Watch	Warning
	Be Aware!	Be Prepared!	Take Action!
No hazardous weather expected in next few days	Early warning of *potential* hazardous weather	Weather conditions are *likely to deteriorate* to hazardous levels	Hazard is *already occurring* somewhere or is *about to occur with a very high confidence*
	2 to 6 days period	1 to 3 day period	Next 24 hours, 3 hrs for FF, TS

Source: Adopted from South African Weather Services FCAST-PRE-201205171 Poolman (2012)

According to Mercer et al. (2010) South African Weather Services (SAWS) operate a MultiHazard Emergency Weather Service (MHEWS) which requires closer cooperation with disaster management structures at national, provincial, and local level. Severe weather hazards include extremely hot conditions, heat waves, very cold conditions, snow, heavy rain, flash floods, destructive coastal waves, Veldfire danger rating, gale force winds and stronger and severe thunderstorms. These alerts are issued by SAWS and are used by Disaster Management Centres in preparation and readiness for emergency actions such as evacuation in the face of the hazard. The alerts are also issued directly to the public through the media, internet, and cell phone service providers (Poolman, 2012). Table 2.3 shows comprehensive list of requirements to be met in order to operationalize Disaster Management Centres.

Table 2.3: Skills shortage in Fire fighting

Emergency Response and Disaster Risk Management topics	Professional Fire Fighting Skills
	Victim Management Skills
	Emergency Management Skills
	Incident Management Training (i.e. Xenophobic Violence, Disease Outbreak)
	Incident Assessment
	Radio Communication
	Disaster Management (general and introduction)
	Contingency Plan Development
	Disaster Risk Assessment
	Training Communities and Training of Trainer Programme
	Life Safety Education
	Safety Planning at Live Events
	How to Conduct Planning and Awareness Events
	Disaster Operation Centre Management Principles and Procedures
	GIS Use
	Linking Disaster Risk and IDP
	Post Disaster Analysis
Administrative topics	Report Writing
	Project Management

Source: Adopted from Report to the South Africa Local Government Association (SALGA) Vol 24. Botha et al, 2011)

The South African Local Government Association (SALGA) had identified areas within disaster risk management that need attention to ensure that coordination of emergency services is effective. Table 2.3 above reflects a host of items that still need to be streamlined. For example, numerous municipalities experience acute lack of Veldfire risk assessment and Incident management skills are among many which have constrained the implementation of Municipal Disaster Management Framework's Key Performance Areas (KPAs) and Enablers (SALGA, 2013).

2.5 IDENTIFYING GAPS IN EXISTING KNOWLEDGE

A litany of existing literature in Veldfire management reveals that fire presents major problems in South Africa and around the world. Van Wilgen et al., (2010) argue that Veldfire destructions reverses economic gains made over many years. These assertions are supported by a wide range of studies done by Goldammer and de Ronde (2004) who is of the opinion that the impact of Veldfire disasters on the economy and environment can be felt for many years into the future with devastating effect. The studies done by Kruger et al., (2006) and Calvin & Wettlaufer (2007) emphasize that Veldfire risk assessment is one of the many overarching features of Veldfire management. The economical, social, and environmental impacts of Veldfire are increasingly being felt everywhere in the world as though Veldfire is a new phenomenon. The gap here is to find a fitting explanation as to why this is so and to answer the question relating to how veldfires were managed in history. Notwithstanding the fact that the old-age technology referred to as the fire scar and also known as tree-ring based network generated Veldfire data into the International Multiproxy Paleofire Database (IMPD) which reveals that Wildfires had been experienced in America and northeastern Canada for the past 900 years. In southwestern Australia and Papua New Guinea, Veldfire have occurred in the last 300 years (Kitzberger et al., 2007). According to Strydom and Savage, (2016) this seemingly perplexing situation about Veldfire, plays into the world's ignorance despite the existing wealth of information on Veldfires management.

The study recognizes that there is lack of preparedness and appropriate measures to ensure response readiness to Veldfires. What is also known is the disturbing non-availability of reliable Veldfire data, lack of landowner support system, and poor collaborations of interagency are tell-tales reveals the bare truth that the world is yet not having the required level of capacity that commensurate with the levels of threats posed by increasing Veldfire frequency. This is happening in the world that is making headways into the fourth industrial revelation (4IR), which advocates for rampant use of advanced technology in addressing the world problems. The gap in knowledge is that technology should be widely explored to provide easy ways in which communities can be able to conduct their own Veldfire risk assessment. In this way, accurate hazard profiling will be produced by communities themselves to further inform efficient use of the limited resources.

Shimabukuro (2000) argue that so much is known about the association of disaster hazards with factors such as sustainability, capacity, exposure, severity, and resilience, and yet the world is becoming more vulnerable to risks posed by Veldfires hazard and others (Pyne, 1995). Stocks and Flannigan (2009) argue that the cost of fire suppression is rising so are the number of Veldfires. Countries such as Canada opted for modified suppression policy, which allows fire to operate naturally in the lower priority areas (Weber and Stocks, 1998). As stated previously, most fire suppression equipment's in sub-Sahara are in urban areas making response readiness to reach the rural areas difficult. Surely this is a gap that explains the degree of challenges faced by poor rural communities such as those living in the far-flung areas of the districts of the Limpopo province.

CHAPTER THREE

METHODOLOGICAL CONSIDERATIONS

3.1 INTRODUCTION

This chapter reflects the philosophical assumptions and approaches which provided for the appropriate methodologies used to investigate Veldfire response readiness in this study. Thus, the chapter consists of five different sub-sections. In the introductory subsection, we recapitulate the aims and the objectives of the study, followed by the second subsection in which the philosophical positionality of the research is dealt with. In this section, we present the underling philosophical approaches influencing how data collection and analysis of this study were approached. The third subsection presents the research design in which we highlight the step-by-step process of the whole research process including the description of the study area and the population demography, methods of data collection and analysis techniques. The fourth subsection presents the validity and reliability of the methodologies. The last subsection is the methodological reflection where we discussed how challenges emanated from the application of the methodologies were addressed and overcome.

3.2 RECAPITULATION OF THE AIM AND OBJECTIVES OF THE STUDY

This section serves to give a restatement of the aim and the objectives of the study that forms the basis for the selection of methodological approach and data collection techniques. The study aim is mainly to interrogate the readiness to respond to Veldfires by the District disaster Management Centres of the Limpopo province. This study achieved this aim through careful analysis of Veldfire incidences within Mopani and Capricorn districts, the assessment of the effectiveness of the interagency collaborations for tackling Veldfires in the districts, the examination of Veldfire response mechanism and evaluation of the extent to which early warning information is disseminated to communities exposed to Veldfire risks.

3.3 PHILOSOPHICAL POSITIONALITY OF THE STUDY

This section first and foremost discusses the research approach and the methodological underpinnings adopted for the study. Merriam (2009) argues that a philosophical positioning of qualitative research is necessary to explain what one believes about the nature of reality or ontology and of knowledge and epistemology. This argument was supported by Carter and Little (2007) who point out that a theory of

knowledge is inescapable. Gephart (1999) argues that the three research paradigms namely categories as constructionism, interpretivist, and critical postmodernism have distinct characteristics but can be used to complement each other. He further argues that the three philosophical paradigms are popular in contemporary social, organizational, and management research. The three paradigms are illustrated in Figure 3.1 which provided the study with a balanced approach for data collection, analysis and interpretation to gain understanding on Veldfire response readiness in the districts of Limpopo province.

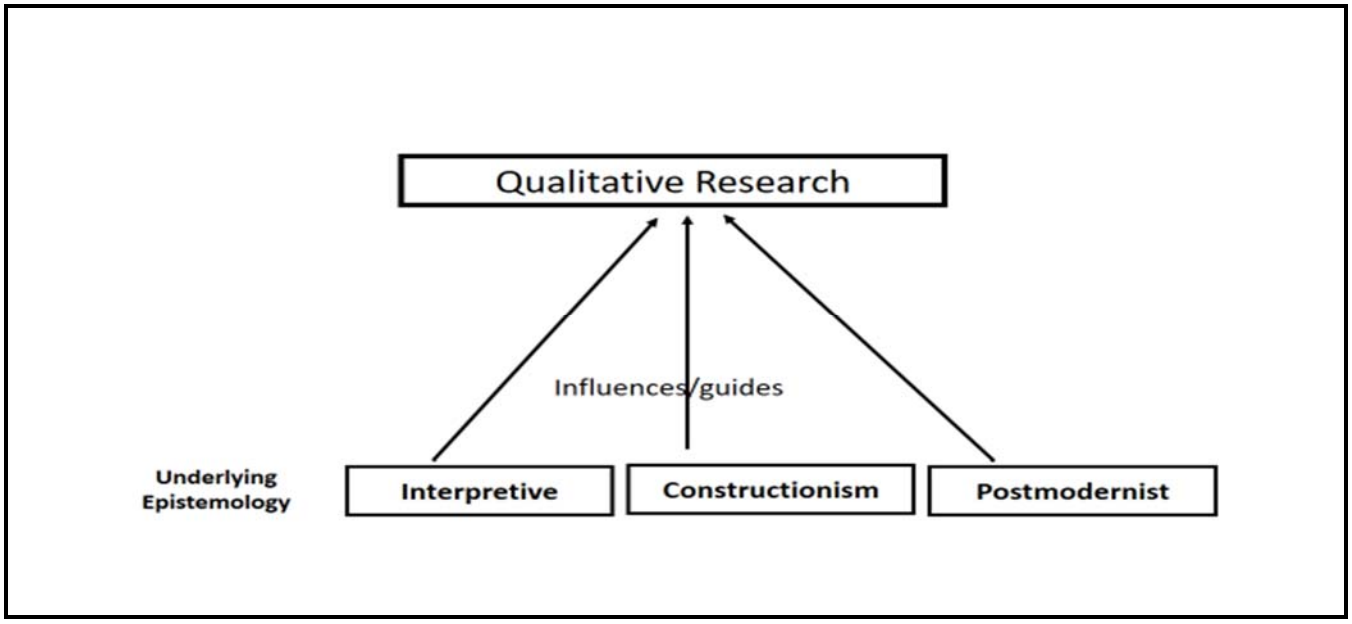


Figure 3.1: Philosophical assumptions of the study
Source: adopted from Henning, van Rensburg, and Smit, 2004

Figure 3.1 illustrates the three-paradigm pronged approach and how it was used in this study to enrich the usage or handling of the research data. The diagrammatical representation shows convergence of the three approaches into one wholeness. In essence, dealing with qualitative data requires a broad base approach which ensures that the outcomes of the research are solidified.

According to Henning et al. (2004) in the interpretive approach the researcher does not stand above or outside but is a participant observer who engages in the activities and discerning the meanings of actions as they are expressed within specific social contexts (Carr and Kemmis, 1986:88). Aikenhead (1997) states that interpretive paradigm is underpinned by observation and interpretation, thus, to observe is to collect information about events, while to interpret is to make meaning of that information by drawing inferences or by judging the match between the information and some abstract patterns. During observation, the

researcher understands phenomena through the meanings that people assigned to them (Deetz, 1996). An interpretive inquirer or researcher presents an argument which revolves around the idea that there does not exist worldwide and universal truth, but that truth is relative or subjective conception or view of the globe or world (Aliyu et al., 2014). This argument is supported by Creswell (2003:8) who point out that interpretivist researcher tends to rely on the "participants' views of the situation being studied" and recognize the impact of their own background and experiences on the research. Equally important is the argument that the purpose of the interpretive approach in information science is to produce an understanding of the context and the process whereby information science is influenced by the context (Walsham, 1993).

This study is situated in the interpretivist paradigm. Table 3.1 displays the characteristics of interpretivism, as used in this study, categorised into the purpose of the research, the nature of reality (ontology), nature of knowledge and the relationship between the inquirer and the inquired (epistemology) and the methodology used (Cantrell, 2001).

Table 3.1: Characteristics of interpretivism

Feature	**Description**
Purpose of research	Understand and interpret perspectives of the leading role players (Chief Fire Officer, Fire fighters, Fire Protection Association, Working on Fire, Head of Disaster Centre and Traditional Leaders) on the factors that could impact Veldfire response readiness in the district of Limpopo province.
Ontology	✦ There are multiple realities. ✦ Reality can be explored, and constructed through human interactions, and meaningful actions. ✦ Discover how people make sense of their social worlds in the natural setting by means of daily routines, conversations and ✦ Many social realities exist due to varying human experience, knowledge, views, and interpretations.
Epistemology	✦ Events are understood through the mental processes of interpretation that is influenced by interaction with social contexts. ✦ Those active in the research process socially construct knowledge by experiencing the real life or natural settings. ✦ Inquirer and the inquired-into are interlocked in an interactive process of talking and listening, reading and writing. ✦ More personal, interactive mode of data collection.
Methodology	✦ Processes of data collected by text messages, interviews, and reflective sessions. ✦ Research is a product of the values of the researcher.

Source: Adapted from Mertens (2005) and Creswell (2003)

Table 3.1 elaborates on the characteristics of interpretivism, which defined how this study collected data and construct meaning out of the experiences, knowledge and views expressed by the participants. During data collection in both Capricorn and Mopani, the researcher and the participants interlocked in an

interactive process of talking and listening to share the experiences and knowledge of informants on Veldfire response readiness. Capricorn District experiences mainly grassfire, whereas Mopani district, due to large plantation experiences plantation fire. These unique elements enriched the research data which was analyzed and interpreted to provide in-depth understanding on preparedness to respond to Veldfires. Deetz (1996) argues that interpretivism provide the researcher with a wider scope in which to identify the implications of the study. It enables the researcher to ask questions such as 'why' and 'how' particular issues function in the way that they do. Daymon and Holloway (2011) are of the view that interpretive researchers are not interested in predicting behavior, but rather interpret human understanding of individual experiences. Their interpretations are based on multiple realities and truths that change, because individuals interact socially, resulting in multiple realities (Daymon & Holloway, 2011).

There are different philosophical paradigms which could have been used in this study. However, the study relied on the perceptions of the participants to understand and interpret reality on preparedness to respond to Veldfires. In other words, the use of interpretivist approach in this study, is based on the perception that the researcher interpreted different meanings in the data which shaped the findings and the interpretations of the study. Bland (2013) argues that interpretivists or constructionists assumed that reality is not "out there" but is constructed through the interpretations of researchers. Greener (2008) is of the view that studying the social world through a subjective thought and ideas confirms the significance of interpretivism which sees the world through the eyes of the people being studied, allowing them multiple perspectives of reality, rather than the "one reality" of positivism.

Crotty (1998) echoes that interpretivist is a research strategy to create new, richer understandings and interpretations of social worlds and contexts through looking at organizations from the perspectives of different groups of people. In this study, data was collected from both experts and community structures, see Table 3.4, which provides rich and diverse views captured to form data that comprises multiple realities. The use of interpretivism philosophy in this study strengthened interpretation of varying perceptions that provide for a deeper understanding of the phenomenon.

Kula (2000) describes Constructivists as gathering of information through observation such that members of a society together invent the properties of the world. Information gathering leads to knowledge creation which according to Ernest (1999); Gredler (1997); Prat and Floden (1994) are created by individuals through their interactions with each other and with the environment they live in. The study recognizes that

the experience and insight of members of the community, constructed through subjective knowledge was shaped by their prior knowledge of interaction with one another, practice, and understanding. In addition, the researcher was also immersed into the research environment thereby making observations of the circumstances surrounding the environment in which research was conducted, and the usage of the research instruments.

According to Deetz (1996) the research environment allows the researcher to observe, investigate, and understand what he is investigating and further, gather more information through strategies such as participant observation, various written texts, and face-to-face individual as well as focus-group interviews in a social and cultural context.

Defining Postmodernism, Gephart (1999) states that reality is constructed through cultural processes of simulations. He adds that knowledge was constructed and transformed along with cultural changes, conversions and perspective. According to Brown (1994:28); Littlejohn & Foss, (2005:324). Postmodernism or relativistic social construction promote the notion that social realities are not static. They are compatible to environmental changes (McQuail, 2010:129). This study applied postmodernism to understand how Veldfire response was perceived through cultural norms and standards and maintained that cultural practices influence knowledge. For example, the Queen Mojaji clan believe that if it "does" not burn, it "does" not rain, meaning that fire should be allowed to burn to make way for the rain. This is an example of a social construct which formed part of truth within majority of the communities living in Mopani district. This practice does not hold truth to Capricorn district communities due to different cultural settings.

3.4 RESEARCH DESIGN

According to Creswell (2007) research design is a blueprint of the study which helps the researcher to discover knowledge based on validated assumptions. In any research, a design presents a plan whereas methodology presents a strategy to carry out the plan. Merriam & Kim (2012) for example, argues that a research design is like an architectural outline which could be actualization of logic in a set of procedures that optimize the validity of data for a given research problem. For this research to attain the set objectives, qualitative methodology was adopted to obtain data.

The use of observations, interviews and questionnaires was deemed suitable data measuring instruments against which participants made sense of their social worlds as informed by the natural settings. Qualitative research is heavily dependent on the researcher's analytic and integrative skills and personal knowledge of the social context where the data is collected (Miles and Huberman, 1984). This qualitative study relied on individual voices of participants which were triangulated using questionnaires including group discussions as ways to deepen understanding on the perspectives expressed and maintain rigor.

Creswell (2005) argues that qualitative research could be defined as a study conducted in a natural setting. The researcher, in effect, becomes the instrument for data collection. It is up to the researcher to gather the words of the participants and to analyze them by looking for common themes, by focusing on the meaning of the participants, and describing a process using both expressive and persuasive language. Merriam (1998) is of the view that qualitative research considers researcher as a primary instrument of data collection and analysis. Furthermore, that the researcher engages the situation makes sense of the multiple interpretations, as multiple realities exist in any given context when both the researcher and the participants construct their own realities. She/he strives to collect data in a non-interfering manner, thus attempting to study real-world situations as they unfold naturally without predetermined constraints or conditions that control the study or its outcomes.

Figure 3.2 below depicts the research plan flow-chart for the study. It illustrates steps that the study covered to obtain the data from the inception. It also shows how each stage for example, ethical clearance, methodology, instruments for data collection and analysis are linked to one another. Stages 4 and 5 in the flow-chat illustrate some of the important processes.

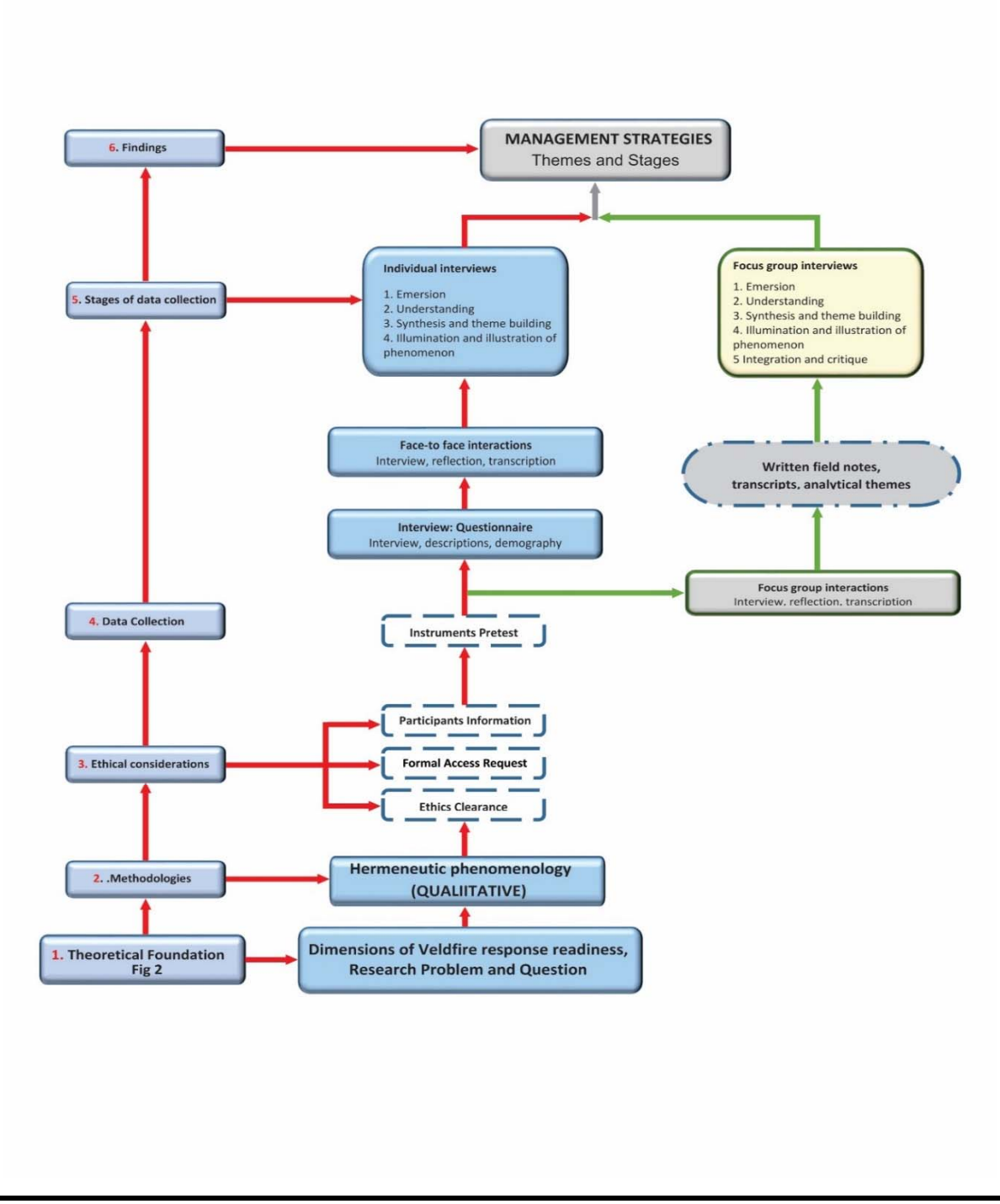


Figure 3.2: Research Plan flow-chart
Source: Van Deventer (2013)

The case study design was adopted as the most appropriate for this study because it is an in-depth inquiry that investigates a contemporary phenomenon empirically within its real-world context (Yin, 2014). Simons (2009) indicates that, while case study design frame may incorporate several methods. It is an in-depth exploration from multiple perspectives of the complexity and uniqueness of a particular project, policy, institution, program or system in a 'real life. It should not be a method in and of itself, it can be studied through qualitative analysis strategies such as grounded theory, hermeneutically, culturally, or content analysis, analytically or holistically (Stake, 2005).

This qualitative study was conducted in Mopani, and Capricorn Districts which form an integral part of Limpopo province. Participants in the study were selected through purposive sampling. According to Palys (2008) there is no one best sampling strategy which is best, all will depend on the context in which the researcher is working and the nature of research objectives. Of the many purposive sampling alternatives, the study used stakeholder sampling defined as an approach that is often used in policy analysis and evaluation, involving the identification of who the major stakeholders are involved in designing, giving, receiving or administering the program or service being evaluated, who might otherwise be affected (Stake, 2005). Any appropriate sampling strategy often depends on what the researcher wants to know and accomplish. Stake (2005) argues that embedded in conducting judgmental sampling is the notion that the researcher identifies the participants due to who that person is and where that person is located within the group. In judgmental sampling, participants are not created equal unlike in quantitative studies (Becker, 1998). In this study, it is believed that research participants will articulate their diverse views as informed by their different positions which they occupy in the organization to they benefit and advancement of the study. This allowed the researcher to zoom into a broader picture through case study analysis.

According to McMillan and Schumacher (2001), a case study examines a bounded system or a case over time in detail, employing multiple sources of data found in the setting. All the collected evidence are collated to arrive at the best possible responses to the research question(s). As a result, the researcher may gain a sharpened understanding of why the instance happened as it did, and what might become important to look at more extensively in future research. Tellis (1997) states that case studies do not claim to be representative, but the emphasis is on what can be learned from a single case. They have value in advancing fundamental knowledge and understanding of the phenomena than generalization. The disadvantage of case study research is that of non-representativeness and a lack of statistical

generalizability. Moreover, the richness and complexity of the data collected meant that the data was often open to different interpretations, and potential 'researcher bias's (Cornford and Smithson, 1996). Additionally, George and Bennett (1998) argue that case studies are generally strong precisely where quantitative studies are weaker. They have potential to achieve high conceptual validity, strong procedures.

The methodological design discussed above, is not only best suited for this study, but ensured that best possible answers to the questions stated in the research are answered effectively. The researcher addressed the inherent weakness in the methodology thereby ensuring that every possible chance of bias in purposive selection of the participants is justified as discussed in detail. Given the interpretive stance adopted in this research and the nature of the research questions asked, the researcher maintained that a case study approach was the most appropriate strategy because of its ability to engage in a detailed analysis of phenomena under investigation.

3.5 DESCRIPTION OF THE STUDY AREA

Data used in this study were collected from Mopani and Capricorn Districts of the Limpopo province, from November 2019 to April 2020. This section briefly discusses the characteristics of the two districts, with Figure 3.5 and 3.6 showing the study location in Limpopo province.

3.5.1 A Brief Geographical Profile of Limpopo province

The Limpopo province is in the Northern tip of South Africa, it borders the countries of Botswana to the west, Zimbabwe to the north and Mozambique to the east between the latitude 23°24'4.66"S and the longitude 29°25'4.56"E. The province has a total area of 125 754 square kilometers accounting for up 10.3% of South Africa's land area (Statistics SA). Limpopo is the fifth largest of the country's nine provinces in both surface area and population (Demarcation Board, 2016). The dry season stretches from May to October each year posing seasonal fire risk.

Limpopo is one of South Africa's rural provinces, in which the gap between poor and rich is distinct especially in rural areas. The province also suffers from a low skills base with high unemployment, particularly the youth. This translates to indicate that the province has extremely limited socio-economic

development opportunities (Department of Social Development, 2015). It is divided into five district municipalities namely Capricorn, Sekhukhune, Waterberg, together with Vhembe and Mopani who incorporate some parts of the northern half of Kruger National Park which lies in the east of Limpopo (Demarcation Board, 2016)

According to Du Toit and van Niekerk (2013) Limpopo is more likely to experience climate that is significantly hotter, and drier compared to the present-day climate. Under low mitigation, temperature increases as large as 7 °C may occur by the end of the century, with increases of about 4 °C plausible by the period 2040-2060. Such a climate regime will also be associated with an increase in the frequency of occurrence of heat-wave days and high fire-danger days. It is likely that the province may become drier under climate change resulting in adverse impacts on agriculture and livestock production further aggravating the economic development opportunities.

a) The Mopani District

The Mopani District represented in Figure 3.3 is situated in the north-eastern part of the Limpopo Province, about 50km from Polokwane (the administrative capital of Limpopo Province). It is bordered in the east by Mozambique, in the north, by Vhembe District Municipality (through Thulamela & Makhado municipalities), in the south, by Mpumalanga province (through Ehlanzeni District Municipality, Bushbuckridge, Thaba-Chweu and Greater Tubatse) and, to the west, by Capricorn District Municipality (Molemole, Polokwane & Lepelle-Nkumpi), in the south-west, by Sekhukhune District Municipality (Fetakgomo). The district spans a total area of 2 001 100 ha (20 011 km^2), inclusive of portion of Kruger National Park from Olifants to Tshingwedzi camps or Lepelle to Tshingwedzi rivers Mopani District Integrated Plan (2013).

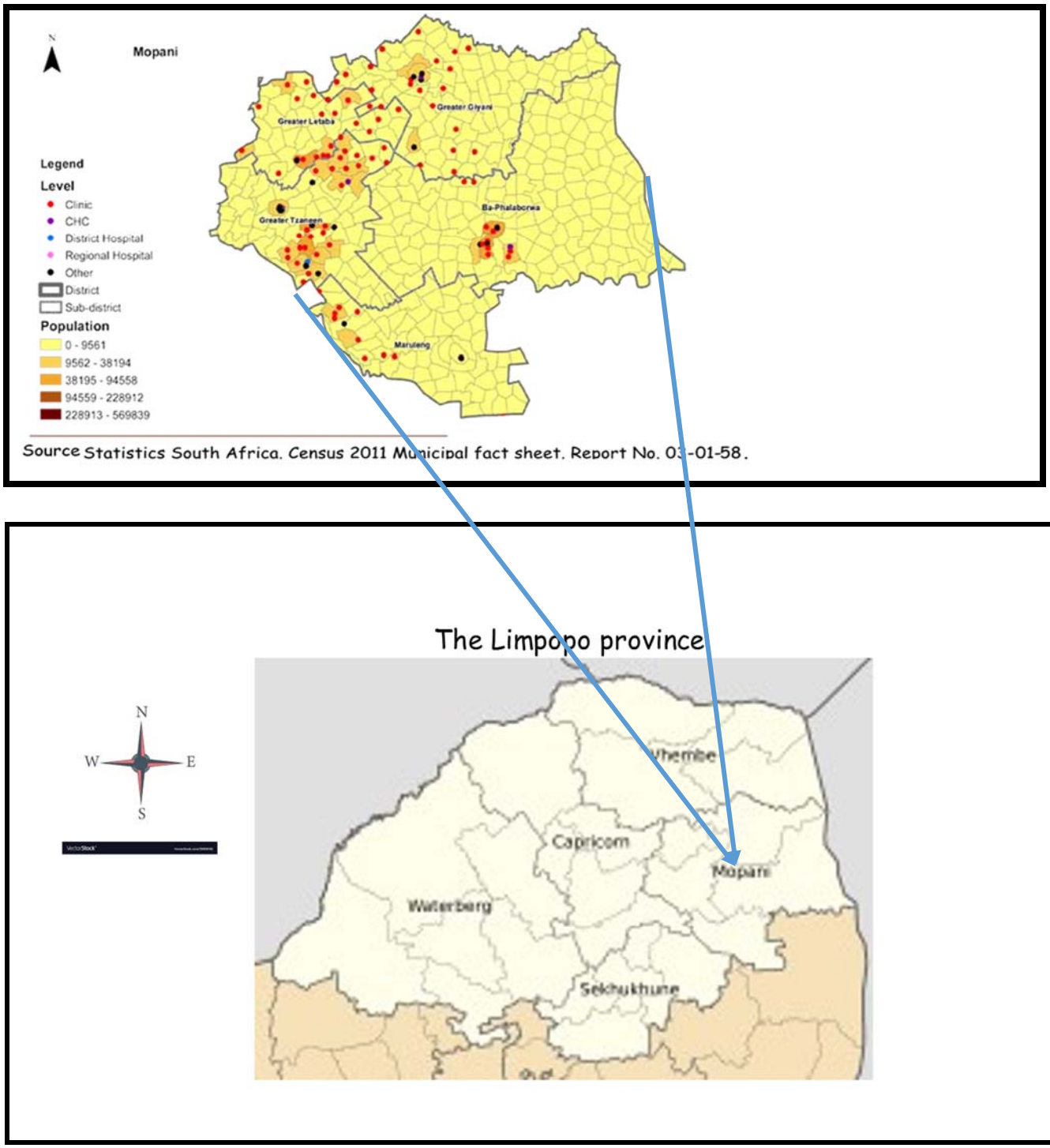
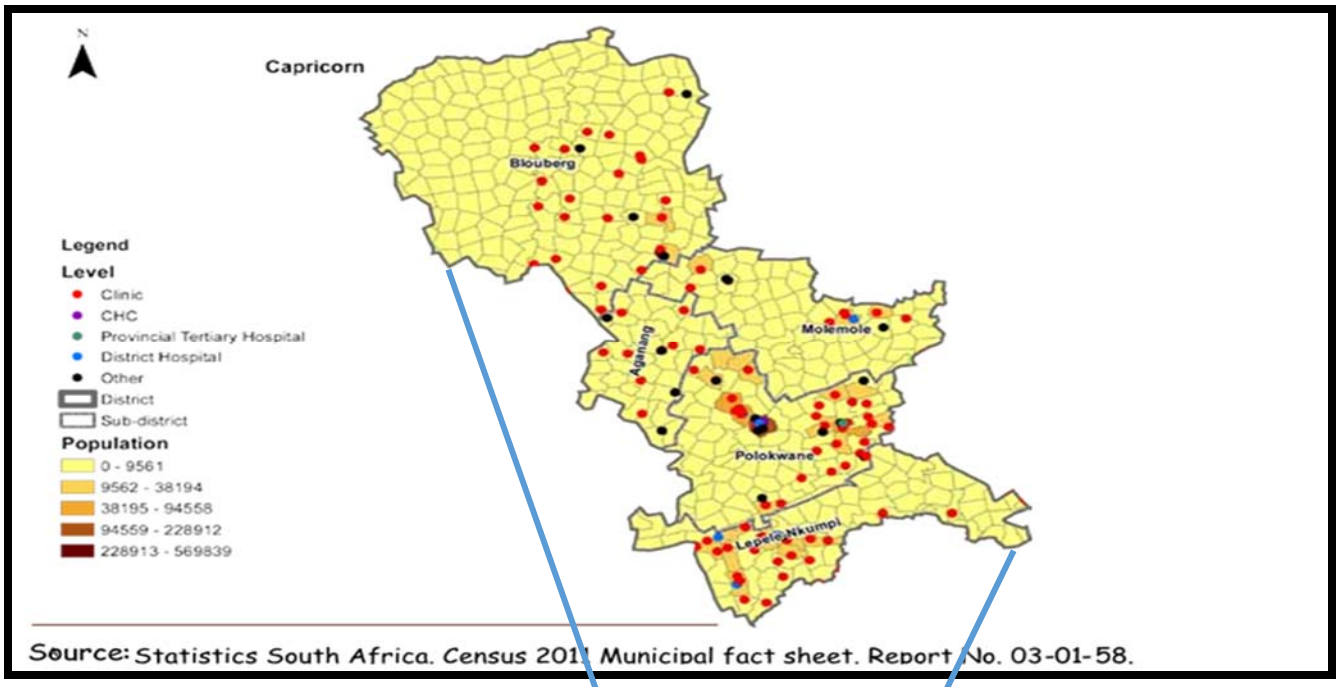


Figure 3.3: The map of Mopani District
Source: Adopted from Annual Report : Analysis of Transport Corridors. Limpopo Department of Transport 2012.

There are 16 urban areas (towns and townships), 354 villages (rural settlements) and a total of 129 Wards. The Mopani District is also part of the Great Limpopo Trans frontier Park, which joins South Africa, Mozambique, and Zimbabwe. The strategic location of the District embodies both advantages and disadvantages. The main eeconomic sectors Mining (30%), community services (23%), trade (14%), finance (15%), transport (8%), and agriculture (3%), and electricity (3%), construction (2%). The Mopani District Municipality has an identity code of (DC 33) as per the South African Demarcations Board. It has a population of 1 138 063, with a population density of 56.9 persons per km2 and falls in socio-economic Quintile 2 (Mopani District IDP, 2016).

b) Capricorn District

The Capricorn District represented in Figure 3.4 is a Category C municipality situated between the north-western areas of the Kruger National Park. It forms a gateway to Botswana, Zimbabwe, and Mozambique. It occupied a geographic area of approximately 21 705km². The municipality consists of the following four local municipalities: Blouberg, Lepelle-Nkumpi, Molemole and Polokwane. It derives its name from the Tropic of Capricorn. The district is home to the only Limpopo's capital city Polokwane, which is equidistance of the province regions (Capricorn, Integrated Development Plan (2015). The district is linked to Gauteng by one of the best stretches of the N1 highway connecting Limpopo with the rest of Africa. It also has an Airport named the Gateway to Africa. It is the third-largest district in the province and is predominantly rural in nature (Capricorn District Local Economic Development Report, 2017).



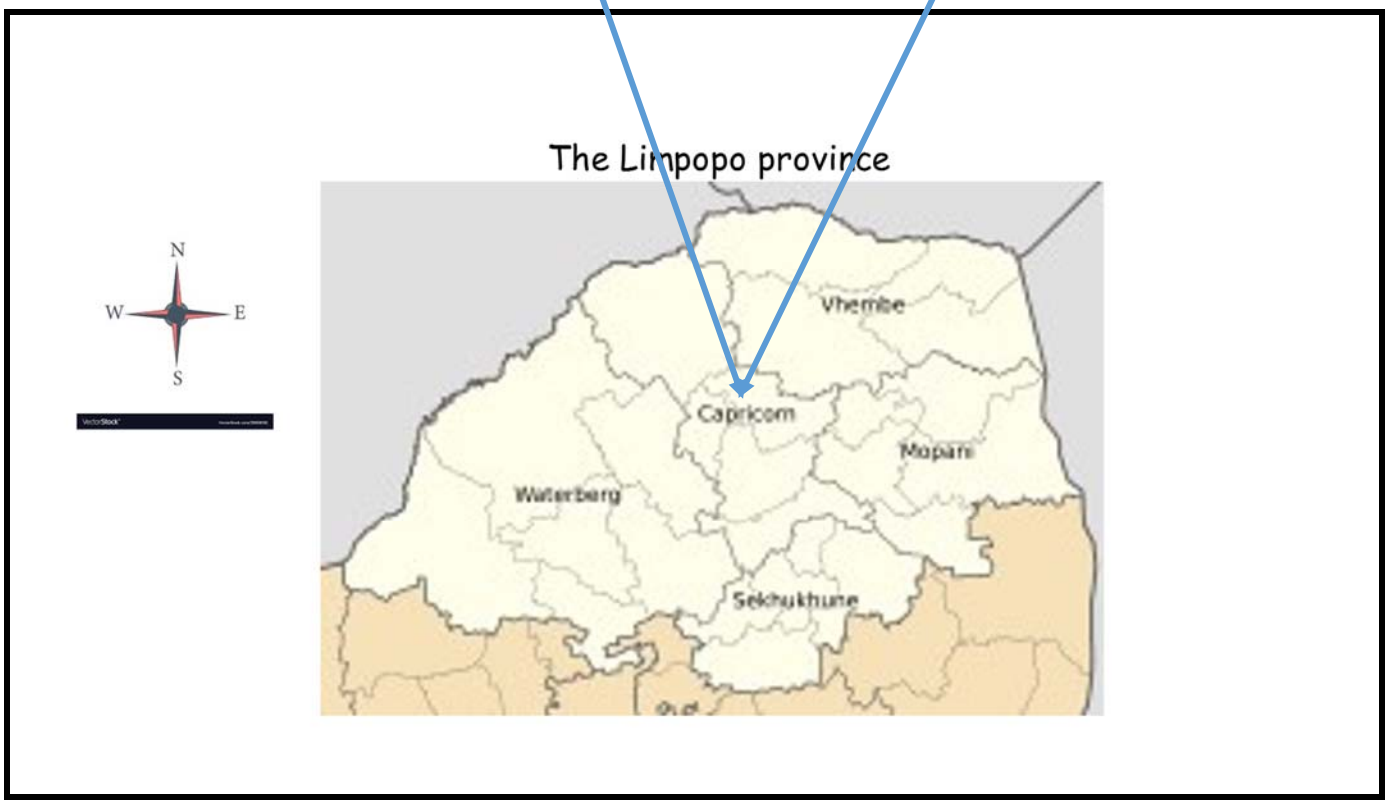


Figure 3.4: The map of Capricorn District
Source: Adopted from Annual Report : Analysis of Transpor Corridors. Limpopo Department of Transport 2012

The urban centers are Alldays, Dendron, Morebeng (Soekmekaar), Polokwane, Senwabarwana (Bochum), and Zebediela. The main economic sectors are mining (2%), community services (31%), finance (26%), trade (14%), transport (13%), manufacturing (4%), construction (3%), agriculture (3%), and electricity (3%) Capricorn District Municipality has an identity code (DC 35). It has a population of 1 296 247, with a population density of 59.7 persons per km2 and falls in socioeconomic Quintile 2, among the poorer districts (StatsSA, 2016).

3.5.2 Demographic Features

The Limpopo province has a population of 5 518 000 living in both rural and urban areas of the province. This is 10% of the Republic of South African population in 2013. The age distribution of Limpopo's population is also shifting towards older age groups. In 2001, 52% of the provincial population was 19 years old or younger, while in 2011, this group dropped to 46%. At the same time, the population aged between 20 to 64 years comprised 42% of the total in 2001 but increased to 48% of the total in 2011. Now there are also more people aged 65 years older, from 6% of the total in 2001 to 8% of the total in 2011. Limpopo had the highest proportion of elderly people who were classified as poor, at 78% (STATSA, 2010).

The distribution Table 3.2 reflects steady increase of the population of Capricorn District from 2017 to 2020. In the year 2018 the indications are that the district experienced a decrease of population group aged between 15 and 24 years, including children under five years. This observation took an opposite turn in 2019 and 2020. According to De Ronde (2013) the population dynamics play a pivotal role on land management. The unaccounted-for statistics is mainly from the influx of foreign nationals, which give rise to human encroachment and poor land management (Forsyth, 2010).

Table 3.2. Population distributions of Capricorn District

Population category	2017	2018	2019	2020
under 1 year	26 010	26 502	27 544	28 620
under 5 years	140 277	139 988	140 489	141 561
05-09 years	141 791	141 957	141 319	140 646
10-14 years	127 560	130 638	134 409	137 512
15-19 years	132 359	126 901	123 108	121 997
20-24 years	139 026	135 336	130 559	125 155
25-29 years	134 581	135 208	134 700	132 691
30-34 years	108 146	114 385	120 770	127007
35-39 years	84 954	88 452	91 544	94 141
40-44 years	65 419	67 995	70 836	73 900
45-49 years	53 636	54 785	56 115	57 693
50-54 years	46 017	46 818	47 542	48 271
55-59 years	38 064	38 846	39 763	40 690
60-64 years	32 613	32 820	33 001	33 261
65-69 years	26 596	26 948	27 296	27 614
70-74 years	20 183	20 501	20 819	21 116
75-79 years	15 207	15 108	15 073	15 114
80 years and older	18 704	19 268	19 859	20 472
Total	1 325 135	1 335 951	1 347 201	1 358 841

Source: STATSSA. 2014

Table 3.3 below reveals some intersession statistics about the Mopani District population. The similar increase trend in population growth is also realized in Mopani. The decrease in population growth was also experienced in the same segment of the population aged between 15 years to 24years However, the decrease was observed in the 2019 instead. While this decline is interesting, it has no significance to the issues of Veldfire management, however the general steady population increase over a four-year period should be a course for concern to the local authorities in terms of implementation of the land, environmental and disaster management policies.

Table 3.3 Population Distributions of Mopani district.

Population category	2017	2018	2019	2020
under 1 year	27 962	27 875	27 195	26 012
under 5 years	137 287	137 200	135 841	133 506
05-09 years	128 595	130 142	131 931	133 933
10-14 years	119 168	121 295	123 342	125 104
15-19 years	113 626	111 946	111 872	113 308
20-24 years	122 592	118 219	113 340	108 806
25-29 years	124 009	124 059	123 035	120 664
30-34 years	99 610	105 531	111 694	117 599
35-39 years	81 012	83 494	85 532	87 295
40-44 years	63 687	66 218	68 904	71 636
45-49 years	51 503	52 907	54 444	56 182
50-54 years	42 753	43 816	44 867	45 919
55-59 years	35 655	36 304	37 086	37 936
60-64 years	31 102	31 481	31 693	31 910
65-69 years	22 768	23 921	25 085	26 115
70-74 years	14 742	15 277	15 930	16 729
75-79 years	10 364	10 340	10 316	10 325
80 years and older	9 736	10 054	10 383	10 725
Total	1 208 210	1 222 202	1 235 297	1247 693

Source: STATSSA. 2014

Malthus (1978) argues that population growth inevitably leads to social ills such as poverty and unemployment. Most farmland in Mopani district contribute immensely to job creation in Mopani, a situation commonplace across district of rural provinces. When the population increases, the demand for land also increases. The lessons leant are that the local authority have the responsibility to ensure that land is developed and managed according to their town planning schemes (Kruger and de Ronde, 2013).

3.6. SOCIO-ECONOMIC FEATURES

According to Stats SA (2014), the average annual economic growth rate for Limpopo from 2003 to 2013 was 3% and the real annual economic growth rate for 2013 compared with 2012 was 2%, ranked number three amongst the nine provinces, after Gauteng at 2.6% and Northwest at 3%. Limpopo's economic growth rate in 2013 was attributable to a contribution of mining at 26%; government services at 18%; wholesale, retail and motor trade, catering, and accommodation at 14%; and finance, real estate and business services at 12%. These institutions contribute to major job opportunities in the province. The predominantly black university of Limpopo previously known as Turfloop University contributed immensely to uplifting the province educated population and skills development in the entire province and beyond.

3.7 LOCATING THE STUDY SITES

Chambers (1983) argued that it is a challenging issue for the researcher to choose study location devoid of biases, as this could have implications on the results of the study. Often the researcher is familiar with the study sites, or it is simply within reach as opposed to others. To manage the subjectivity on the selection of study sites, the researcher also used the Council for Scientific and Industrial Research (CSIR) 2018 report to analyze the total areas burned in the Limpopo province as shown in Figure 3.5. The researcher also chose to observe the trends between July, August, and September for both 2018 and 2019 as this is the quarter within which the provinces experiences fire season.

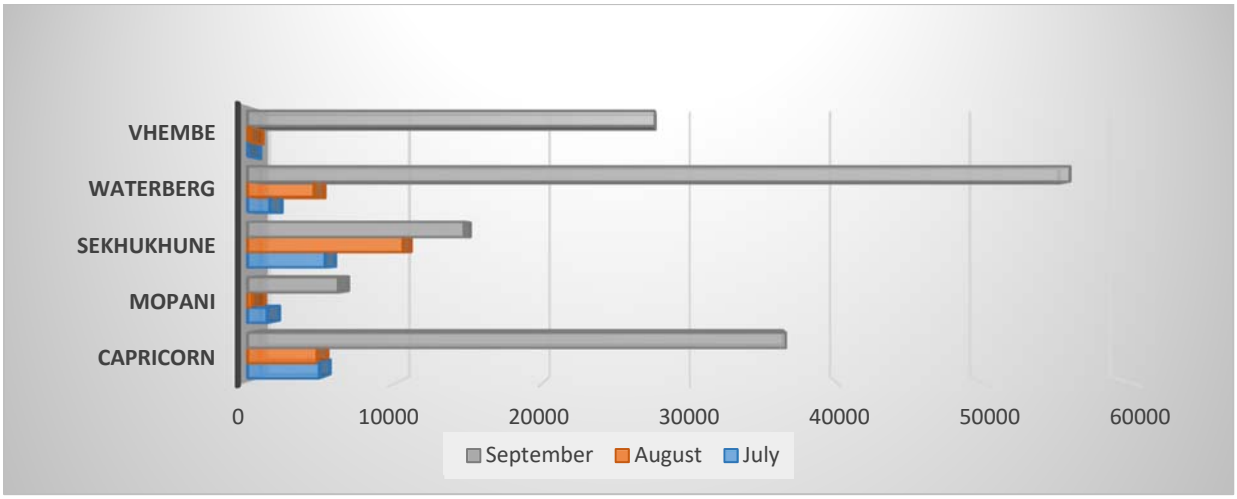


Figure 3.5: 2018 Total Area Burned Per Hectare in Limpopo
Source: Statistics supplied by CSIR (2020) New Generation of Geospatial and Modeling Analysis

Figure 3.5 provides frequency on the size of areas burned area per hectare. The burned areas were observed over a period of three consecutive months namely July, August, and September in 2018. The same applies to the observations based on Figure 3.6, the Limpopo province experiences high frequency of areas burned during the month of July, August and September in Capricorn, Waterberg and Vhembe in 2019.

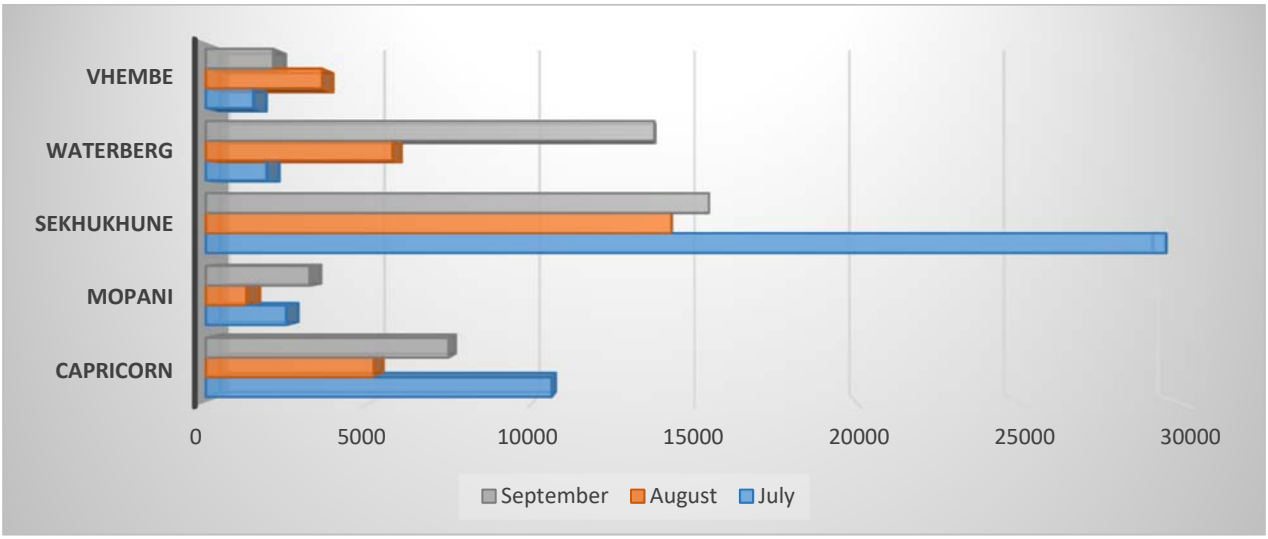


Figure 3.6 2019 Total Area Burned Per Hectare in Limpopo
Source: Statistics supplied by CSIR (2020) New Generation of Geospatial and Modeling Analysis

Figure 3.6 also confirms that all districts of the Limpopo province experience Veldfires during the third quarter of the year. I further observation however revealed that the largest area burned by Veldfire during this time is Sekhukhune District. The least burned area is once again Mopani district.

The researcher chose Mopani and Capricorn district as providing convenient locations for the study. Each of the two districts are situated less than an hour away from the place where the researcher comes. In this way the researcher optimizes on the time and travel expenses to reach the study sites, and to ensure that the researcher could meet the project time lines. The researcher observed from the data that Capricorn experienced the second and the third largest burned areas in 2018 and 2019 respectively during the period under observation. Furthermore, the researcher wanted to understand what factors are at play in Mopani district as it is the district at which the least burned areas has occurred in the period under observation.

It is for these reasons that the researcher decided to focus on these two districts as they seem to be within the range of interesting characteristics which could help the study understand preparedness to respond to Veldfires in the districts of the Limpopo province. It is also important to indicate that by virtue of this study to appoint purposive sampling technique in choosing the research participants, it also provided the researcher with the choice to make in respect of which district the researcher believe will be able to answer the questions this research is asking.

The researcher could have chosen Waterberg or Sekhukhune as they experience the largest burned areas in 2018 and 2019 respectively, to examine the circumstances around their preparedness to respond to Veldfires. However, the two districts present a challenge in the researcher would be constrained with time and travel resources to reach them as they are situated more than two hours away from where the researcher comes. It was going to be difficult for the researcher to always access the research participants in Waterberg and Sekhukhune when needed, as opposed to Mopani and Capricorn. Vhembe and Mopani seem to share similar status being the district in which the least burned occurred in the period under observation. So, it could be a situation where the researcher had to choose either of the two. Another important factor which supported to the choice of the researcher was that the two districts Mopani and Capricorn experience high temperatures, particularly from mid-August to January. Temperature is also understood to be a factor of influence when it comes to fire behavior.

The forest fuels receive heat by radiation from the sun providing the opportunity for fires to burn more intensely in the afternoon of an above average hot day which gives rise to heat requirements for ignition (Trollope, 2000). The combination of high temperatures and winds provide a favorable condition for run-away fires; hence the winds start in July to October in the Limpopo province. According to SAWS (2019) report, for 3.5 months, from August 15 to November 30 Capricorn experienced strong winds with average wind speeds of more than 7.9 miles per hour. The windiest day of the year is October 16, with an average hourly wind speed of 9.5 miles per hour.

3.8 TARGET POPULATION AND SAMPLING

As a standard practice, before any resumption of interview clearance was sought with the University Non-Medical Research Ethics Committee, which ensured that portals are for this study are clarified and followed. Parallel to this process of clearance, research participants institutions identified were contacted telephonically and later through e-mails to get authorization to conduct research at their respective premises. Later after permission was obtained, the researcher sent questionnaires together with pre-determined interview questions through email provided by the institutions. In all the study sites both at Mopani and Capricorn districts, a criterion for selections of participants include:

i) All participants are members of the District Disaster Advisory Forum, or their organization is a member of the advisory forum.
ii) All work in the emergency sections of their institutions
iii) That they are older than 21 years of age
iv) That they reside in either Mopani or Capricorn district

The population of the study consisted of all the Disaster Management Advisory Forum (DMAF) members from the Mopani and Capricorn Districts making a total of 113 members (i.e., 57 for Mopani and 56 for Capricorn). A sample size of 68 participants consisting of 34 participants from each of the two districts were drawn through judgmental sampling technique. According to Etikan and Bala (2017) judgment sampling design was based on the judgment of the researcher as to who will provide the best information to succeed for the objectives study. The person conducting the research needed to focus on those people with the same opinion to have the required information and be willing to sharing it. Foley (2018) argues that judgment sampling is, also referred to as authoritative sampling, was a non-probability sampling technique where the researcher selected units to be sampled based on his own existing knowledge, or his professional judgment. However, Sharma (2017) is of the view that the subjective component of judgment sampling was only a major disadvantage when such judgments were ill-conceived or poorly considered. The rationale for choosing judgmental sampling was for this study was that the researched will be able to judge as to who provide the best information to achieve the objectives of the study, furthermore in this study volume of subjects is low to such an extent that it allows the researcher to go directly to the target group.

This study is not providing for the testing of a hypothesis using statistical approaches, but to obtain an in-depth understanding of Veldfire emergency preparedness in the study site. The selection technique comes with own imperfections for example, Sharma (2017) point out that since each sample was based entirely on the judgment of the researcher, the judgment sampling was prone to researcher's bias due to the point that each sample was based entirely on the judgment of the researcher and therefore there was room for human error. He further pointed out that researcher's bias was detrimental to the validity of a study, and the data thereof. To provide for these imperfections, the researcher employed snowball to enable him to have assistance by other people in the identification of other people who should be part of the study group. In this study it is believed that using snowball sampling technique also strengthen the judgmental samples reduces likelihood of the bias factor from the researcher.

In this study, the participants were selected based on the researchers elaborate experience of working in Local Government, through which the key informants were identified to help the researcher to answer the questions of the study. To manage the bias element, the study also used snowballing sampling technical defined by Etikan et al (2018) as a process of selection usually done by using networks. This technique was mostly used in a situation where the researcher knows little about a group or organization to study in which contact with few individuals directed the researcher to the other group. The researcher knew management key personnel of District Disaster Management and Fire Services.

In summary, Table 3.4 shows that a total of 65 people were interviewed against the 68 planned. This was in part due to the COVID situation that the three participants interwove could not participate. However, every category of participants was represented. The study interviewed the Head of the Dismast Centers (HoDC), Chief Fire Officer (CFO). Government departments represented were:

i) Department of Environmental Affairs (DEA)
ii) Department of Agriculture Forestry and Fisheries (DAFF)
iii) Department of Water Affairs (DWA)

From community structures, the study interviewed the Famers organized under Fires Protection Association (FPA). Furthermore, the Traditional leaders and Working on Fire (WoF).

Table. 3.4: Total number of participants in the study

PARTICIPNATS (EXPERTS)			
	Mopani	**Capricorn**	**Total**
HoDC/CFO	2	2	4
DEA/DWA/DAFF	6	6	12
WoF	6	6	12
Firefighters	7	10	17
TOTAL	**21**	**24**	**45**
PARTICIPNATS (COMMUNITY)			
FPA	4	4	8
Traditional leaders	4	8	12
TOTAL	**8**	**12**	**20**

Source: Field based data (2020)

The 65 interviewees who participated into this constitute 95% per cent of the targeted sample. The FPA is formed in line with the NVFFA in recognition of landowners to take responsibility to protect their property against Vleldfires, the other structure in the name of Working on Fire (WoF) is the multi-million-rand job creation Environmental sector programme under the Expanded Public Works Programme (EPWP) initiated by Department of Environment, Forestry and Fisheries (DEFF) to help community members uplift their living standards, formed in line with the environmental protection laws.

3.8.1 Methods of data collection

Main data source research was primary source. It was collected from listed in Table 8. Information on the participant's experiences on Veldfires was shared by way of speech, written feedback and body language. Perri and Bellamy (2012) agree that sharing of information by participants by way of speech, text or behavior, which is guided by their experiences within their world, is referred to as primary interpretation. The study also obtained data from secondary sources. In secondary review, literature was reviewed. The accuracy of secondary interpretation is based on the standard of interviewer, to fully interpret and capture the essential structure of the material reviewed. (Perri and Bellamy, 2012). The main data collection techniques used in this study was interviews, questionnaires, participant observation, group discussion, and literature review.

3.8.2 Pilot study

In this study a trial-rum pilot was conducted in preparation for a full-blown study. According to Berker (1994) pilot study are conducted to pre-test of the research instruments. It was found to be important for this study to determine the thoroughness of the questionnaire and probing depth of the predetermined interview questions. In the overall, the validity of responses was important to determine (Pole and Lampard, 2002). De Vaus (1993) have shown that that the researcher should not take a risk, instead a pilot test is worth the time. The pilot study was conducted with the Capricorn Fire Chief and the Divisional officers, and Senior Firefighters, who made a total of 8 participants. In conducting the pilot study, the researcher used the Tashkkori and Teeddlie (1998) approaches where first, in-depth interviews were used to address the large-scale questionnaire survey, followed by the wording and the order of questions. Pilot study is particularly useful in that it reveals the need for major corrections on the questionnaires and interview questions. What was even more important is that major corrections were carried out before the full-blown research was conducted. Though it was a painstaking process to adjust the questions, the proper use of terminology was ascertained in the process.

3.8.3 Interviews

Interviews are methods of gathering information orally using a set of preplanned core questions. According to (Shneiderman and Plaisant, 2005), interviews can be very productive since the interviewer can pursue specific issues of concern that may lead to focused and constructive suggestions. Genise (2002); Shneiderman and Plaisant (2005) state the main advantages of interview method of data collection are:-

a) Direct contact with the users often leads to constructive suggestions.
b) They are good at obtaining detailed information.
c) Few participants are needed to gather rich and detailed data.

Depending on the need and design, interviews can be unstructured, structured, and semi-structured with individuals, or may be focus-group interviews.

i) Structured interviews

The structured questionnaire interviews were used in this study. The researcher used a set of predetermined questions which are short and clearly worded; in most cases, these questions were closed and therefore, require precise answers in the form of a set of options read out or presented on paper (See Appendix 2, 3 and 4). This type of interviewing is easy to conduct and can be easily standardised as the same questions are asked to all participants. According to Preece, Rogers, and Sharp (2002) argue that structured interviews are most appropriate when the goals of the study are clearly understood, and specific questions can be identified.

ii) Semi-structured interviews

This study used semi-structured focus groups interviews were engaged. In this way, in-depth information about the target group's perceptions, knowledge, experiences, opinions, and beliefs (Anderson, 2004:109; Best & Kahn, 2003:255, 257). Semi-structured interview has features of both structured and unstructured interviews and therefore use both closed and open questions. The semi-structured interviews were used in this study in line with Abawi (2013) argument that they allow the researcher to collect complex information with higher proportion of opinion-based information. In these interviews, the researcher also used a set of pre-planned core questions for guidance such that the same areas were covered from each interviewee (see Appendix 5, 6 and 8). During the process of interview, interviewees were given opportunity to elaborate or provide more relevant information whenever it was necessary.

iii) Unstructured interviews

The unstructured type of interviews was used in this study to allow the researcher to pose some open-ended questions and the interviewee to express his/her own opinion freely. This required both the interviewer and the interviewee to be at ease because it was more of discussion or brainstorming on the issues of Veldfire response readiness (See Annexure 8). Abawi (2013) contends that that the direction of unstructured interview is determined by both the interviewee and interviewer, not predetermined. According to Preece, Rogers, and Sharp (2002) interview across different interviewees takes on its own format. However, it is possible to generate rich data, information, and ideas in such conversations because the level of questioning can be varied to suit the context and that the interviewer can quiz the interviewee

more deeply on specific issues as they arise; but it can be very time consuming and difficult to analyze the data.

3.8.4 Participant Observation

According to Creswell (2003) participant observations begins with the researcher mainly observing to participating through the following steps: when obtaining permission to gain access the research site; identifying who or what to observe, when and how to observe, interacting with the research site for the very first time when getting a general and the actual sense of the site and lastly, getting to determine the exact role to play as an observer. Creswell (2003) argues that participant observation allowed the researcher to immerse him or herself into a social setting, enabling him/her to learn first-hand how: the actions of participants were compatible with their words, patterns of existing behaviors, expected and unexpected experiences occurring, trust and relationships with others.

3.8.5 Secondary data

Lusthaus et al (1999) opines that secondary data is referred to as document review, in which the researcher is reviewing existing internal documents or program of an organization in the form of hard copy or electronic which may include reports, program logs, performance ratings, funding proposals, meeting minutes, newsletters, and marketing materials. In this study, secondary data was collected from the government website of the Local Government and Traditional Affairs, Demarcation Board, Limpopo Provincial Government, and Western Cape Provincial Government. Mopani and Capricorn District Municipality. Department of Agriculture, Land Reform and Rural Development (DALRRD) and the Department of Environment, Forestry and Fisheries (DEFF) Some of government reviewed policy documents reviewed in this study were as follows: - National Veld and Forest Fire Act (Act no. 101 of 1998); The Disaster Management Act of 2002 (Act no.57 of 2002); Fire Brigade Services Act (Act no. 99 of 1987); The Integrated Fire Management Handbook 2016; The National Environmental Management Act (Act no. 107 of 1998); The Policy Framework for Disaster Risk Management 2005 and lastly; Policy on Financial Support to Fire Protection Associations.

3.9 DATA ANALYSIS

Marshall and Rossman (1999) describe data analysis as the process of bringing order, structure and meaning to the mass of collected data. It is described as messy, ambiguous, and time-consuming, but also as a creative and fascinating process. This view was supported by Schwandt (2007) who is of the opinion that the process of data analysis did not proceed in linear fashion but signifies a search for general statements among categories of data. Bogdan and Biklen (2003;43) posit that data analysis was about organizing and breaking collected information into manageable units, coding them, synthesizing them, and searching for patterns.

Partington (2003) argues that in analyzing qualitative data, there is little standardization with no absolutes and specifics. Previous studies by Neuman (2011); Schurink et al. (2011) stress that no single qualitative data analysis approach is widely accepted. They argue further that there are variations in the number and description of steps for the same process of data analysis by different authors. To analyze the data, this study followed six steps illustrated in Figure 3.7 hereunder.

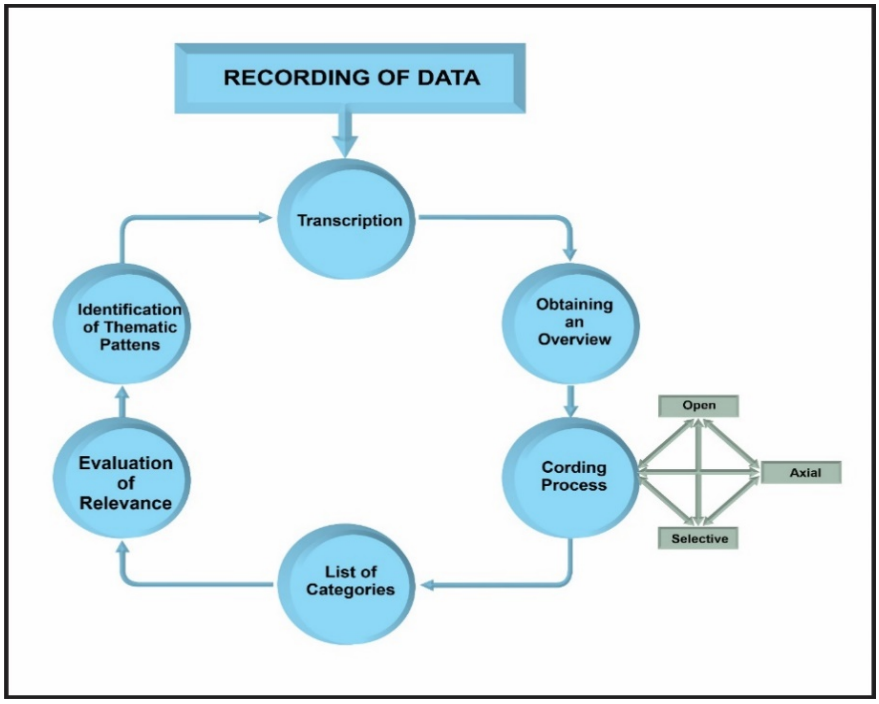


Figure 3.7: The analysis process model
Source: Adopted from Thietart (2007) and Neuman (2011),

Figure 3.7 represents the six generic steps followed in this study for data analysis. Five of these steps in the model are themselves self-explanatory and were used in the study. In this study the Coding Process is the sixth step divided by three stages namely open coding, axial coding, and selective coding. Each one of the three stages benefited the study in the following manner:

a) ***Open coding***: the study focused more on consistency of phrases, frequency, comments that stand out and extensiveness, highlighting and labelling at the same time. The researcher was then able to identify segments and names.

b) ***Axial coding***: the study clarified the researcher reviewed the initial codes seeking clearer patterns and categories.

c) ***Selective coding***: the researcher compared, matched, contrasted data, and eliminated where necessary to avoid repetition. Ultimately the codes were aligned with the research aims ensuring that each research aim is covered. The analytic process often sighted literature and discussions from the data to give impetus to both inductive and deductive reasoning where necessary.

During the first stage of the analysis process, the researcher listened to tapes from recorded interviews, transcribing interview from tapes to paper and reading over the written transcript which were manually captured in the computer spreadsheet for an easy read and allowing the researcher to go through them several times. These processes assisted the researcher to bring some form of order during the analysis. Marshall and Rossman (2014) argue that one of the critical steps of qualitative data analysis was to bring order on the mass of data. Further benefit derived from these processes was that the researcher was able to re-connect with the data this time in the analysis, thereby having a general feeling or an idea of what people were saying and what results of the study could possibly look like.

During the second stage, the researcher spent most of the time grouping similar kinds of information together in categories, the reason was that the researcher had to concentrate in listening to the responses which were re-played to give the researcher other opportunities to further identify and differentiate between questions on topics the study was trying to answer, and those that were included in the interview guide as important, which were somewhat considered not essential. This analysis process was important to address the view expressed by Creswell (1998), who argues that each of the response categories had one or more associated themes that gave a deeper meaning to data. The third stage helped the researcher

to collapse different categories under one main over-arching themes, it was at this stage where certain categories were merged. In this way, it helped the researcher to understand the data with a high level of clarity.

In summary, the data analysis was carried through clear steps that are based on the model in Figure 3.7, which provided for great caution and order as clarified earlier. It is however important to indicate that the study adopted two methods of data analysis namely Content Analysis (CA) and Thematic Content Analysis (TCA). According to Sandelowski and Barroso (2003) the use of such qualitative descriptive approaches was suitable for studies which would employ a relatively low level of interpretation in contrast to grounded theory in which high level of interpretive complexity were required. Studies done before (Giorgie, 1992; Holloway and Todres,2005; Sandelowski (2010) reveals that the use of both Content Analysis and Thematic Content Analysis made for low level interpretation due to the lengthy processes of discussions of its broader narrative and exploration, which increasingly masked the interpretive approaches.

Both these methods were found to be used interchangeably in such a way that often it was difficult to choose one from the other. What is different on how these methods were used in this study as oppose to others, was that Content Analysis was used to analyze secondary data, whereas Thematic Content Analysis was used to analyze primary data. It should be noted that both approaches allow for a qualitative analysis of data. By using content analysis, it is possible to analyse data qualitatively and at the same time quantify the data (Garich, 2007). Content analysis uses a descriptive approach in both coding of the data and its interpretation of quantitative counts of the codes (Downe-Wamboldt, 1992; Morgan, 1993). Conversely, Thematic Content Analysis provided a purely qualitative, detailed, and nuanced account of data (Braun & Clarke, 2006). In this study the two methods complemented each other by improving consistency between the study purpose and methods of data analyses. The details of the two methods were presented here later.

3.9.1 Content analysis

Content Analysis (CA) was well-suited to analyze the multifaceted, important, and sensitive phenomena (Elo and Kyngas, 2008; Vaismoradi et al., 2011). If conducting exploratory work in an area where not much on the subject was known, content analysis may be suitable for the simple reporting of common issues mentioned in secondary data (Green and Thorogood, 2004). When using CA, the primary aim

should be to describe the phenomenon in a conceptual form (Elo and Kyngas, 2008). The content analyst views data as representations not of physical events but of texts, images, and expressions created to be seen, read, interpreted, and acted on for their meanings, and must therefore be analyzed with such uses in mind (Krippendorff, 2004).

To use this method, the Mopani and Capricorn Disaster Management Centres who were themselves central to this study as they were asked to collect documents in the form of regulations, plans and annual reports, which provided for the explanation in the extent to which the District Disaster Centres preparedness to respond to Veldfires. Schilling (2006) describes Content Analysis as the systematic analysis of the content of a text in a quantitative or qualitative manner. In this study, the researcher begun by identifying documents and sampled selected set of texts from the population of texts for analysis. This was quite challenging considering that such documents were from different participants mandated to perform duties and functions related Veldfires by different pieces of legislations for example Fire Brigade services guided by Fire Brigade service Act and the Department of Agriculture, Land Reform and Rural Development guided by the National Veld and Forest Fire Act (NVFFA), similarly Department of Water affairs ad Working on Fires, were also mandated by different legislative locations. The researcher selectively chose texts that had more pertinent content.

The second step was to divide each text into segments for example skills, resources, communication as units of analysis. Third, the researcher constructed and applied one or more concepts to each text segment to enable coding process which was linked to the themes the researcher uncovered when classifying the text. The documents were themselves very recent and could articulate the state of Veldfire response readiness of the two Disaster Centres namely Mopani and Capricorn. In addition, further documents such as Annual Reports of the Fire Protection Associations (FPA), Working on Fire, DALRRD and DEFF were also collected and analyzed to compare respective roles performed towards building response readiness to Veldfire across the districts.

The one specific challenge encountered when doing the content analysis was that there was lack of data which specifies in numerical terms how most if not all agencies had responded to Veldfires year on year to make for a good comparison. Furthermore, there was no systematic collection of Veldfire response data that was linked to Disaster Management Framework policy and performance outcome from each agency under observation, which would be of great assistance to this study in terms of baseline and actual performance and the performance evaluation that could have determined strength of interventions

(programs and projects) of the impact thereof. The policy documents, reports, regulations, and plans were however analyzed to compare what was intended and the resultant actual performance of the district in respect to gaps that existed on response readiness required within the two districts.

Miles and Huberman (1984) expound that Content Analysis has several limitations. First, the coding process is restricted to the information available in text form. For instance, if a researcher is interested in studying people's views on capital punishment, but no such archive of text documents is available, then the analysis cannot be done. This study encountered instances where certain information on Veldfires was not disaggregated, particularly in the annual reports. What the researcher did was to make a follow-up and contact the respective agencies for further clarity.

3.9.2 Thematic content analysis

According to Braun and Clarke (2006) Thematic Content Analysis (TCA) is a flexible and useful research tool, which provided rich and detailed, yet complex, account of the data. Clearly, thematic analysis involved the search for and identification of common threads that extend across an entire interview or set of interviews (DeSantis and Ugarriza, 2000). Perhaps a more fitting description of Thematic Content Analysis was that it was a process in which the researcher identifies themes and categories that emerge from the data from which the researcher discovered themes in the interview transcripts, verified, confirmed and qualified them through searching the data repeatedly to identified further themes and categories.

According to Creswell (2005), in qualitative research data collection and analysis are carried out at the same time and that some level of interpretation was required during analysis. When engaging these steps, Creswell and Clark (2007), stress that qualitative research should take steps to ensure that preconception is minimized and that personal beliefs of the researcher did nor contaminate the process while sorting and naming themes, but by keeping interpretation to a minimum could ensure that the researcher's own feelings and thoughts about the themes did not overshadow what they might signify.

According to Pope et al. (1990) the use of Thematic Content Analysis approach presents data in an intelligible and interpretable way, making it possible to identify trends and relations in accordance with the research aims. Themes got discovered from interview transcripts through a repeated verification, confirmation, and qualification process.

Ogden (1999) posit that most inductive studies report their findings based on three to eight main categories. According to Creswell and Clark (2007), in the data that was collected through methods of observation, interviewing and document analysis, the results cannot be measured exactly, but must be interpreted and organized into themes and categories. The philosophical assumption of this study which underpinned the methods of data analysis provided for the use of themes and categories in the processing of the study findings from the data analysis. The following four themes namely competence, compliance, risk management and governance emerged from participants' narrative. Table 3.5 below illustrate the four themes and the categories associated with the themes which helped the researcher to understand and organize the data.

Table 3.5: Themes and categories

Themes	Categories
Competence	Training, Skills, and Resource
Compliance	Monitoring, Enforcement, Gaps
Risk management	Communication, Awareness, Warning
Governance	Coordination, Collaborations, Agreements

Source: Field based surveys (2020)

The following provide a brief highlight on each of the four themes form the Table 3.5.

i) Competence: Competency was used to reflect the capabilities that exist to perform Veldfire response duties within the district. To obtain maximum impact necessary, districts required the skillfully trained and talented staff who are committed to excellence to perform their Veldfire response functions very well.

ii) Compliance: Compliance was viewed as either a state of being in accordance with established guidelines or specifications, or the process of becoming so. In general, compliance means conforming to a rule, such as a specification, policy, standard or law.

iii) Risk management: Risk management comprised processes of identifying, assessing, and controlling threats or risks posed by man and nature which resulted from Veldfires.

vi) Governance: It is the exclusive responsibility of a governing body which entails performance and conformance of the organization using regulations or mechanisms to balance the powers of the members.

Thematic Content Analysis adopted and used in line with three stages of qualitative data analysis identified by (Berdine, 2009). The three stage were Pre- analysis: Exploration, Treatment and Interpretation were used in the following ways: -

(i) **Pre-analysis**: Analysis involved defining the objectives, there by selecting the materials according to its relevance in relation to goal, reading and organizing the material to be analyzed.

(ii) **Exploration**: this stage of analysis involved defining the units of analysis which could be the portion of the text to which the code is associated. The unit can be worse, paragraph or theme. Code must be defined and may arise from the literature which then become known as construct codes. The categorization of text established a structure and that codes can be descriptive of what was in the text or analytical meaning requiring more reflection of what was expressed in the text (Gibbs, 2009).

(iii) **Treatment and Interpretation**: This third stage involved drawing of inferences. In this stage, the researcher should minimize bias as far as possible. There were three ways to do this suggested by Krippendorff (1990), Kurasaki (2010) and Webber (1990) namely stability, reproducibility, and accuracy.

The use of the three stages illustrated above in this study, was enriched the analysis process meanwhile enriching the drawing of inferences. The three stages of Thematic Content Analysis benefited this research in obtaining the depth of meaning from the data.

3.10 VALIDITY AND RELIABILITY

It is necessary for every study to establish validity regardless of whether the study employed qualitative or quantitative research methodology. Qualitative researchers rely on the accuracy of the final report to determine the validity of the study, hence various methods are used to ensure that accuracy is attained. For this study validity was measured in terms of what was indicated by Cresswell & Clark (2007) arguing that validity procedures rely on the participants, the researcher, or the reader. In terms of validity, the study followed what was stated by Merriam (1998) who argue that if a study is reliable, it follows straightforward standards which signified a measure of trustworthiness.

Bryman and Bell (2015) argue that validity in a study happens when an indicator (or set of indicators) devised to gauge a concept really measures that concept. In other words, validity is the extent to which the instrument measures what it is supposed to measure. According to Taylor (2013) validation is a process by which theoretical statements are tested. In this case interview guides and questionnaires were subjected to review by experts in the field of Disaster Management and Fire Service to the effect that tremendous improvement was achieved from their contributions.

The pilot study also added a dimension towards validation of the instrument. The result of the pilot study was such that the potential participants from the study sites provided an opportunity to receive feedback from respondents which improved reading of questionnaire and interpretation of the questions. This exercise benefits the study in that it raised the confidence that the used measure is accurate for its intended purpose (Goodwin, 2010).

It should be emphasized however, that in a qualitative study, it remains difficult if not impossible to follow straightforward standards the same way it is in quantitative studies as qualitative studies are meant for obtaining deeper understanding of meaning and interpretation of issues. In this study, the researcher appointed structured, semi-structured and unstructured interviews to collect data adhering to standards for each technique for data collection as accounted by the following interview settings, the researcher also

followed the required protocols for conducting interviews with informants from both government organizations and community formations.

3.11 METHODOLOGICAL REFLECTIONS

Every research project presents its set of problems. According to Groves (2006) some of the common problems encountered when conducting research are for example, i) whether the interviewees respond to every item of the questionnaire or not; ii) whether the answer to the question is accurate or not; iii) weather enough interviewees responded to the questionnaire, and iv) Cultural believes. These factors do find their way to any research project, often impacting on the research time frames.

This research was conducted under COVID-19 pandemic disaster situation. The new normal dictated by the protocols to prevent the spread of the disease such as wearing of mask, social distance and sanitizing changed every facet of life space, research included. The fear of infection contributed to postponement of scheduled group discussions, and at worst some participants did not want to take part in fear of COVID-19 infection up until alert-level three was announced. To overcome this challenge, some participants agreed to be interviewed telephonically and where possible interview questionnaires were sent through emails to the respondents.

CHAPTER FOUR

EMPIRICAL EVIDENCE

4.1 INTRODUCTION

This chapter constitute the central part of the study. It presents the results of the study from the data gathered from two study sites, namely Mopani and Capricorn districts. The findings are shaped by the way the researcher deems appropriate through narration of a story that emanate from the depth of the data that comprises perceptions of the respondents. This Chapter is divided into six sections, the second section is the biographical data of the interviewees. The section presents a summary on population size, and dynamic aspects such as gender, age, educational level, years of service, and race composition. The third section deals with the extent to which institutional, legal, and regulatory policy frameworks on Veldfire are implemented within the Mopani and Capricorn districts. This section also highlights related policy alignment and implementation impediments. The fourth section looks at the coordination challenges facing Disaster Management Centres and Umbrella Fire Protection Associations. The fifth section explores governance in Veldfire management as one of the essential elements needed for effective coordination and control of District Disaster Management Advisory Forums member agencies. The last section focuses on the Early Warning Systems. This section explores the use of other forms technology in the research sites to enrich strategies for Veldfire management. It also looks at the dissemination of Veldfire satellite data to districts for purposes of response readiness.

4.2 BIOGRAPHICAL DATA

It is important that the study presents the demographic variables of the respondents. The researcher engaged respondents at the research sites to find out their level of education, work experience, age, gender, and race. The finding of the study in this assessment is that majority of the respondents are males at 79% (See Table 4.1).

Table 4.1 also illustrates that all participants were above the age of 18 years. 45% were between the ages of 36-45 years, whereas 3% were 56 years and above. The table also shows that majority of the respondents were approaching middle age. Heikkila et al (2010) are of the view that issues related to

training in fire management are complex for example recruiting young people ensure that the fire team is made of physically fit members. He further argues that Fire Training Curriculum should always be relevant provided by accredited authority. People responsible for fire management and local people alike, need to appreciate and understand the active role to be performed in line Integrated Fire Management Strategy (De Ronde, 2008).

Regarding racial grouping, majority of the participants at 82% are black, while only 18% are white (see Table 4.1. According to Murray (2007) the recognition of minorities who are largely White Afrikaans speaking people was under threat from transformation policies of the democratically elected government of the Republic of South Africa. Given the situation, many white people left the employ of government. This provides an understanding that municipalities and government departments of the Republic of South Africa have fewer white people in the employ of these institutions than it was during apartheid. This assertion is supported by the Chief Fire Officer who state that:

> *"During Apartheid, Fire Brigade Service was meant to serve small towns only. The democratically elected government changed the municipalities into Local Municipal Councils whose jurisdictions incorporate far flung villages. Consequently, many white people left the employ of municipalities and government alike." (Pers.com, 2020A)*

Table 4.1 also shows that 48% of the respondents have diploma education. While only 3% have primary education. This result reflects that level of education in Veldfire management is important to secure a job, and to ensure that meaningful level of understanding for the relevant policies and regulations is ascertained within sector's environment.

Table 4.1 shows that majority of respondents at 40% have work experience ranging between 15 years and 19 years. Only 5 % of the respondents have less than 5 years' experience.

Table 4.1: Demographic factors in the study sites

Variable	Category	Frequency	Percent
Sex	Male	51	79%
	Female	14	21%
Age	56 and above	2	3%

	46-55	16	25%
	36-45	29	45%
	26-35	13	20%
	19-25	5	8%
Race	Black	53	82%
	Coloured	0	0%
	Indian	0	0%
	White	12	18%
Level of Education	Primary	2	3%
	Secondary	17	26%
	Diploma	31	48%
	Degree	11	17%
	Post Degree	4	6%
Work Experience	< 5	3	5%
	5-9	13	20%
	10-14	12	18%
	15-19	26	40%
	>20	11	17%

Source: Field based surveys 2020

4.3 INSTITUTIONAL POLICY AND LEGISLATIVE FRAMEWORKS

This section addresses the question about the institutional and policy frameworks for the management of Veldfires in the study sites of Mopani and Capricorn Districts. In this section we present the data and the responses provided by various actors drawn from different institutions responsible for disaster management, particularly the management of Veldfires in Mopani and Capricorn Districts. Like most decentralized systems of government, South Africa has three tiers of government namely National, Provincial and Local government which are interdependent and autonomous from one another.

One of the issues the researcher was interested in was to establish how Veldfire management is understood in the districts of the Limpopo province. It was important to identify the policy, legislative and regulatory frameworks which constitute the dispensation of Veldfire management. Through document review, the researcher was able to make comprehensive identification of these frameworks that creates an enabling environment for management of Veldfires in the study site. Table 4.2 provides a summary of the existing set of government policies, legislations and regulations which exist and used in the two study sites to manage Veldfires.

Table 4.2: Policy framework for Veldfire management in South Africa

Title of legislation, policy or guideline	**Institutions**
The Disaster Management Act (DMA) (Act no.57 of 2002) This legislation provides for the establishment of the framework within which Integrated Fire Management must take place. This is the aspect which relates to the fire service stakeholder coordination by the District Disaster Management Centre.	Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA)
National Policy Framework for Disaster Management in South Africa (NPFDMSA), 2005. The framework provides for the recruitment of volunteers established in high risk or remote areas, where speedy response time by professional services is not possible due to distances, accessibility or terrain to be covered. This particular aspect relates to the involvement of the community on response readiness	Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA)
Fire Brigade Services Act (FBSA) (act no. 99 of 1987) This legislation provides for the Minister to designate firefighting services. The legislation emphasizes collaborations among stakeholders in Veldfire management	Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA)

Local Government Municipal Structures Act (act no. 117 of 1998) deals with the division of functions and powers between district and local municipalities and provides that a district municipality has the following functions and powers in relation to firefighting services: a) Planning, coordination, and regulation of fire services. b) Specialized firefighting services such as mountain, veld, and chemical fire services; c) Coordination of the standardization of infrastructure, vehicles, equipment, and procedures; and d) Training of fire officers.	Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA)
National Veld and Forest Fire Act NVFFA) (Act no. 101 of 1998) provides inter alia, for the establishment of Fire Protection Associations (FPAs) and the adoption of a fire danger rating system. It creates specific duties around fire prevention and firefighting.	Department of Agriculture, Land Reform and Rural Development (DALRRD)
National Environmental Management Act (NEMA) (Act 107), Amendment Act (NEMA) provides for the management of natural resources. Many landscapes are fire-dependent and fire-adapted, wildland fires have a significant impact, both positive and negative, on natural resources, resulting in the Department has embarked on a wildfire management. initiative under the umbrella of the Working on Fire Programme.	Department of Environment, Forestry and Fisheries (DEFF)
The National Water Act (NWA),1988 (Act 36 of 1998) it provides for the likely impact of the servitude on the land or its use,in repect of Veldfire management	Department of Water and Sanitation

Source: Integrated National Forest Protection Strategy (2015)

A review of Integrated National Forest Protection Strategy (INFPS) (2015) report revealed that a handful of policies, legislative and regulatory framework are consistently interfacing to create an ideal environment for the administration of government's intentions to manage Veldfire hazard. These frameworks are placed across different ministries as shown in Table 4.2. The identification of policy, legislative and regulatory framework, was coupled with in-depth discussion around the powers and functions accorded to these institutions.

Further review of INFPS (2016) report, reveals that the Department of Agriculture, Land Reform and Rural Development (DALRRD), for example, derives part of its mandate from the National Veld and Forest Fire Act of 1998 (Act no. 101 of 1998) and Fire Brigade Services Act of 1987 (act no. 99 of 1987) there by ensuring that Veldfires are properly managed and prevented across the provinces of the Republic of South Africa. To accomplish this objective the department executes responsibilities which include:

(*i*) *Formation and registration of Fire Protection Association (FPA)*
(ii) *Appointment of Fire Protection Officer (FPO)*
(iii) *Consulting with South African Weather Bureau for the Fire Danger Ratings*

Scott (2001) argues that Department of Agriculture, Land Reform and Rural Development (DALRRD) also ensures the sustainable management and development of forests for the benefit of all. Veldfire provisions were removed from the National Forests Act of 1998 (Act no. 84 of 1998) and drafted into a separate Act, to provide an explanation for reasons why fire prevention and suppression is now a national, provincial and local government competency.

A further review of CSIR (2010) report shows that Department of Environment, Forestry and Fisheries (DEFF) is also one of the institutions mandated to manage Veldfires. Deriving its mandate from the Environment Conservation Act of 1989 (Act No. 73 of 1989). The main objective of the department is stated as to influence and promote the protection and utilization of the environment. This assertion is supported by the responses from an environmentalist from Department of Environment, Forestry and Fisheries (DEFF) who for example, pointed out that:

> *"The department establishes the Expanded Public Works Programme which supports the legally responsible firefighting services i.e. those institutions responsible for implementation of the NVFFA, FBSA and the DMA, thereby creating fire belt and conducting awareness campaigns as part of the programs informed by their Integrated Fire Management Strategy, although the responsibility to manage Veldfires lies with the landowner" (Pers.com, 2020B).*

The Municipal Structures Act of 1998 (act no. 117 of 1998) reveals that Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA) derives the Veldfire management mandate from Fire Brigade Service Act of1987 (Act No. 99 of 1987). The main objective

of the department is to establish co-ordination and standardization of fire brigade services. To accomplish the objective, the department performs functions which include:

(i) Fighting and preventing the outbreak or spread of a fire.
(ii) Protection of life or property against a fire or other threatening danger.
(iii) Rescue of life or property from a fire or other danger.

Further review of INFPS (2016) shows that the Department of Corporative Governance, Human Settlement and Traditional Affairs (COGHSTA) derives some of its mandate from Disaster Management Disaster Management Act of 2002 (Act no.57 of 2002) and Fire Brigade Services Act of 1987 (Act no. 99 of 1987). The main objective is to ensure that disaster management services and fire brigade services are not only established but monitored for effective implementation of emergency services in the district. To accomplish the objective, the department performs functions which include:

(i) Development of risk reduction and mitigation strategy.
(ii) Promotion of emergency services at local sphere of government.
(iii) Provides policy and a framework within which disaster management plans, and strategies can be established.

From the field observation, it was found that the South African Weather Service (SAWS) is responsible for issuing Fire Danger Index forecasts daily. CSIR (2019) report reveals that South African Weather Service (SAWS) derives its mandate from the South African Weather Service Act of 2001 (Act No 8 of 2001). The main objective of the agent includes:

(i) Extend and improve the quality of meteorological service.
(ii) On-going collection of meteorological data over South Africa and surrounding southern oceans for the use by current and future generations.

A further review of NVFFA and the FBSA has revealed strong existence of legislative gaps. Supported from the field-based evidence, it was found that the policy, legislative and regulatory framework gaps do exist within the realm of Veldfire management. The gaps are an impediment towards achievement of set objectives for proper management of Veldfire. This assertion is supported by Chief Fire Officer, who for example pointed out that:

"The municipality does not provide specific budget for the roles and functions of the FPO since the Fire Brigade Services Act is silence about it. The expectation is that the Department of Agriculture, Land Reform and Rural Development (DALRRD) should make budgetary provisions for the fulfilment of the powers and functions of the FPO as reflected in the NVFFA, but this is not happening, how then do we expect the FPO to run all his powers and functions without budget" (Pers.com, 2020C).

The comment made by the Chairperson of the Fire Protection Association in relation to policy, legislative and regulatory framework. He indicated that:

"The power relations between the FPO and the FPA chairperson need to be managed and closely monitored, to maintain a balance of relations between the two critical stakeholders at all times. Furthermore, their roles should be clearly delineated, this will minimize potential for overlaps that have become a source of tension between these important role-players in the fire management space" (Pers.com, 2020D).

Some participants in the Fire Brigade Services raised concern that, the work of the Chief Fire Officer is primarily mainly to manage Structural Fires in the entire district. It is now further compounded by the additional powers and functions espoused in the NVFFA. One of the Senior Firefighters argues that:

"The Chief Fire Officer is a fire expert. Resuming the FPO responsibilities requires, for example that he automatically becomes a legal expert as he would have to contend with enforcement of the NVFFA which provides for laying charges against those who break the law, policing anyone requires knowledge of the law" (Pers.com, 2020E).

To further support the policy, legislative and regulatory gaps that exist, a Divisional Officer (DO) had this to say:-

"On the one hand, it is expected that the relationship between the employer and the employee should always be cordial. However, it is unthinkable to maintain these relations when for example, the Chief Fire Officer, who is appointed as a FPO begins to institute court cases against the Municipal Council for not complying with the NVFFA. These kinds of arrangements set the relations between the FPO and Council at an awkward position, sometimes for a while longer affecting the smooth running of the Fire Brigade Services which I believe are his primary responsibilities" (Pers.com, 2020F).

In discussion with the Head of Disaster Management Centre on the existence of legislative and regulatory framework, he pointed out that:

> *"The Key Performance Area (KPA) 4, Response and Recovery is giving more emphasis on Recovery than it does to Response. Separating the two would help to re-focus each one of them without depriving the other. Government has put clear mechanisms in place for resource mobilization to do Recovery, Reconstruction and Rehabilitation. My view is that there is no meaningful financial support structure set out to support Response as compared to Recovery. The impression here is that recovery is more important than response. How can it be so? perhaps this is a political decision." (Pers.com, 2020G).*

The response below, for example, is from WoF participant serving at the provincial structure, who explained that policy and legislative gaps are stumbling blocks, by stating that:

> *"The cultural practices associated with Veldfires are not pronounced within the Fire Brigade Service Act. When these fires get out of hand and resources get spent to bring them down, it is costly. It remains unclear whether these fires are allowed or not as communities on the other hand justify them through their cultural beliefs. In my view anyone who starts a fire must first have the equipment's to manage it and take full responsibility for any damage caused. There should be clear legislative position on these kinds of practices" (Pers.com, 2020H).*

The researcher was further interested to understand whether the policies of the institutions are aligned or not aligned with one another. It was particularly important to have a more comprehensive and in-depth understanding of whether the participants in the Veldfire management have any knowledge on policy alignment issues in the research site. Table 4.3 provides the summary of the views on policy alignment from the participants involved in Veldfire management on daily basis in the districts.

Alignment of policy refers to the process of participation of the public in police making to ensure that its impact to their lives is maximized. When policy is not aligned, it is believed to have not been given due attention for the public to input diverse views during policy development stages (Stephens, 2016).

Table 4.3 illustrates the issue of alignment and non-alignment of institutional policies.

Question	Responses	Frequency		Percent
Are the policies of the institutions aligned to one another?	Yes	12		18%
	No	52		82%
TOTAL		65		100%

Source: Field based surveys (2020)

From the field-based evidence it was observed that there exists non-alignment of institutional policies. Table 4.3 for example, shows that 82% of the participants recognized that Veldfire management policies are not aligned. Whereas only 18% of the respondents argued that Veldfire management policies are alighted.

4.4. COLLABORATIONS AMONG VELDFIRE MANAGEMENT INSTITUTIONS

The researcher was also interested in finding out the extent to which these institutions work together to build response capacity. When this question was asked, the responses are captured in Table 4.4 which provides summary of the responses which expressed weather they work or do not work together in the Mopani and Capricorn District.

Table 4.4: Institutional collaborations (work together)

Question	**Responses**	**Frequency**	**Percent**
Do the institutions identified as key in the management of Veldfire work together or do not work together?	Yes	18	28%
	No	44	67%
	I do not know	3	5%
TOTAL		65	100%

Source: Field based surveys 2020

Table 4.4 for example, suggests that majority of respondents at 67% articulated that the institutions as identified to manage Veldfires do not work together and 28% of the respondents believe that the institutions that manage Veldfire in the research sites work together. To further support the position that the institutions do not work together, a participant from DAFF who participated in the study stated that:

"The high costs of membership fees are a deterrent from joining Fire Protection Associations. It is contributing to institutions not to working together, because in the vent that fire breaks out, the FPA will say members first. This create an impression that Veldfire fighting is very expansive, when it was supposed to be a basic service available within the means of everyone who needs it. The highly commercialized Arial Firefighting Service is close to impossible to be accessed by many landowners except the big and rich ones. Not many landowners can afford their rates charged per hour of aerial fire combat" (Pers.com, 2020I).

One critical comment made by Fire Chief Officer in support that the institutions do not work together was captured as stated:

"In our district, we are continuously pleading with other role players for them to come to the table. Often, I wonder if it is achievable, for example, the government parastatals such as TRANSNET, SANRAL, RAILWAY, PRASSA and ESKOM are not members of the FPA nor are they providing any funding to support the Fire Protection Association. This lack of cooperation is to blame for shortage of resources to fight Veldfire in the district" (Pers.com, 2020J).

Having established that majority of the respondents indicated that the institutions do not work together. The researcher also needed to understand factors that exist that make it difficult for these institutions to not work together. The research respondents identified the following factors listed in Figure 4.1 and a summary of factors contributing to institutions not working together is illustrated.

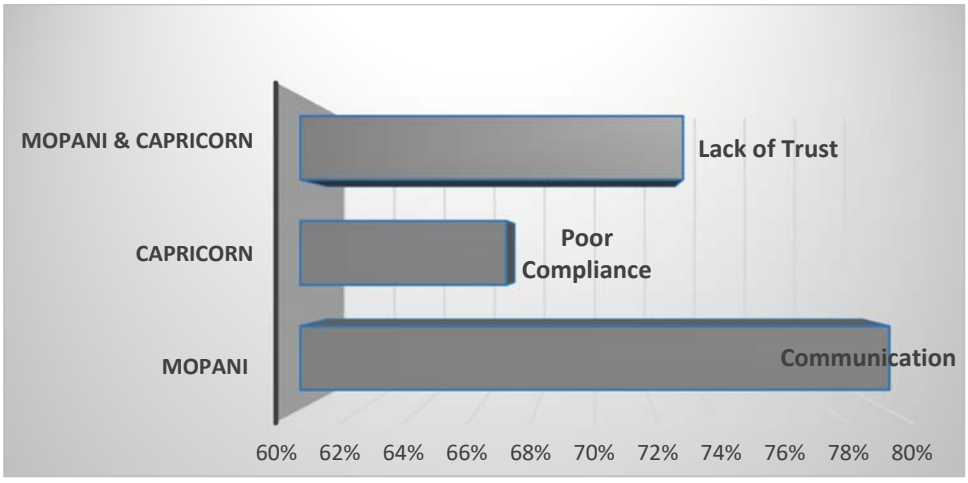


Figure 4.1 Factors contributing to institutions not working together.
Source: Field based surveys (2020)

Figure 4.1 reveals that participants at 74% suggested that in Mopani district, institutions are not working together due to lack of trust, whereas at 82 %, participants also suggest that in Capricorn district institutions do not work together due to Legislative challenges. A remarkably interesting finding was that at 78%, participants suggested that communication contribute to institutions not to work together both in Mopani and Capricorn. A participant from DEFF argues that legislations are not binding anyone to be a member of FPA, he therefore stated that:

> *"I think that legislations created both this management and coordination challenges. It is voluntary for private landowners to become members of the FPA however it is mandatory for leading agencies such as ESKOM, TRANSNET and Municipalities. The same goes for government departments, for example Department of Environment, Forestry and Fisheries has game farms while Department of Water Affairs has servitudes that go into thousands of kilometers around those huge water dams, but they are not members of the FPA. FPA was a government idea, and a good one for that matter, but now government departments do not recognize the importance of being members of that structure, who then will? Similarly, Department of Agriculture, Land Reform and Rural Development is not getting full cooperation from FPAs, this is an opportunity we are missing to work cooperatively together in the management Veldfires" (Pers.com, 2020K).*

Additionally, a participant from DALRRD explained the extent to which the legislations create this environment where institutions are not working together, he pointed out that:

> *"When the Fire Protection Officer litigate his own municipal council, he applies provisions of the National Veld and Forest Fire Act. Similarly, the FPA does not give help to a landowner who is not their member as per their constitution. Furthermore, WoF is a government initiative program, but their Advance Arial Firefighter equipment is not accessible to every landowner, particularly those who are not members of the FPA. In my view, there are some legislative issues that create an environment for institutions not to work together, in my view" (Pers.com, 2020L).*

4.5 PERSPECTIVES ON COORDINATION OF VELDFIRE MANEGEMENT AGENCIES

The Disaster Management Centres together with the Fire Brigade Services at district level coordinate the stakeholder responsible for Veldfire management. In this subsection, the study establishes factors that influence Veldfire coordination in Mopani and Capricorn districts. It was observed from the policy documents, that the Disaster Centres should identify the hazards and presents the risk profile of the district, which informs the disaster management plan. From the policy documents, it was stated that the disaster risk management plans become incorporated into the Integrated Development Plan (IDP) of the district municipality to inform the need for resources allocations needed for response, risk reduction programmes and projects to list a few. Furthermore, the Fire Brigade Services for example, is expected to coordinate the Integrated Fire Management plan, together with the other fire management agencies. These policy pronouncements ensure that there exist meaningful mechanisms to coordinate stakeholders responsible for Veldfire management.

The researcher then wanted participants to identify best ways to coordinate Veldfire management agencies. Figure 4.2 shows that 62% of the respondents suggested Response Action Plan, 67% indicated Procedure for reporting emergencies, 78% indicated trained personnel, 68% suggested Equipment's, and 90% recommended Budget, 80% functionality and Power relations at 92%.

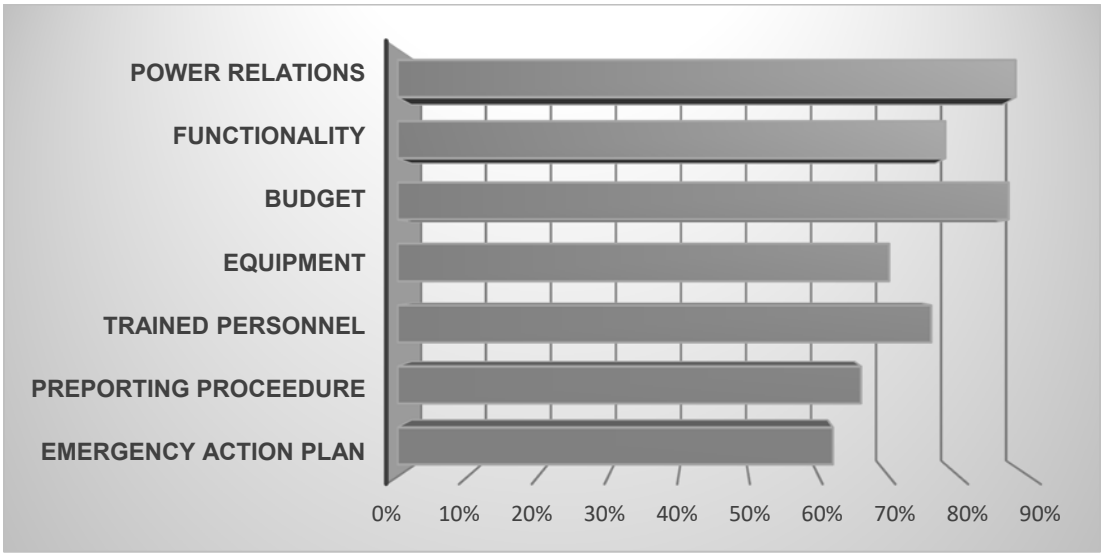


Figure 4.2 Elements for Veldfire coordination
Source: Field based, 2020

The result as presented in Figure 4.2 also shows that 62% were the least respondents who suggested that emergency response action plan is necessary to ensure that districts coordinate stakeholders for effective response services. Whereas 92% of respondents believe that power relation is affecting coordination of Veldfire response agencies.

The Head of District Disaster Management Centre stressed that power relations has affected the meaningful coordination which once existed. He therefore pointed out that:

> *"The Disaster Management Centre, institutional capacity unit, is responsible to ensure that members of the advisory forum, and respective technical task teams are coordinated to attend the scheduled meetings and take part in educational awareness campaigns targeted at vulnerable communities. However, these meetings are poorly attended. These meetings often do not corrade as people no longer attend them, under the given situation, Disaster Centres are seen to be failing to coordinate stakeholders effectively. Stakeholders do not feel duty bound to honour the invitations for them to participate into our programs" (Pers.com, 2020M).*

Moreover, 90% of the respondents indicated that lack of budget is presenting a serious financial constrain in the running of the Disaster Management Centres and Fire Services alike. The Chief Fire Officer argues that, while there is poor budgeting for Fire and Disaster Services, misappropriation has become synonymous with municipal finance management. The Chief Fire Officer pointed out that:

> *"From time-to-time municipalities poorly perform in their state of financial affairs. The level of corruption is increasing as there is no consequence management. Often people who are involved get away and rewarded with high positions. Defrauding municipality has a new meaning. This mismanagement of funds has affected service delivery, Disaster Management and Fire Services operations are no have been hard hit by these maleficent" (Pers.com A, 2020N).*

To further support the above, the Head of the Disaster Management Centre argues that municipalities are not taking Disaster and Fire Services seriously. If they do, they will allocate resources to ensure functionality of these institutions. He pointed out:

> *"If you look at Western Cape for example, they are proactive, they have massive Fire Budget. The Disaster Management Centre plus Fire Services do Veldfire Assessment to know where the high-risk spot is. Once that is established, they put Aerial Firefighting of Choppers at a strategic*

location to put down fire soon as it is spotted. They work on fire in an integrated manner, government and private together in such a way that first the provincial Disaster Management pays for the initial hour and they activate response so much faster. From the second hour, the District Disaster Centre then takes over and pay for the remaining time. They have an exceptionally good response system. Here in Limpopo, we still struggle with the Provincial Disaster Management Centre to get this kind of response mechanisms right" (Pers.com, 2020O).

In addition to the above, the Chief Fire Officer complained that both Disaster and Fie services are not taken seriously by the decision makers. He stated:

"One of the problems affecting budgeting and funding of disasters is that the management can request us to do costing in order to request funding for Disaster Management from National Treasury. After getting the funds, we do not have power to control the funds. What also happen is that Disaster funds get diverted to accelerate the water projects. We end up accounting to National and Provincial Treasury on how we used the funds which we did not. This is not helpful but unethical" (Pers.com B, 2020P).

Figure 4.2 for instance, also suggests that 78% of the respondents indicated that Training is a requirement for meaningful coordination to take place. Several firefighters have complained that recruitment of firefighters who are not professionally trained presents a serious barrier when they actual response to Veldfires is takes place. The Chief Fire Officer revealed to the researcher that, coordinating firefighters without the necessary training is a serious challenge: He made the following comment:

"In a fire emergency scene, coordinating response from firefighters who were not professionally trained is one of the most difficult things. Trained workforce can save life and the opposite is also the case" (Pers.com C, 2020Q).



Figure 4.3: Researcher observing Physical fitness training, at WoF Giyani Fire Base
Source: Picture by Takalani Makananisa, (2020)



Figure 4.4: Researcher observing WoF Yellow Card Fitness Tanning at Makhado Fire Base
Source: Picture by Takalani Makananisa, (2020)

Some participants from Working on Fire agency agreed that training ensures that they are not only fit, but renew mindset required to combat fires. Additionally, participants from the Capricorn Fire Brigade pointed that training as one of the factors affecting management of Veldfires. The WoF Team Leader agrees that training in firefighting should be done periodically. He has this to say:

> *"Inadequate training is the last thing you need in the firefighting business because people lose their lives when responding to Veldfires. It is important that a higher standard of response readiness is met to ensure that Fire Services force delivers satisfactory service at all given material times" (Pers.com, 2020R).*

It can be deduced from this discussion that there exists a relationship between budget and stakeholder coordination in the realm for fire emergency management.

Observed from Figure 4.2, a 72% of the respondents acknowledge that shortage of equipment in the study site is hampering coordination efforts. These participants told the researcher how difficult it is to coordinate Veldfire emergency without the required equipment in place. This is what the Chief Fire Officer of Capricorn district said:

> *"Fire Brigade Services perform their responsibilities with skeletal staff. When a fire fighter resigns the position does not get filled. This is frustrating because we are expected to still perform our job effectively. Similarly, we do not have proper response vehicles. To deal with major fires, the fire brigade can coordinate stakeholder when proper fire and rescue equipped vehicles are in place. For example, how do we carry our firefighter crews to the fire scene without a bus? This makes our job very tedious and unprofessional" (Pers.com, 2020S).*

In support of the view expressed earlier, the Chairperson of the Fire Protection Association stated that:

> *"The district does not have equipment necessary to respond to Veldfires. I am aware that they even struggle to deal with their primary function, that of fighting structural fires. What more about Veldfires. Truly something needs to be done to support the district in this regard, and it must happen sooner rather than later" (Pers.com, 2020T).*

However, a response from Working on Fire painted a different picture. He pointed out that:

> *"The Working on Fire (WoF) teams are well trained and have extremely useful equipment which could be coordinated during fire emergency. They also have an agreement with private institutions to provide Advance Aerial Fire Support Service who provide Airplanes and Helicopters, which can be dispatched to put down huge fires. This service is only available to their members only" (Pers.com, 2020V).*

Review of the Integrated Fire Management Handbook (2016) has revealed that equipment seems to be the backbone for successful Veldfire response mission. Firefighting requires adequate supply of both advance and basic equipment fit for the purpose. While there is shortage of general equipment in the fire sector, WoF seems to have no problem which others are facing. The only challenge here is that

they are contracted to a private company who owns and control the equipment making it awfully expensive to access in the time of need.



Figure 4.5: Working on Fore Aerial support
Source: The Integrated Fire Management Handbook (2016)



Figure 4.6: WoF Equipment at Makhado Fire Base (2020)
Source: Source: Picture by Takalani Makananisa (2020)

In addition, a review of the Integrated Fire Management Handbook relating to the equipment for Veldfire fighting. The researcher observed from the documents that from now and into the not-so distant future, the world is set to experience increasing temperatures, creating more chances for Veldfires to occur. The firefighting agencies, for example, DALRRD, WoF, FPA, and the Fire Brigade Service in particular, are faced with high shortage of Fire engines, Skid units and Helicopters to fight Veldfire. From the research site Voorspoed State Plantations under the DALRRD, the researcher observed that they plantation is under the guard of a big Fire Engine Truck. Figure 4.7 shows the DALRRD Fire truck at Voorspoed State Plantation Estate.



Figure 4.7: DALRRD Fire Engine Truck
Source: Picture by Takalani Makananisa, (2020)



Figure 4.8: DALRRD Voorspoed State Plantation in Capricorn District
Source: Picture by Takalani Makananisa, (2020)

Based on this observation, it can be argued that Veldfire fighting presents a great challenge within the Mopani and Capricorn district. The need for equipment cannot be over emphasized. Without equipment, it is not possible to effect response. Equipment are fundamental pre-requisites for Veldfire management.

Figure 4.2 shows that 80% of respondents indicated that functionality of Disaster Centres is paramount to coordination of emergency response. This assertion is supported by the respondent who stated that: -

> "*Capricorn District Disaster Management Centre experiences coordination challenges, one reason, is that when people attend your meeting, they look at your level of authority commanded by the position you occupy. How do you coordinate stakeholders when you are at assistant manager level? You are seen to be without the necessary authority. It is not possible to command senior managers form other response agencies to come to sit in your meetings, what often happens is that they send their junior officials to attend, just for compliance" (Pers.com, 2020W).*

However, during the field observation, the researcher observed that majority of the stakeholders did not attended the scheduled Disaster Management Advisory Forum (DMAF) quarterly meeting which took place on the 25th of February 2020 at the Council Chamber of the Capricorn District Municipality. The nonattendance of critical stakeholder is adding to the dysfunctionality of Disaster Centres as depicted by figure 4.10. Further observation was that those who arrived most of them arrived late to such an extent that it took the chairperson 30 minutes more into the time of the meeting waiting for members to arrive to form a quorum. Lastly, the researcher observed that business, insurance, famers were among some of the stakeholder which did not turn up for this important meeting.

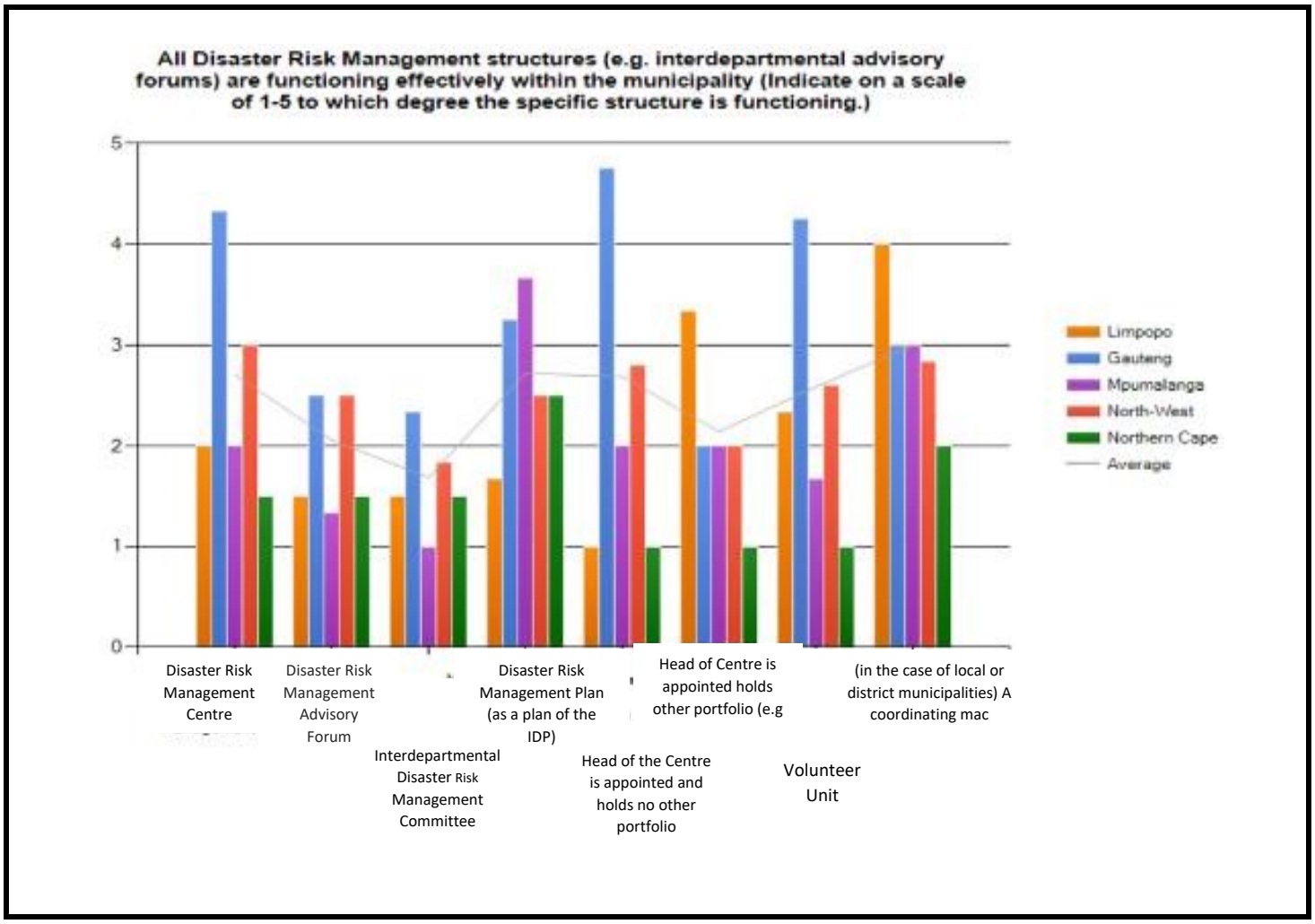


Figure: 4.10 Functionality of Disaster Management Centre
Source: Unknown (CSIR, DEA, GIZ Federal Republic of Germany and SANBI)

Figure 4.10, for instance, suggest that Limpopo Disaster Risk Management Advisory Forum's functionality is assessed at a scale of 1 to 5. In Figure 4.2 responded also identified that there is poor coordination of these forum meetings by District Disaster Centres in the Limpopo province. This view is further supported by the Head Disaster Centre who argued that functionality of the disaster Centre is a serious challenge. He stated that:

> *"If you look at Western Cape Provincial Disaster Management Centre for example, the manager there is a Chief Director who reports directly to the City Manager. At this level, as a disaster Centre Manager you have the powers to take decisions. The Provincial Disaster Management Centre head is at a director level, and the Centre is not functional. There is poor coordination of stakeholders. At district level, the Head of Disaster Management Centres report*

to Director Community Services which is a practice that is not in line with the provisions of the Disaster Management Act" (Pers.com, 2020X).



Figure 4.10: The Mopani District Disaster Management Centre
Source: Photo supplied by Mopani Disaster Centre



Figure 4.11: The Capricorn District Disaster Management Centre
Source: Picture by Takalani Makananisa, (2020)

The above comment is further supported by the response of the Chairperson of the FPA who argues that the law does not compel the FPA to be affiliate members of the Umbrella Fire Protection Association (UFPA). In so doing, there may be a lost opportunity for addressing and solving coordination challenges. He explained the situation by pointing out that:

> "*Coordination is problem, perhaps one of the biggest problems faced by the fire services. Also, the regional coordination is lacking among FPA. The UFPA body seems to have serious coordination challenges. This in my view is because now there is a move towards pitching FPAs at district level as opposed to local municipal boundary level. These are the issues which should be debated, and their practicality scrutinized at the level of the umbrella body, but instead this seems to be a top-down wish" (Pers.com, 2020Y).*

In addition to field-based evidence, review of the Integrated Fire Managements Handbook (2016) shows that there is an Umbrella Fire protection Association (UFPA) which is responsible to coordinate firefighters from various institutions. According to the review, this structure operates at a provincial level. Figure 4.12 reflect the UFPAs structural arrangements. Furthermore, it is revealed that for this body to achieve effective oversight, it should adhere to communication channels as illustrated in Figure 4.12 through structure listed here below.

(i) FPA chairpersons
(ii) Officials from departments that carry the Veldfire mandate:
(iii) PDMC
(iv) DALRRD management
(v) DEFF officials

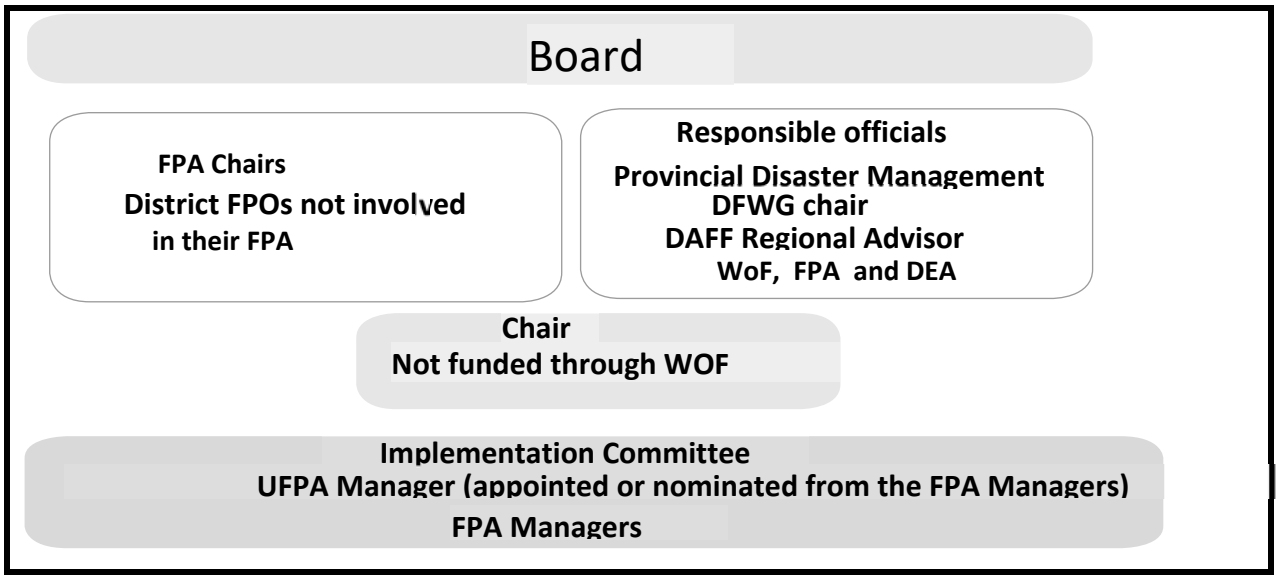


Figure 4.12 the Umbrella Fire Protection Association (UFPA)
Source: CSIR (2016)

Figure 4.7 for example gives the summary which shows that 92% of respondents also suggest that power relations influence coordination of stakeholders. Figure 4.17 gives a structure of the UFPA which may also be contributing to exercise of power by various stakeholder. The Head of District Disaster Centre was further asked about Veldfire coordination and power, he pointed out that:

> *"The Disaster Management Centres faces power relations challenges on a continuous basis. For example, the Disaster Management Act requires that the Head of The Disaster Management Centre is appointed by council. What this means is that Head of the Disaster Management Centre is section 59 position. In line with the Municipal Systems Act, it is a director accountable to the municipal manager. Now without the necessary authority, it is not possible to ensure that every stakeholder account to Head of the Disaster Management Centre" (Pers.com, 2020Z).*

To further support the above comment, the Disaster Management Head argues that power relations are impacting heavily in the operationalization of Disaster Centers: he stated that:

> *"For as long as Disaster Centre Head reports are not Section 59 employees, (directors accountable to the municipal manager), we are biting about bush and our mission to save lives is impossible, under the given situation. Coordination will remain a challenge for a while longer, affecting the operationalization of the centres. This arrangement should be corrected to streamline the emergency services" (Pers.com, 2020AA).*

From the Annual Provincial Disaster Management Report (2017), it was observed that Chairpersons of District Disaster Management Advisory Forum are always complaining of poor attendance Disaster Management Advisory Meetings by the local municipalities. The observations were corroborated by the response of the Chief Fire Officer, who stated that:

> *"Municipalities complained that when district establish their Disaster Advisory Forums they are not consulted, as a result they would rather have to constitute their own Local Disaster Advisory Forums, to take care of their local issues" (Pers.com M, 2020BB).*

It can be deduced from these discussions that; Disaster Management Centres are facing serious coordination challenges. Respondents argued that in support of the researcher's observation that this situation cannot be allowed to go on unattended. It seeks to undermine the role of Disaster Centres at the same time demoralizing individuals managing these centres.

4.6 EARLY WARNING SYSTEMS

Another important question the researcher wanted answered in this study relates to the existing systems used for Veldfire detection in Mopani and Capricorn district. To obtain a comprehensive and in-depth understanding of the early warning system in the study site, responses from participants on the extent to which early warning systems are used in rural areas, on private land and state forest land were critically analyzed.

The Traditional leaders under Ga-Ramokgopa Traditional Council reflected in Figure 4.14 believe that early warning systems are important because they inform communities about the eminent danger posed by Veldfires and other hazards in their areas. A member of the Traditional Council had this to say:

> *"Unlike rain, Veldfires are difficult to foretell their eminent occurrence using indigenous knowledge. In the past, thunder was believed to cause fires in the wild. Government introduced the AFIS system which is believed to detect fires. We do not know how AFIS works. This is the only early warning system we have heard about; we however do not have the system. We also do not receive the information from this system. From our radios we hear about weather forecast and the daily high and low temperature readings. This is all we have. However, we feel that this is not enough to prepare communities for Veldfire occurrence. The issue here is that*

our village has grown too big, without that early warning information, we continue to experience fires that are difficult fight as we respond when the fire is already big to control. " (Pers.com, 2020CC).

The researcher also observed in the research site that traditional councils do not have any forms of early detection. What is even more frustrating is that some of the villages have poor network for mobile phones, making it difficult to control their cultural practices on fire shown in Figure 4.14.



Figure 4.13: The Ramokgopa Traditional Council
Source: Picture by Takalani Makananisa, (2020)

Another member of the Traditional Council responsible for land s under Communal Property Association (CPA) responded to the question of existence of early warning systems in their area. He stated that:

"Some under the Communal Property Association (CPA), we hear that they use existing technology which they found when they claimed the land, others were not that lucky. However here in the villages, we are not covered, and we have vast land in which community members look after their livestock. Many families have lost their livestock to Veldfire. It is important that information is communicated effectively by SAWS through various community structures including members of the Disaster Ward Committee, to ensure response readiness. (Pers.com, 2020DD).



Figure 4.14: Cultural burning practices "If it does not burn it does not rain."
Source: ForestrySA(2017)

Another participant, from the Department of Agriculture, supported the view expressed earlier by WoF by clearly indicating that:

> *"Through the use of AFIS, more farmland receives information of the impending fire danger. It is a good early detection system. The only unfortunate part is that this information does not reach members of communities in the rural areas unless a special request is made. I however heard that the system is going to be faced out." (Pers.com, 2020EE).*

From the above comment, putting early warning system in place, could build capacity for communities to be effective first responders to Veldfires. Without these systems in place, communities as first responders are put in vulnerable position. The researcher therefore asked for furthermore suggestion on issues of early warning from the participant from Working on Fire (WoF). He pointed out that:

> *"We have the National Fire Danger Rating System (NFDRS) under the Department of Water Affairs and Forestry which enables us to predict the number of fires that could be expected to occur in the given area. It also helps us to now the possible potential intensity with which it will burn and the level of damage that would likely result. What is important also for us is the potential size of the fire and the area where it is likely to happen so that we know what to do when and how to prevent it from happening" (Pers.com, 2020FF).*

Additionally, a member of the Fire Protection Association also responded to existence of Veldfire early detection system and how it is used. He responded by stating that:

> *"AFIS is highly an effective system, it provides the temperature, wind direction and speed and further determines the fire dander ratings to all our members for early detection of Veldfires. On average the AFIS can send SMS alert messages to more than 30 000 members which I convinced that it has the capacity to reach all the stakeholders responsible for Veldfires management. One thing for sure is that it generates Veldfire warning data twice at 10am and 2pm daily. Our Fire Team members also use CASTRAL, a portable instrument to calculate the fire danger index. However, this instrument can only cover a small area" (Pers.com, 2020GG).*

In addition to field-based evidence, the reviewed CSIR (2010) report reveals that, CSIR developed the AFIS system used to detect Veldfires by the FPAs. The AFIS system provides alerts through SMS and email messages straight from the satellite camera. Viewers can access the information through the portal at any place. Figure 4.15 is an example of use of existing technology to monitor Veldfire behavior on their private land.



Figure 4.15: The Fire Detection Camera
Source: The Integrated Fire Management handbook (2006)

Additionally, another member of the Fire protection Association explained from his personal experience on the effectiveness of the camera on Veldfire detection. He pointed out that:

"Firehawk detection camera is an effective Veldfire management tool. The camera is so powerful that it can scan full 360 degrees in under four minutes. It is without a doubt a breakthrough in the management of Veldfires" (Pers.com, 2020 GG).

A review of the Integrated Fire Management Handbook (2016) in relation to the Fire Danger Rating, it is revealed that the Fire Protection Associations and Chief Fire Officers communicate the FDR to local weather offices at District Disaster Management Centres who then communicate to community and Disaster Management Advisory Forum Members on the actual and forecast FDI on daily basis through text messages. Radios and television are mostly used to warn communities of eminent fire danger. Furthermore, documents revealed that FPAs are charged with the responsibility to update FDI information to their members. Table 4.5, for example shows the FDI Table with coded colours.

Table 4.5: The Fire Danger Rating Table

FDI Description	Colour	Category	Lowveld FDI Precaution
SAFE	BLUE	0 – 20	Low fire hazard. Controlled burn operations can normally be executed with a reasonable degree of safety.
MODERATE	GREEN	21 – 45	Although controlled burning operations can be executed without creating a fire hazard, care must be taken when burning on exposed, dry slopes. Keep constant watch for unexpected wind speed and direction changes.
DANGEROUS	YELLOW	46 – 60	Controlled burning not recommended when fire danger index exceeds 45. Aircraft should be called in at early stages of a fire.
VERY DANGEROUS	ORANGE	61 – 75	No controlled burning of any nature should take place. Careful note should be taken of any sign of smoke anywhere, especially on the upwind side of any plantation. Any fire should be attacked with maximum force at hand, including all aircraft at the time.
EXTREMELY DANGEROUS	RED	75<	All personnel and equipment should be removed from the field. Fire teams, labour and equipment placed on full standby. At first sign of smoke, every possible measure should be taken to bring the fire under control in the shortest possible time. All available aircraft should be called for without delay.

Source: The Integrated Fire Management handbook (2006)

Table 4.5 shows the Fire Danger Rating (FDR) table. The FDR table is divided into five categories. The categories provide an overview of the prevention and preparedness required in each category. In this way it is believed to leverage the implementation of the Integrated Fire Management (IFM) strategy and give impetus to efforts to respond to Veldfires at the inception point.

Furthermore, review of CSIR (2010) report shows that Early Warning Systems uses atmospheric generated indicator information technologies which rely on the remote sensed data. The data information is disseminated to strategic points in the country for further handling. The report further shows that this warning information is meant to end up with the users who in this case are landowners. What is known in the research sites is that this information is not reaching out to the community leaders. The participants who is a member of Working on Fire shared information on how AFIS information is disseminated to landowners. His response was as follows: -.

> *"It is unfortunate that the Fire Danger Index Rating (FDI) is not communicated to all who need it in the province. Community leaders and traditional leaders alike are unfortunately not privileged to receive this information to their detriment. Their high degree of exposure to Veldfires could easily lead incidences of Veldfire into full scale disasters as they are often caught off guard, without the necessary capacity to protect themselves. Access to this information may prove to be the difference between life and death. Besides, information is power." (Pers.com, 2020HH).*

CHAPTER FIVE

ANALYSIS AND DISCUSSION

5.1 INTRODUCTION

The purpose of this chapter is to interpret the findings in respect of the research objectives. Furthermore, the implications of the findings and limitations will also be discussed. This chapter is structured and broadly divided into five sections. The first subsection provides the analysis of Veldfire management in Mopani and Capricorn districts in the Limpopo province. The sections look at the institutional arrangements for Veldfire management, the collaborations issues, existing gaps and alignment in the legislative and policy framework. Subsection two of the study examined the demographic factors of the respondents considering the required capabilities on critical areas of Veldfire management namely the response mechanism, resources allocation, and governance within the Fire Protection Association. Subsection three is about the response mechanisms. The section scrutinizes coordination of stakeholders in the districts. The analyses in this section, unravels how coordination impacts on governance within the Veldfire management spaces of the two research sites. The fourth subsection scrutinizes the use of Veldfire early detection systems in the land under both Traditional Leaders, Communal Property Association (CPA), state and private ownership. It further brings out the possible benefits for accessing the Fire Danger Rating in the management of Veldfires. The last subsection provides a view on the implications of the overall findings in the management of Veldfires in South Africa as a whole and sub-Saharan Africa.

5.2 THE VELDFIRES DISPENSATION IN MOPANI AND CAPRICORN DISTRICTS

In this study, the first objective investigated was the existing dispensation on Veldfire management in the districts of the Limpopo province, Mopani and Capricorn. The empirical findings presented in chapter four (See Table 4.2) have shown that wide range of policy, legislative and regulatory frameworks exist to enable government to manage Veldfires, and the environment at National, Provincial and Local sphere. Kidd (2008) argues that policy and legislative framework are enablers for fire management. The unfortunate part is that the municipal environment is perceived as overregulated

environment. He further argues that municipalities experience administrative burden emanating from unfunded mandate that overwhelm their existing capacity. Schoeman (2010) argues that land use decision making processes are based on fragmented legislations which often is the cause for conflicts. The lack of coherence between national land management policies and the legislations is to blame for the impact this has on environmental management. When organizations operate without policies and legislative frameworks is a problem. It is even more so when they operate in an environment where policies speak to one direction and legislations to the other.

The South African Local Government Association (SALGA) (1998) report shows that management of Veldfires requires laws and impartial regulations that are constantly enforced, monitored and their impact evaluated. The report propose that regulations should ensure that those who cause fire face penalties. Furthermore, the SALGA holds a strong view that this impasse should be averted from plaguing government's intention for providing sustainable quality services.

According to Kruger et al., (2006), Veldfires in South Africa causes substantial, and severe losses to life, property, and the environment in most areas of the country. They opine that Veldfire management policies and legislative frameworks should be applied consistently. Jurveluis at al., (2010) argue that the risk, frequency, intensity, and impact from Wildfire can be reduced through more holistic, approaches to fire management anchored on sound policies, legal, regulatory frameworks, and law enforcement. Regulations and laws must consider the local living situations and conditions for them to be implemented (Heikkila et al., 2010). It can be argued that inconsistent application of Veldfire management laws point at the need for government to review each one of them. From the field evidence, it came out strongly that the issue of stakeholder non-compliance with policies and legislations will continue to be an indicator on how emergency services agencies are managed in the districts of the Limpopo province.

A scenario that best explains a similar situation is observed by Menya and Kumu (2016) in Kenya, in which they argue that the Kenya National Disaster Centre finds it very difficult to coordinate fire management stakeholders and even more difficult to obtain help from the organized business and donors because Government has no legislations for fire disaster management. Dube (2016) observes that although Veldfire management policies, legislative and regulatory framework in Mangwe District of Matebeleland in Zimbabwe, are in place, a lot is still having to be done on the implementation of

such regulations. He further purports that a closely monitored policy implementation and the right amount of attitude are equally important to avert the high number of human activities causing Veldfires.

A crucial responsibility of government and government institutions is to ensure that resources are in place to implement policies. To do this, government institutions require organizational structures and suitably qualified people who must be supported to deliver the services (Whitaker, 1980). Lack of resources continue undermine good intentions of government to deliver services. The coordination of interagency emergency stakeholder and collaboration with peer institutions require substantial financial support. Failure by government to provide resources renders the country unprepared to effect meaningful response to Veldfires.

The in-depth interviews revealed that the responsibility in the management of Veldfires resides with the landowner. Further review of document revealed that land in South Africa belongs to government, municipalities, State-Owned Entities, private individuals, and communities. However, most of such land is not properly maintained and managed in line with the Chapter four of the NVFFA. Looking at the issue of land ownership, which is intertwined with the responsibility to manage Veldfires, it came out strongly from the field evidence that there is a sense of lack of accountability among private and government entities owning vast pieces of land. Ganz and Moore (2002) argue that lack of accountability in Veldfire management reflects underlying institutional weakness, poor community capacity, and lack of incentives and years of suffering alienation from land management.

Dube and Mafoko (2009) are of the view that causing fire in Botswana is a criminal act punishable by law. People are caught and charged for causing fires in Botswana. In recent years, there has been less attention placed on investigating the causes of fire due to dwindling sponsorships from both the Botswana government and other donor countries. We can argue that for sustainable management of Veldfire, we need to ensure that the Integrated Fire Management Strategy and Disaster Management Risk Reduction programme on Veldfires management are adequately resourced, and further that conditions for donor countries to supporting government fire management programme should be reviewed to promote involvement of donor countries at a bigger scheme of things on Veldfire management in the districts of government of the Republic of South Africa.

The NVFFA provides for the Fire Protection Officer enforce the law, thereby issuing fines in line with chapter 4 and chapter 7 of the act. The FPO is expected to carry regular inspections to effect control. There are however no finding provisions which are made to fulfil this important role. Neither DALRRD nor Fire Brigade Services sets aside budget allocations for this role, it is viewed generally as unfunded mandate. The implication here is that the role of the FPO is important as articulated in the policy but less important when it comes to budget allocations.

The Botswana Office of Auditor General (2008) report reveals that the lack of resources and statutory instrument to compel landowners to comply, add to a host of impediments on Veldfire management. Funds which were put aside for creating fire breaks were depleted by the use machinery instead of public. The situation has led to increasing damages to property and livelihood when fire breaks out. We can argue that existing laws, policies, and regulations are arguably very difficult to implement in under the prevailing situation where government are financially constrained, human resource skills are inadequate, poor stakeholder commitment, and dysfunctional Disaster Management Advisory Forums and Umbrella Fire protection Associations.

The issues of collaboration failure are demonstrated by the Integrated Fire Management Handbook (IFMH) (2016) report which reveals that in line with Section 6(1) of the NVFFA, Fire Protection Associations should work in collaborations with the appointed Fire Protection Offices. In a situation where a municipality is a member of the FPA, the Chief Fire Officer of that local municipality or any delegated person may be appointed as the Fire Protection Officer (FPO) to perform roles espoused by Section 6(1). The field evidence show that respondents believe that often the FPA manager does exactly what that FPO is doing, resulting in tensions between the FPO and the FPA chairperson. Review of IFMH reveals that ideal governance provisions requires that the Fire Protection Managers report their daily activities to the FPA Chairperson, similarly those reports be shared with the Chief Fire Officer. This arrangement is believed to be a source of tension and should be revisited. This is even though Kruger et al., (2013) argues that the Eastern Cape Province has the most successfully run FPAs in the country.

Atkinson et al., (2000) observe that in Brazil, power relations between authorities within the same sphere of government requires constant monitoring and balance. While Brazil faces numerous calls for Veldfire emergency response, there has been successes much as there had been failure. The situation in South Africa is such that power relations at local level of government impact on the policy implementation, exacerbating transparency, accountability and (Erasmus and Gibson, 2008). We can argue that power in this research is understood as a means through which control is attained to drive Integrated Fire Management Strategy in the districts. Unfortunately, when you lack resources, you display weakness to manage power. This is a challenge Disaster Management Centres must put up with. It can be argued that government is responsible for weakening some of these important emergency services institutions, this tendency if not addressed, has great potential to hinder response readiness of the districts of Limpopo.

It is also important to note that the Policy Framework for Disaster Risk Management in South Africa reveals serious structural defects in the policy to leverage response to Veldfires. Looking at the Key Performance Area (KPA) 4, the mere fact that it is called Response and Recovery, seems to suggest the fusion of two different processes. Although in practice, one dominates the other, in this case recovery dominate response. The Response and Recovery are two critical elements for disaster management which are worlds apart. For example, response defines spaces in which fire management agencies occupy to act within a moment of time to fight fires to reduce social, economic, and environmental impacts. Recovery is the process of salvaging what was left after the fire incident. It is mostly defined by the two processes which are reconstruction and rehabilitation to properly manage disasters, we can argue that it is important that response and recovery be treated as uniquely different and separated from each other. From the field evidence, participants of the study argue that government is unable to set aside separate resources for response and for recovery, and often because it is not known when and how many times response will be needed. They instead put resources mainly to cater for disaster recovery standardized by treasury regulations. From a distance, it is evident that government values recovery more than response. The high cost of response equipment is making the situation in municipalities worse. Donovan and Rideout (2003) argue that constraints on responding resources are more numerous and complex to capture the multitude of tasks performed in the process. They are of the opinion that production rate of the response equipment and their high costs become a function of their accessibility and their effective use. Additionally, Holmes and Kalkin (2003) argue that the

shortage of fire teams or hand crews is exacerbated by lack of aerial resources needed to access terrain that are difficult to reach. We can argue therefore that, for government to effectively operationalize response, a bold move to separate response from recovery be contemplated. This is to ensure that we reduce the current skewed allocation of resources, which continues to undermine Veldfire response efforts.

From the field evidence presented in Chapter 4, it was made clear that there are serious issues of local fire resource management experienced by traditional leaders who are not covered by the legislative and regulatory framework. The participants argue that existence of legislative gaps create tensions between the government and traditional leaders. For example, the Modjadji clan, under Mopani District jurisdiction, believes that 'if it does not burn, it does not rain'. What this means, is that fires are started for purposes of inducing the rain. This rich cultural heritage of the Modjadji clan is seen as an age-old tradition which should be regulated. We can argue that through African traditions have always been looked down upon. It is necessary that these traditions be subjected to scrutiny for purposes of their recognition.

Mbow et al., (2000) in Burkina Faso and Senegal fires are used for multiple purposes for example land and resource management initiatives, including livestock production, arable crop production, forestry, and hunting. They further point that while this is clearly reflected in the observed fire regimes of the region, it is still not provided in the legislations creating difficulties for enforcement if the cultural practices encroach on these laws. Nielsen et al; Mbow et al (2003) opine that fires are used at sacred sites to propitiate the ancestors and thereby securing the future fecundity of the land to its people. They further argue that in these ancient African traditions, fire use is extremely variable. The challenge however is those legislations do not provide for these ancient traditions. We can argue that legislative gaps should be addressed to not only recognize, but also to integrate indigenous knowledge on Veldfire management. We can argue that the move to integrate indigenous knowledge into Veldfire management should ensure that these practices are recognized, and their existence find expression into laws, polices and regulations.

The results as presented in Table 4.3, also shows that 82% of respondents who indicated that Veldfire management policies are not aligned in the research site. This is compared to 18% of the respondents,

who indicated that Veldfire policies are aligned. Ansell and Torfing (2015) are of the opinion that alignment of policies reduces chances for silos operations between governments and agencies. Baker (2004) and Looney (2011) also stress that misalignment of policy goals and processes lead to a serious problem of inefficiencies and poor outcomes. We can therefore argue that disasters require capacity from joint planning. This enhances the confidence to the communities as they believe that in working together there is strength. We can argue that without alignment of government plans the communities will always be uncertain about the competence of government to protect them against Veldfire disasters. The condescending view by Hill, and Spillane (2016) and Cohen-Vogel (2005) state that misalignment is a serious problem however the solution is not simply alignment. There is more to misalignment than simply turn it inside out. The issues of poor stakeholder participation may not necessarily be associated with misalignment, these issues often play-out due to other factors, such as leadership problem, lack of relevance and approaches that are not people centered.

5.3 COLLABORATIONS AMONG STAKEHOLDERS

One of the important finding from the respondents in the research site was that collaboration among stakeholders is impacting on the preparedness to respond to Veldfire in the district. The results, as presented in Table 4.4 in chapter 4, also shows that 67% of the respondents indicated that institution as identified in the management of Veldfire do not work together. This in comparison with the 28% of respondents, who indicated that institutions work together. This scenario is also observed by Twigg (2004) who argue that Veldfire response enquires collaboration between disaster management structures at all levels of governance including the national, provincial and local levels to plan and respond together. Supporting this argument, Jurveluis et al., (2010) argue that Veldfire management requires joint efforts. They should be viewed as a hazard which no single organization can address single-handedly, but with concerted effort and organized collective responsibility. Additionally, from Spain, Velez and Munoz (2005) argue that joint projects and formal agreements between governmental and non-governmental institutions are essential to enable nations to develop sustainable fire management capabilities.

FAO (2004) report reveals that countries have improved their response to forest fire through co-operations which strengthened confidence for building successful response experience. This approach

was adopted in Europe, for example, the Balkan region by the Euro-Atlantic Disaster Response Coordination Centre (EADRCC) in 2002, and EASTEX FIRE by the UN-ISDR Regional Southeast Europe/Caucasus Wildland Fire Network in 2005. The other co-operation example was in Europe (OSCE)/UNEP/GFMC in 2006. We can argue that cooperation is key in the management of Veldfires and is significant contributory factor to joint ventures and integration of resources and membership costs involved. Through joint ventures, institutions maximize their impact on service delivery. We can postulate that government should promote formal working agreements among Veldfire stakeholders to ensure clear confines within which relations are fostered.

From the field-based finding, Figure 4.1 in chapter 4 presents factors identified to contribute to institutions not working together in the implementation and monitoring of Veldfire policies and regulatory framework in the study site. The result presented in Figure 4.1 showed that 74% of respondents indicated that lack of trust is one of the contributing factors to institutions not to work together in the study sites. Olivier (2009) argues that trust among interacting parties is the foundation of building strong and long-lasting relationship among people and organisations. Therefore, organizations can reap rewards from strengthening it. Williams (2007) argues that lack of trust comes when institutions feel that their agenda are different from others, and that others are not honest about theirs. This lack of trust is often extreme, whereby institutions end up fearing each other and subsequently not prepared to reveal themselves to others.

Foorhuis and Bos (2011) argue that compliance with the rules, procedures, conventions, standards, guidelines, principles, legislation or other norms not only ensure collaborations but had saved so many lives in the fire sector. Meyers (2003) also argues that land use management requires that landowners do completion of the protection boundary to promote safely of others. Compliance ensures that there is sustainable land use. We can postulate that laws, policies and regulations are not there just to occupy space, they should be followed. We can argue that strong new ways to build working relations be devised to ensure innovations in institutional collaborations.

The results in Figure 4. 1 also showed that 78% of the respondents indicated that poor communication contributes to institutions in the study site not to work together. The issue of communication in this study came out strongly as a theme that is fundamental to many if not most government operations. Communication in this study presents an opportunity for dialogue and appreciation of diverse views

among institutions. Through communication, institutions maximize their efficiency, for example through sharing of information. Manner (2007) argues that lack of communication with other institutions, media and surrounding communities had often failed disaster management plans, evacuation plans and response missions. Russel-Smith et al (2007) also stress that an open communication model, like Crew Resource Management (CRM) improves coordination between the Firefighting Teams to reduce incidence of human error.

In support of these findings, previous studies conducted by Badwell et al., (2014); Meade (2010); Meehan (2013); Thamas et al., (2013) present evidence that shows that effective communication has a range of considerable benefits, these for example include high quality of service, greater levels of engagement and trust and reduces tensions and unrest. In view of these existing knowledge and the current findings, we can postulate therefore that it is important to consider communication as a primary or co-requisite for Veldfire management. Further that communication ensures that information is shared, and projects and programs are worked on in collaborative ways.

5.4 RESPONSE MECHANISM

According to Drabeck (1991), one of the best ways to effectively coordinate fire response agencies, is to employ elaborate response mechanism. The example of good response mechanism is displayed in the scenario by Kruger (2005), who argues that the Naval Fire Department at SAS Saldanha, responded to the Veldfire that was advancing toward the South African National Defense Force (SANDF) installation at Langefontein. The officer in charge made reconnaissance immediately and dispatched a SA MAG 4x4 fire tanker from the base, more units responded at the same time to join forces. Figure 4.8 for example, suggest that 62% of the respondents identified Fire Emergency Response Action Plan (FERAP) as one of the elements of Veldfire response mechanisms that ensures effective response in the districts.

The response mechanism theme came out strongly suggesting its significant contribution to Veldfire response readiness. The indications are that Fire Emergency Response Action Plan (FERAP) determines the kind of response mechanisms required by the Incident Command Management (ICM) and how resources and manpower are deployed in any given Veldfire outbreak situation. Ball (2001) observes that a critical stage in Veldfire response phase is the activation of proper response action plan.

He further argues that the way in which response is mechanized on the ground, potentially determines the outcome of a given Veldfire response mission. Cote (1997) argues that the first few minutes of response mission determines success and failure thereof. It provides an idea on the degree of the severity of the impact.

From both the existing knowledge and the field-based evidence, we can argue that meaningful level of awareness on the existence of the response action plan by most if not all response agencies, enhances integration of Veldfire response mission. Often without the Fire Emergency Response Action Plan (FERAP), the emergency scene becomes chaotic, and resources poorly administered to the detriment of the collective effort. The use of common communication radio frequency ensures that everyone particularly Aerial Attack Team (AAT) and Ground Operations Teams (GOT) are coherently coordinated. The field evidence suggests that different emergency response agencies use unique radio frequency preventing them from carrying a successful joint response operation due to poor communication.

There is strong evidence from the filed observations which indicate that human factor is one of the major contributors to Veldfire response mission failure. It was observed that emergency response agencies, still afford to arrive late at the fire emergency scene. According to Zielinski and Madziala (2019) organizational operation standards are crucial to carry out an effective Veldfire rescue operation. It can be argued that the human factor and the call for adherence to operation standards for Veldfire response need to be monitored and evaluated on a constant basis, in order to achieve well-coordinated and integrated response operations.

The acute lack of resources in the fire management sector undermines all efforts to implement Integrated Fire Response Plan. Notwithstanding the visible reality on the resource constraints facing the sector, government insists on the effective implementation of response policies. These contradictions are far reaching in the fire management sector, they tend to de-professionalize the fire service and demoralize the firefighters.

The result presented in Figure 4.2 shows that 67% of respondents believe that reporting procedures are adding to the challenges for Veldfire management. Communication is very important in ensuring that information reaches the intended recipients. How it does that is even more so important. The people impacted upon by Veldfires, need information on how Veldfire scene is being attended to, and how

much of it is under control. Ball (2001) argues that the way how Veldfire information is communicated determines the procedure. There are pre and post reporting procedures used in the emergency. Both stages of the procedure are responsible for informing the right responses from agencies. The pre-incident reporting procedure if done haphazardly, could be treated as a prank and may results in huge loses. The post incident reporting is important in that it creates an environment for information sharing particularly with people that are exposed to the hazard. Insurance policy value how information procedure is carried, and responded to, for them to process policy claims for compensation from Veldfire damages.

The CSIR (2004) reports revealed that reporting procedures are an important assert to a successful organization. They reside with the Communication Strategy unit lead by Communications Manager who is also designated to talk to the media during a Veldfire incidences. The Incident Commander ensure that all the details are communicated regularly to the designated spokesperson to enable him or her to deal effectively with the media. Similarly, information about smaller Veldfires, are dealt with by the Incident Commander himself, who in this case acts as the designated alternative spokesperson to deal with the media on few things which include:

a) Direction of the Veldfire (where it is headed)
b) Deterring the threat to people and property and
c) Veldfire under control or dangerously out of control
d) How many people are fighting the Veldfire?
e) What equipment is being used and
f) Are reinforcements required?
g) What roads should be avoided?

We can argue that Veldfires often occur distance away from human habitations. Sometimes it occurs for hours unnoticed. Grant (1999) argues that ground-based methods of monitoring smoke can assist in detection of fires. If spotted early, and fought with the necessary resources and skills, greater chances of success exist. From the field-based evidence, it was observed that 78% of the respondents in Mopani and Capricorn indicated that skilled and trained personnel in Veldfire management are pillars for critical component for effective Veldfire response. Zielinski and Madziala (2019) argue that rescue

operations are technical and should be carried by skilled and qualified personnel with professional training obtained as part of complementary in-service training. Bond et al (1996) argue that since the compositions and structure of forest changes overtime, and weather conditions have produced, dry lightning and high winds which present conditions that increase the likelihood of catastrophic fires, It would be naïve to think less about the skill training required of fire fighters. He further argues that technical skills required for Veldfire preparedness must include the following:-

a) Designation of a location for meeting and directing manpower and equipment.
b) Provides directions for the actions of the emergency response units.
c) Assessing safe performance of the emergency response operations.
d) Reports to the Control Centre on the progress of the response and emergency rescue operations.

Polet and Omi (1999) argue that United States Federal Emergency Management Agency (FEMA) issued revised qualification systems for firefighting and prescribed fire positions to ensure that the U.S. continues to field the finest firefighters and prescribed fire force in the world. Furthermore, Volunteers who support Firfighters are subjected to Volunteer Fire Assistance Training Program (VFATP) which include proper use of equipment to meet Federal interagency standards. The South African situation is presented by Forsyth and van Wilgen (2008) who argue that Veldfire disasters which took place in September 2001, at the Kruger National Park destroyed animals, and property. The impact assessment of the damage revealed that firefighters were poorly skilled to manage huge fires. Trollope et al., (1999) argue that while training in fire management has become complex challenge, the Emergency Services, NGOs and local communities be subjected to basic firefighting skills training to prepare them to reduce the severity of Veldfires impact. They further argue that communities should also be part of the regular simulation drills conducted in their villages by the local fire stations.

The result as presented in Figure 4.2 shows that 72% of the respondents indicated that adequately equipped fire service, delivers well-coordinated Veldfire response. This view is supported by significant number of respondents in Mopani and Capricorn districts. Given this overwhelming position, there exist no doubt that lack of firefighting equipment has a far-reaching implication towards maintaining high professional standards for performance. FAO (2006) report reveals that fire equipment are by default located in urban municipal, capital or bigger cities causing people in rural

areas to use tree branches, palm leaves etc. to fight fires. The report also points that these are barefooted people, without any protection against radiant heat, smoke inhalation and flames, who have no means for combating fires, unless equipped with tools, clothing and water to contain the fire. Well-made rake-hoes, fire swatters and backpack sprayers should be supplied to these communities who are at the coal face of Veldfire occurrence. Nowell and Steelman et al. (2014) argue that most developing countries have had serious lack of Veldfire fighting equipment. Similar findings are made by Stocks and Flannigan (2009) who reveal that the rising costs of equipment used to respond to Wildfire presents an unprecedented challenge on how governments contain and prevent the possible damage from Wildfires.

Payne (1996) observes that very few Fire services can afford or justify owning all fire equipment, nor be able to organize all the resources that are required to combat generally large fires. We can postulate that government should partner with willing private organizations to reduce waste of huge money spent on purchasing equipment that are complicate and expensive to maintain. The re-thinking on this new approach can change the course of Veldfire management in Limpopo.

From the empirical findings of this study, Figure 4.2 also shows that 90% of the respondents believe that funding is the backbone of the existence of Veldfire management. Lack of funding causes systems to stop running, and in the end failing to deliver services. Huang et al. (2009) and Goldammer (2010) argue that lack of financial support undermines sustainability of important specialized response agencies. Van Zyl (2011) argues that maladministration is depleting the much-needed resources from government which are meant to provide services that could change people's lives slowly but definitely.

The field evidence revealed that 80% of respondents were of the view that Disaster Management Centres are not functional. This finding was in comparison with 22% of respondent, who indicated that Disaster Management Centres have some fair level of competency and capabilities to coordinate their stakeholders. Visser and van Niekerk (2009) observe that most if not all Disaster Management Centers are not fully functional. Functionality of Disaster Centres in this research came out strongly pointing at institutional failure to fulfil the legislative mandate. It can be argued that inadequate allocation of resources is strangling the mandate for emergency survives management. Subsequently there is an expectation for the districts to continue to be unprepared to deal with Veldfire effective response. The coordination role played by the Umbrella Fire Protection Association (UFPA) is equally faced with

unlimited challenges such as to lead a competent Provincial Fire Advisory Forum (PFAF) and their participation in the District Disaster Advisory Forums Technical Task Teams. Botha et al. (2011) and van Riet and Diedericks (2010) argue that the coordination authority of emergency agencies both at district and provincial level are not functional, not only in Limpopo, but in some parts of the country too. Van Niekerk (2014) argues that the implementation of the Disaster Management Act (DMA) and the National Disaster Management Framework (NDMF) is hindered by the lack of a strong institutional capacity.

Results as presented in Figure 4.2, show that 92% of respondents identified power relations as a critical factor of response mechanisms. Power relations is viewed as a universal set in which critical elements such as cooperation, coordination, and stakeholders authority are at play to influence direction in the implementation of the Integrated Fire Management Strategy (IFMS). Power relations influence the way in which stakeholders relate to one another. For instance, between Fire Brigade Service and Fire Protection Association, and between Disaster Management at District and at Local level also between Disaster Advisory Forum and Joint Operation Council (JOC). All these platforms carry some degree of power in the management of emergency services. Cornwall (2002) observes that balancing power relations is difficult but essential for institutional co-existence. Additionally, Moose (2001) argues that government policymakers, officials, program implementers use powers through community participation platforms to push their external agendas that influence thinking into a particular direction. We can argue that positions come with powers. It is one thing to have power, and another to know how and when to use it. This is an important balancing act facing Veldfire institutions. In their big to manage Veldfire effectively, they should find ways to operate with congruent powers so that they continue to complement one another than compete for against one another.

5.5 EARLY WARNING INFORMATION

From the field base evidence, traditional leaders stressed that they have no access to South African Weather Service (SAWS) early warning information. They believe that early warning ensures that people are informed about the impending danger beforehand to prepare themselves. De Ronde (1998) argues that early warning plays an important role in disaster management. They fulfil an important task of saving lives that otherwise lost. Du Plessis (2004) argues that SAWS disseminates weather

information to communities at risk from damaging weather events posed by hazards such as heavy rain, heat waves, cold weather and Veldfires. UNISDR (2010) recommend that for communities to mitigate disasters, they must have equipment in their disposal and receive early warning information regularly to minimise the severity of the impact of the risk. We can argue that early warning information conscientizes communities to the notion of living with risk and that they could raise their capacity against the possible impact, or else face the uncertain eventuality.

Seng & Stanley (2012) argue that the four key elements that make early warning successful are (i) risk identification, (ii) monitoring and warning system, (iii) warning dissemination, and (iv) response actions. Expanding this argument, Taruvinga et al., (2013) state that while majority of the people in the rural areas rely on the cellphones to receive early warning information, they still do not access fire danger data from the Advanced Fire Information System (AFIS). They remain unable to monitor and detect Veldfire activities in their respective areas. This technology is mostly available to commercial farm owners, their Fire Protection Associations and Working on Fire teams, but cannot be accessed by the poor rural communities (Teie, 2003).

5.6 IMPLICATIONS

Veldfire incidences which have led to disasters have occurred and continue to do so with devastating effects in and around the world. The 2019 Australia Veldfire which took place for more than a month, the 2018 Woolsey fire in California which destroyed 98 000 acres of land, the 2019 Brazil Amazon fires and the 2017 Western Cape, Knysna, Sedgefield and Plattenberg Bay Fires which destroyed more than 500 hectares of forest plantations are just few examples which provide not only the record for the extent of the Veldfire risk magnitude facing the world today, but also a glimpse of what to expected to happen in the future.

The districts of Limpopo province in South Africa have experienced their fair share of impact from raising temperatures which exposes lives, properties and environment at risk, particularly during summer seasons. The widely shared perceptions are that Veldfires are in part caused by climate change, and largely by human encroachment. The districts in Limpopo province of the Republic of South Africa are exposed to high Veldfire risks leaving government without any choice but to find ways to the authorities at both district and provincial level, should tackle risks associated with Veldfires. The

one way of doing this, is that the district authorities should ensure among others, that Veldfire risk is constantly profiled and monitored. It should also be integrated development planning to leverage sustainable development and capacity building.

The notion that Veldfire can be prevented is losing meaning both in academic debate platforms and in real life situation. It is gradually replaced with the living with risks notion. The calls for an undivided attention of the three spheres of government National, Provincial and Local on Veldfire management is gaining momentum. This put local authorities at the edge to activate programs and projects that are aimed at improving community resilience against Veldfires. Veldfire causes incredible pollution and destruction of fauna and flora. Smoke pollution from major fires knows no boundaries. The fires that start in Zimbabwe, Botswana or in South Africa cross the borders with virtually nothing to stop it. The implications are that there is a need for South Africa together with its neighbouring countries to strengthen collaborations through agreements that will ensure mobilization of resources and broadening communication essential for tackling cross boarder fire emergencies. Establishment of cross border agreements go a long way into bolstering preparedness for countries to jointly respond to Veldfire outbreaks to reduce the scale of impact.

CHAPTER SIX

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

6.1 INTRODUCTION

The chapter presents summary of the key findings, at the same time discusses the meaning of these findings. In the conclusion, aspects on how much the study has managed to satisfy the study's research aim and objectives which were outlined in Chapter one is discussed. Recommendations are later suggested to government and various stakeholders involved in Veldfire management to improve preparedness to respond by all agencies in the Districts of the Limpopo province.

The chapter is divided into five subsections. The first subsection, presents the summary of critical findings by providing answers to various research questions, aims and objectives of the study. The subsection offers some recommendations based on the research findings to Veldfire management agencies. The study suggests ways by which Veldfire can be effectively managed within the Mopani and Capricorn districts. The third subsection presents the study limitations which were unforeseen and impacted on the results of the study. The fourth section details the recommended study areas, and lastly, the conclusion which deals with summary on how the study achieved the objectives.

6.2 KEY RESEARCH FINDINGS SUMMARY

The preparedness to respond to Veldfires was explored in this study through examination of the existence of institutional and policy frameworks existing within the Mopani and Capricorn districts of the Limpopo province. The study further explored the collaboration and relationships among the Veldfire stakeholders, the extent to which the coordination bodies exercise their powers and functions and lastly the use of early warning systems to reduce the impact of Veldfires.

The research found that all the three spheres of government (national, provincial and local) have been assigned clear mandates for management of Veldfires. It was also observed from the field evidence that land management rests primarily with landowners. Furthermore, five institutions identified by the participants (COGHSTA, DALRRD, DEFF, DWA and Fire Brigade Services) oversee Veldfire management. Their roles and functions were examined in chapter four of the study. Notwithstanding

all the institutional arrangements in place, the results from this study show that the agencies have challenges in discharging their duties, as such this explains the reasons for poor institutional frameworks which pointed at strong existence of the structural gaps and policy alignment challenges impacting negatively on the execution of their roles and functions.

The most apparent finding that emerged from this study is that there is a mix of different types of legislations, regulations, and policies on Veldfire management in the districts. However, it was further observed that the main weakness is poor enforcement of the policies and regulations that resulted in failure to execute the institutional responsibilities.

The most noticeable finding for example, was the problematic use of Response and Recovery as one Key Performance Area (KPA) in the management of Veldfires within the Mopani and Capricorn district. It was observed that these two concepts Response and Recovery are distinct and critical major components in the management of Veldfires but presents serious resource allocation challenges in the management of Veldfires in Limpopo. If treated as one KPA, one tends to overshadow the other, and in this study for example, it is observed that more resources are easily allocated to recovery, reconstruction, and rehabilitation and very less on response.

The study further identified main barriers impacting on the Veldfire management. They were classified based on the field evidence collected from participants in Mopani and Capricorn district into two significant headings namely collaborations and coordination challenges. The participants are of the view that poor coordination and lack of collaborations between Veldfire response agencies disrupt the legislative order prescribed in the management of Veldfires.

The investigation on the functionality of the Disaster Management Centres shows that both Mopani and Capricorn district municipalities barely perform their powers and functions due to lack executive authority (HoDMC not council appointees) and yet perform such a critical role and functions which have the gravity to impact socially, economically, and environmentally.

The investigation on the functionality of Fire Protection Association shows that it is the legislative requirement which makes it optional for landowners to form and belong to an association. This is believed to be the weakest link in the policy regulations. The field evidence also shows that it is the basis for which the Umbrella Fire Protection Association (UFPA) is failing in its duties to coordinate FPAs at provincial level.

The study also found that Working on Fire‘s Advanced Aerial Firefighting Service is costly and highly commercialized. This service is viewed as the ultimate in Veldfire fighting and yet not accessible to all landowners, but only to the affluent. This is viewed as a thorny issue in the management of Veldfires in the districts of Limpopo province.

The research further examined and analyzed some of the traditional and cultural practices impacting on Veldfire management in Mopani and Capricorn district. Quite a distinct finding was that there are cultures which promote the burning to induce the rain (“If it does not burn, it does not rain”). However, it was found that there is lack of regulations and policies at district level to deal with this age-old fir practice tradition. Furthermore, the field-based evidence revealed that this old-age tradition contributes to Veldfire management challenges that undermine the effort on the efficient use of Veldfire fighting scares resources.

The investigation on the Veldfire Early Warning Systems shows that communities are still not able to receive SAWS information that serves to forewarn them on the likely chances of Veldfire occurrence. Neither are they provided with the Fire Danger Index readings. This is shown in Chapter four, that when communities do not have early warning information, communal land becomes more vulnerable, considering that communities are first responders, but have low or no capacity to respond to Veldfires.

Furthermore, the study revealed that commercial landowners have strategically placed Fire Detection Cameras which use sensors to detect any fire in their land. It is observed that the use of early detection technology ensures proper monitoring of Veldfire occurrence by the Fire Protection Association teams and compliance by the Fire Protection Officer.

The study has identified through review of literature that community involvement is a winning approach in the management of Veldfires. The study also revealed that Working on Fire create awareness and educate the general public and other stakeholders dealing with the Veldfire management, although the campaigns are considered inadequate but do capacitate communities on how to reduce the impact of Veldfire in their areas. For example, it was illustrated in chapter 3 that in 2018 and 2019 both Mopani and Capricorn districts had experienced increasing total area burned per hectares, which according to the field evidence, is to some extend associated with lack of Veldfire education and awareness programs.

The interesting finding is that 79% of fire sector workforce comprises males. This finding is disproportionate to the fact that women constitute majority of the population of the Limpopo province. It is also believed that in the event of Veldfire outbreaks, women were the most affected. It is argued that women should encouraged to form part of the fire sector to contribute knowledge and experience which can shape Veldfire management approached in the districts of Limpopo province.

Furthermore, the study found that the 82% of the participants working in the fire sector are blacks against 18% white. The irony is that there exists a widely shared view which portrays that ownership of farmland in Limpopo is dominated by white. The startling finding from the field evidence also shows that most participants have good level of education with the necessary experience for firefighting. However, as observed, 68% of participants are middle aged. This finding raises discomforting augment among others that physical fitness challenge posed by the ageing workforce could be a concern for effective response to Veldfires.

Having presented summary of the findings and research objectives achieved. It can, therefore, be concluded that Veldfire legislative frameworks needed to be reviewed to address inherent gaps and alignment challenges faced by the institutions in the fire sector. Furthermore, lack of government support continues to undermine the much-needed coordination and collaborations effort by the District Disaster Centres in the Limpopo province.

6.3 RECOMMENDATIONS

From the findings and the analysis thereof, one can deduce that Veldfire management in Mopani and Capricorn district is a serious challenge, in that the two districts are home to millions of hectors of land used by landowners for fresh produce and livestock farming. Reducing the impact of Veldfire in these districts would ensure economic, social and environmental sustainability. The study, therefore, recommends the following:

(a) The Mopani and Capricorn district in the Limpopo province are faced with institutional weakness in the management of Veldfires. Notwithstanding all the legislative, policy and regulatory framework in place, there is conspicuous need for government to provide resources and the much-needed skills to give impetus to effective Veldfire management in the districts of Limpopo province.

(b) Government should strengthen monitoring of emergency policies. Equally important is the need for enforcement of Veldfire legislations.

(c) The Response and Recovery KPA should be split into two new KPAs to leverage allocation of resources within the fire sector in respect of Response.

(d) Government should consider launching a back-to-basic program aimed at re-building trust and improving communication and work relations among Veldfire institutions. This shall be targeted to all the Veldfire governance forums such as Disaster Management Advisory and Disaster Ward Committee and Umbrella Fire Protection Association to mention but a few.

(e) The Head of Disaster Management Centre (HoDMC) should be appointed by municipal council and be accorded the necessary executive authority to execute their powers and functions. In this way they can take decision and advice council directly.

(f) Current legislations on the formation of Fire Protection Association stipulated that landowners have a choice to belong to an association. Government needs to review this provision and make it compulsory for landowners, State Owned Enterprises (SOE) for example, ESKOM, TELKOM and TRANSNET to become members of the FPA.

(g) Government to re-visit the Working on Fire model which includes contracting of the Advanced Aerial Fire Fighting service at such high cost. Also, to ensure that Advanced Aerial Fire Fighting service is accessible to all rich and poor farmers for effective management of Veldfires.

(h) The District Disaster Advisory Forums to recommend bi-laws which regulate the old-age tradition ("If it does not burn, it does not rain") that induces rain, through engagements with the traditional leaders concerned.

(i) SAWS to explore ways to disseminate early warning information to all traditional leaders, Disaster Ward Committee members and Disaster Advisory Forum members in order to cover all sectors of the community.

(j) The Disaster Management Risk Reduction team together with Working on Fire and the Fire Brigade Teams should work together to intensify awareness campaigns aimed at educating the communities on responding to Veldfire risks and reducing levels of vulnerabilities.

(k) Government should also consider promoting women to work in the Fire management sector.

(l) Government to consider recruitment of young people both black and white into the fire sector considering that majority of the workforce is aging and that Veldfires occurrence trajectory is in the rise.

6.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Veldfire response readiness challenges in Mopani and Capricorn district are not different from what is observed in the rest of the other districts in the Republic of South Africa and perhaps in other countries in Southern Africa. The Veldfire management studies conducted in various districts in the country do make specific reference to response readiness to Veldfires. The conspicuous challenge augmented by poor integration of Veldfire management services and the non-affiliation of state-owned enterprises to fire associations, is a serious overarching challenge. Considering this research investigation, the following future research are recommended:-

(a) It is important to explore the rich traditional knowledge on early warnings once that help communities in their cultural settings to respond to Veldfires. Furthermore, researching on blending of indigenous knowledge with modern techniques on Veldfire preparedness.

(b) There is a need to research on the possibility of making Response and Recovery two separate Key Performance Areas (KPA).

(c) There is a need to research on best possible ways to provide Advance Aerial Veldfire fighting service to all who need it.

(d) There is a need to look at the professionalization of Disaster Management Centres and the accreditation of private Veldfire fighting services.

(e) There is a need to look at how cellphones can be used to detect Veldfire occurring within the radius of the local area network, this study will be interesting.

(f) The other interesting study is to determine the possible formation of a Department of Disaster and Fire Management in the republic of South Africa.

6.5 CONCLUSIONS

The Mopani and Capricorn district of the Limpopo province experience extremely high temperatures during summertime which create more favorable conditions for Veldfires to occur. The districts of the Limpopo province, account for areas which experience high incidences for Veldfires in the country. In accordance with the first objective of the study, the results confirm that there is legislative, policy and regulatory framework in place to ensure the effective Veldfire management in the districts of the Limpopo province. However existing legislative gaps and policy alignment present inherent system challenges.

Regarding the second objective, collaboration is an important ingredient for Veldfire management. However, the institutions responsible for implementing and monitoring the Veldfire legislative, policy and regulatory framework are not working together. As to the third objectives, the results confirm that the Veldfire response mechanisms fall short to reach the minimum standards required. Hence the districts Disaster Management Centre and the Umbrella Fire Protection Association are not optimally functional. On the fourth objective, the results reveal that communal landowners do not receive Veldfire Early Warning information from SAWS making them more vulnerable and exposed high levels of Veldfire impact. Further that old age tradition which requires burning in order to induce rain presents a challenge to Veldfire scares resources.

In summary, what is peculiar is that government has put Veldfire legislative, policy and regulatory framework in place but the same government fails to implement its policies the way it should. This for example, results in dismal performance of Disaster Movement Centers, Fire Brigade Services and other respective departments mandated to manage Veldfires.

LIST OF PERSONAL COMMUNICATION (Pers.com)

Pers.com 2020A: Interview with Chief Fire Officer in Capricorn District on the 17th February 2020

Pers.com 2020B: Interview with Dpt. of Environment, Forestry and Fisheries Officer in in Capricorn District on the 25th February 2010

Pers.com 2020C: Interview with Chief Fire Officer in Capricorn District on the 11th March 2020

Pers.com 2020D: Interview with Chairperson of Letaba Fire Protection Association in Mopani on the 6th June 2020

Pers.com 2020E: Interview with Senior Firefighter in Capricorn District on the 4th March 2020

Pers.com 2020F: Interview with Divisional Officer in Capricorn District on the 11th March 2020

Pers.com 2020G: Interview with Head of Disaster Management Centre in Mopani District on the 17th March 2020

Pers.com 2020H: Interview with WoF Deputy General Manager Working at Capricorn District on the 27 February 2020

Pers.com 2020I: Interview with Manager from DAFFF held in Makhado on the 29th February 2020

Pers.com 2020J: Interview with Chief Fire Officer in Mopani District on the 17th March 2020

Pers.com 2020K: Interview with officer from Dpt. of Agriculture, Land Reform and Rural Development held in Makhado on the 29th February 2020

Pers.com 2020L: Interview with Manager from Dpt. of Agriculture, Land Reform and Rural Development held in Makhado on the 25th February 2020

Pers.com 2020M: Interview with Head of Disaster Management Centre in Mopani District on the 17th March 2020

Pers.com 2020N: Interview with Chief Fire Officer in Mopani District on the 17th March 2020

Pers.com 2020O: Interview with Head of Disaster Management Centre in Mopani District on the 17th March 2020

Pers.com 2020P: Interview with Chief Fire Officer in Mopani District on the 17th March 2020

Pers.com 2020Q: Interview with Chief Fire Officer in Mopani District on the 17 March 2020

Pers.com 2020R: Interview with Working on Fire Team leader at Makhado Fire Base 2nd June 2020

Pers.com 2020S: Interview with Chief Fire Officer in Capricorn District on the 4th March 2020

Pers.com 2020T: Interview with Chairperson of the Fire Protection Association in Molemole on the 4th May 2020

Pers.com 2020V: Interview with Working on Fire Team leader at Giyani Fire Base on the 3rd June 2020

Pers.com 2020W: Interview with Head of Disaster Management Centre in Capricorn District on the 18th March 2020

Pers.com 2020X: Interview with Head of Disaster Management Centre in Mopani District on the 17th March 2020

Pers.com 2020Y: Interview with Chairperson of the Molemole Fire Protection Association on the 4th May 2020

Pers.com 2020Z: Interview with Head of Disaster Management Centre in Capricorn District on the 18th March 2020

Pers.com 2020AA: Interview with Head of Disaster Management Centre in Mopani District on the 17th March 2020

Pers.com 2020BB Interview with Chief Fire Officer in Mopani District on the 17 March 2020

Pers.com 2020CC Interview with Chairperson of the Ramokgopa Territorial Council held in Botlokwa 7th June 2020

Pers.com 2020DD: Interview with a member of Ramokgopa Territorial Council held in Botlokwa 7th June 2020

Pers.com 2020EE: Interview with an officer from Dpt. of Agriculture Forestry held in Capricorn on the 25th February 2020

Pers.com 2020FF: Interview with WoF Deputy General Manager Working at Capricorn District on the 27 February 2020

Pers.com 2020GG: Interview with Chairperson of Letaba Fire Protection Association at Mopani district on the 6th June 2020

Pers.com 2020HH: Interview with a member of Fire Protection Association at in Capricorn district on the 6th June 2020

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APENDIX 1: ETHICS CLEARANCE

UNIVERSITY OF THE
WITWATERSRAND,
JOHANNESBURG

Research Office

HUMAN RESEARCH ETHICS COMMITTEE (NON-MEDICAL)
R14/49 Makananisa

CLEARANCE CERTIFICATE	**PROTOCOL NUMBER: H20/05/18**
PROJECT TITLE	Investigating Veldfire response readiness by district Disaster Management Centres. A study of the Limpopo Province
INVESTIGATOR(S)	Mr D Makananisa
SCHOOL/DEPARTMENT	Geography, Archaeology and Environmental Sciences/
DATE CONSIDERED	22 May 2020
DECISION OF THE COMMITTEE	Approved Risk Level: Low
EXPIRY DATE	24 June 2023

DATE 25 June 2020 **CHAIRPERSON** J. Knight
(Professor J Knight)

cc: Supervisor : Professor M Simatele

DECLARATION OF INVESTIGATOR(S)

To be completed in duplicate and **ONE COPY** returned to the Secretary at Room 10004, 10th Floor, Senate House, University. Unreported changes to the application may invalidate the clearance given by the HREC (Non-Medical)

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**

_____ **Signature** **Date** ____/____/____

APPENDIX 2: QUESTIONNAIRES FOR HEAD OF DISASTER MANAGEMENT CENTRE

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY

OF THE LIMPOPO PROVINCE

This questionnaire aims at collecting empirical data in partial fulfilment of the requirement for a PhD degree in Geography and Environmental Studies, in line with the research topic stated here above. Your responses are treated strictly as confidential as per the University research ethics and related laws. Thank you for your cooperation.

Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Does your department deal with Veldfire management? Yes (1) No (2)

7) Is Veldfire management a mandate of your department? Yes (1) No (2)

8) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

9) Does your institution manage Veldfire the same way other functions are managed? Yes (1) No (2)

10) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

11) If yes, identify them? ----------

12) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

13) How in your view do you propose these challenges be met? ----------

Part C: COOPERATION ISSUES

14) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

15) What are some of the factors that influence institutions not to work together? ----------

16) Which of the following factors do you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

17) Identify some of the factor which influence Veldfire response coordination----------

18) Which of the following factors you believe contribute to response mechanism?

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

19) Do Disaster Management Advisory Forum stakeholders attend scheduled meeting? Yes (1) No (2)

20) If No, mention why do you think this is the case

21) Share with us how reporting procedure impact on Veldfire response?

22) Do you have adequate budget allocation for Veldfire response service in your district? Yes (1) No (2)

23) Tell us what skills training is required in the Veldfire management sector?

24) Do you have some of the major Veldfire response service equipment Yes (1) No (2)

25) If No. mention why that is the case?

26) In your view is Disaster Centre effectively coordinating the fire stakeholders? Yes (1) No (2)

27) If No. mention why that is the case?

28) To what expend do you think the Disaster Centres do not have powers necessary for them to execute their functions?

Part D: Early warning and detection of Veldfires

29) In your view are communities in your district ready to respond to Veldfires

30) Do you think communities have access to SAWS early warning information? Yes (1) No (2)

31) If No. mention why that is the case?

32) What can be done to ensure that Traditional leaders together with members of the communities are able to receive Veldfires?

APPENDIX 3: QUESTIONNAIRES FOR CHIEF FIRE OFFICER

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY

OF THE LIMPOPO PROVINCE

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Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Does your department deal with Veldfire management? Yes (1) No (2)

7) Is Veldfire management a mandate of your department? Yes (1) No (2)

8) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

9) Does your institution manage Veldfire the way it should? Yes (1) No (2)

10) If no, why is it so? ----------

11) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

12) If yes, identify them? ----------

13) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

14) If yes, identify them? ----------

Part C: COOPERATION ISSUES

15) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

16) What are some of the factors that influence institutions not to work together? ----------

17) Which of the following factors you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

18) Identify some of the factor which influence Veldfire response coordination----------

19) Which of the following factors you believe contribute to response mechanism?

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

20) When were you appointed as a Fire Protection Officer? ----------

21) How often do you meet with the Fire Protection Association management team? ----------

22) Do you conduct regular inspections for compliance on Veldfire management in your district? Yes (1) No (2)

23) Are all municipalities' members of member of the Fire Protection Association? Yes (1) No (2)

24) If no, share with us why you think this is so----------

25) Kindly share with us the challenges what you do when you respond to Veldfires? ----------

26) How is the Fire Danger Index information communicated to fire stations? ----------

27) Do you have service level agreements with advance aerial firefighting? Yes (1) No (2) ----------

28) Do you receive early warning information from SAWS on Veldfire? ----------

APPENDIX 4: QUESTIONNAIRES FOR FIREFIGHTERS

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY OF THE LIMPOPO PROVINCE

This questionnaire aims at collecting empirical data in partial fulfilment of the requirement for a PhD degree in Geography and Environmental Studies, in line with the research topic stated here above. Your responses are treated strictly as confidential as per the University research ethics and related laws. Thank you for your cooperation.

Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Does your department deal with Veldfire management? Yes (1) No (2)

7) Is Veldfire management a mandate of your department? Yes (1) No (2)

8) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

9) Does your institution manage Veldfire the way it should? Yes (1) No (2)

10) If no, why is it so? ----------

11) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

12) If yes, identify them? ----------

13) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

14) If yes, identify them? ----------

Part C: COOPERATION ISSUES

15) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

16) What are some of the factors that influence institutions not to work together? ----------

17) Which of the following factors you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

18) Identify some of the factor which influence Veldfire response coordination----------

19) Which of the following factors you believe contribute to response mechanism? Indicate by cross on the box next to each factor

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

20) When did you last respond to Veldfires in your district? ……

21) Share with us the challenges you experienced when you responded to Veldfire disaster scenario?

22) Which of the following factors you believe contribute to response mechanism? Indicate by cross on the box next to each factor

Fire Preparedness Readiness Checklist	
Fire Management Administration	
Aviation Management	
Safety Officer	
Fire Training	

Aviation Base Review	
Individual Firefighter	
Dispatch	
Fire Engines	
Interagency Hotshot Crew	
Smokejumper	
Helicopter module	
Dozer	
Water levels in resevoirs and tanks	
First Aid kit	

23) Do you conduct regular inspections for compliance on Veldfire management in your district? Yes (1) No (2)

24) The following is the list of firefighting equipment. Indicate by cross on the box next to each to indicate if you have or do not have them at your Fire Station

Fire Fighting Equipment	Available	Not-available
Fire-fighting Bakkie Sakkies / Skid Units		
Fire Fighting Vehicles / Trucks / Fire Fighting Load bodies		
Labour carrier truck bodies - 25 to 40 Seater		
Compressed Air Foam Systems (CAFS)		
Tractor-drawn, slow speed agricultural trailers		
Buckets (preferably metal) and mops		
Fire beaters, rakehoes and shovels		
Fire Hoses / Fittings / Couplings		
Water delivery nozzles		
Protective woolen blanket		
Knapsack spray and large handkerchiefs to cover nose and mouth		
CNC profile cutting and bending		
Gloves and ladders		
Sturdy boots or shoes and woolen socks		

25) How often do you conduct Veldfire simulation drills per quarter? Indicate by cross on the box next to each factor

One mock drill	
Two mock drills	
Three mock drills	
None mock drills	

26) How is the Fire Danger Index information communicated to fire stations? ----------

27) Do you have service level agreements with advance aerial firefighting? Yes (1) No (2) ----------

28) Do you receive early warning information from SAWS on Veldfire? ----------

APPENDIX 5: QUESTIONNAIRES WORKING ON FIRE

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY

OF THE LIMPOPO PROVINCE

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Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Does your department deal with Veldfire management? Yes (1) No (2)

7) Is Veldfire management a mandate of your department? Yes (1) No (2)

8) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

9) Does your institution manage Veldfire the way it should? Yes (1) No (2)

10) If no, why is it so? ----------

11) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

12) If yes, identify them? ----------

13) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

14) If yes, identify them? ----------

Part C: COOPERATION ISSUES

15) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

16) What are some of the factors that influence institutions not to work together? ----------

17) Which of the following factors you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

18) Identify some of the factor which influence Veldfire response coordination----------

19) Which of the following factors you believe contribute to response mechanism? Indicate by cross on the box next to each factor

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

20) Do you as Working on Fire respond to Veldfires? Yes (1) No (2)

21) If no, why is it so? ----------

22) Do you provide advanced aerial firefighting equipment to every landowner when fire occur? Yes (1) No (2)

23) Do you conduct regular inspections for compliance on Veldfire management in your district? Yes (1) No (2)

24) The following is the list of firefighting equipment. Indicate by cross on the box next to each to indicate if you have or do not have them at your Fire Station

Fire Fighting Equipment	Available	Not-available
Fire-fighting Bakkie Sakkies / Skid Units		
Fire Fighting Vehicles / Trucks / Fire Fighting Load bodies		

Labour carrier truck bodies - 25 to 40 Seater		
Compressed Air Foam Systems (CAFS)		
Tractor-drawn, slow speed agricultural trailers		
Buckets (preferably metal) and mops		
Fire beaters, rakehoes and shovels		
Fire Hoses / Fittings / Couplings		
Water delivery nozzles		
Protective woolen blanket		
Knapsack spray and large handkerchiefs to cover nose and mouth		
CNC profile cutting and bending		
Gloves and ladders		
Sturdy boots or shoes and woolen socks		

25) Do provide fitness skills training to your fire teams? Yes (1) No (2)

26) How is the Fire Danger Index information communicated to landowners? ----------

27) Do you have service level agreements with Fire Brigade Device? Yes (1) No (2) ----------

28) Do you disseminate SAWS Veldfire? Early warning to landowners? Yes (1) No (2) ----------

29) How do you ensure Traditional leaders revive the Fire Danger Index ----------

APPENDIX 6: QUESTIONNAIRES FIRE PROTECTION ASSOCIATION

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY OF THE LIMPOPO PROVINCE

This questionnaire aims at collecting empirical data in partial fulfilment of the requirement for a PhD degree in Geography and Environmental Studies, in line with the research topic stated here above. Your responses are treated strictly as confidential as per the University research ethics and related laws. Thank you for your cooperation.

Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Is Veldfire management a mandate of you Fire Protection Association? Yes (1) No (2)

7) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

8) Is your district vulnerable to Veldfire ? Yes (1) No (2)

9) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

10) If yes, identify them? ----------

11) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

12) If yes, identify them? ----------

Part C: COOPERATION ISSUES

13) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

14) What are some of the factors that influence institutions not to work together? ----------

15) Which of the following factors you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

16) Do you respond to Veldfire? Yes (1) No (2)

17) Identify some of the factor which influence Veldfire response in your district----------

18) Which of the following factors you believe contribute to response mechanism? Indicate by cross on the box next to each factor

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

19) Do you comply with land management? Yes (1) No (2)

20) If no, why is it so? ----------

21) How do you ensure that FPA member's access advanced aerial firefighting equipment? ----------

22) What are the benefits associated with being a member of the Fire Protection Association? ----------

23) The following is the list of firefighting equipment. Indicate by cross on the box next to each to indicate if you have or do not have them at your Fire Station

Fire Fighting Equipment	Available	Not-available
Fire-fighting Bakkie Sakkies / Skid Units		
Fire Fighting Vehicles / Trucks / Fire Fighting Load bodies		
Labour carrier truck bodies - 25 to 40 Seater		
Compressed Air Foam Systems (CAFS)		
Tractor-drawn, slow speed agricultural trailers		
Buckets (preferably metal) and mops		
Fire beaters, rakehoes and shovels		
Fire Hoses / Fittings / Couplings		
Water delivery nozzles		

Protective woolen blanket		
Knapsack spray and large handkerchiefs to cover nose and mouth		
CNC profile cutting and bending		
Gloves and ladders		
Sturdy boots or shoes and woolen socks		

24) Do provide fitness skills training to your fire teams? Yes (1) No (2)

25) How is the Fire Danger Index information communicated to landowners? ----------

26) Do you have service level agreements with Fire Brigade Device? Yes (1) No (2) ----------

27) Do you receive SAWS Veldfire? Early warning information? Yes (1) No (2) ----------

28) How do you assist communities when there are Veldfires? ----------

APPENDIX 7: QUESTIONNAIRES FOR GOVERNMENT OFFICIALS

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

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Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Does your department deal with Veldfire management? Yes (1) No (2)

7) Is Veldfire management a mandate of your department? Yes (1) No (2)

8) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

9) Does your institution manage Veldfire the same way other functions are managed? Yes (1) No (2)

10) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

11) If yes, identify them? ----------

12) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

13) How in your view do you propose these challenges be met? ----------

Part C: COOPERATION ISSUES

14) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

15) What are some of the factors that influence institutions not to work together? ----------

16) Which of the following factors do you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

17) Identify some of the factor which influence Veldfire response coordination----------

18) Which of the following factors you believe contribute to response mechanism?

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

19) As government department do you attend Disaster Management Advisory Forum stakeholders meeting? Yes (1) No (2)

20) If No, mention why do you think this is the case

21) Share with us how reporting procedure impact on Veldfire response?

22) Do you have adequate budget allocation for Veldfire response service in your district? Yes (1) No (2)

23) Tell us what skills training is required in the Veldfire management sector?

24) Do you have some of the major Veldfire response service equipment Yes (1) No (2)

25) If No. mention why that is the case?

26) In your view is Disaster Centre effectively coordinating the fire stakeholders? Yes (1) No (2)

27) If No. mention why that is the case?

28) To what expend do you think the Disaster Centres do not have powers necessary for them to execute their functions?

Part D: Early warning and detection of Veldfires

29) In your view are communities in your district ready to respond to Veldfires

30) Do you think communities have access to SAWS early warning information? Yes (1) No (2)

31) If No. mention why that is the case?

32) What can be done to ensure that Traditional leaders together with members of the communities are able to receive Veldfires?

APPENDIX 8: QUESTIONNAIRES FOR TRADITIONAL LEADERS

SCHOOL OF GEOGRAPHY, ARCHAEOLOGY AND ENVIRONMENTAL STUDIES FACULTY OF SCIENCE

UNIVERSITY OF THE WITWATERSRAND

RESEARCH TITLE:

INVESTIGATING VELDFIRE RESPONSE READINESS OF DISTRICT DISASTER CENTRES: A STUDY OF THE LIMPOPO PROVINCE

This questionnaire aims at collecting empirical data in partial fulfilment of the requirement for a PhD degree in Geography and Environmental Studies, in line with the research topic stated here above. Your responses are treated strictly as confidential as per the University research ethics and related laws. Thank you for your cooperation.

Part A: DEMOGRAPHIC DATA

1) What is your gender?

Male	1	
Female	2	

2) What is your age Group?

19-25	26-35	36-45	46-55	56 and above
1	2	3	4	5

3) What is your work experience?

< 5	5-9	10-14	15-19	>20
1	2	3	4	5

4) What is your level of education?

Never went to school	Primary	Secondary	Diploma	Degree specify……
1	2	3	4	5

5) What is your race group?

Black	1	
Indian	2	
Coloured	3	
White	4	

Part B: VELDFIRE MANAGEMENT ISSUES

6) Is Veldfire management a mandate of you Fire Protection Association? Yes (1) No (2)

7) Do you think there are Veldfire management major problem in your district? Yes (1) No (2)

8) Is your district vulnerable to Veldfires ? Yes (1) No (2)

9) In your view do you have legislation, policy and regulatory framework to manage Veldfire in your district? Yes (1) No (2)

10) If yes, identify them? ----------

11) Does your institution experience legislative and policy challenges regarding Veldfire management? Yes (1) No (2)

12) If yes, identify them? ----------

Part C: COOPERATION ISSUES

13) In your view, do Veldfire management institutions in your district work together? Yes (1) No (2)

14) What are some of the factors that influence institutions not to work together? ----------

15) Which of the following factors you believe contribute towards institutions not to work together? Indicate by cross on the box next to each factor

Lack of trust	1	
Poor legislative compliance	2	
Poor communication	3	

Part D: COODINATION ISSUES

16) Do you respond to Veldfire? Yes (1) No (2)

17) Identify some of the factor which influence Veldfire response in your district----------

18) Which of the following factors you believe contribute to response mechanism? Indicate by cross on the box next to each factor

Response action plan	1	
Reporting procedure	2	
Skills training	3	
Equipment	4	
Budget	5	
Functional coordinating bodies	6	
Power relations	7	

19) As traditional leaders what is your role in Veldfire management?

20) Are Veldfires common in the land under you custardy? Yes (1) No (2)

21) If yes, could you give us some indication as to how communities respond to these fires?

22) Do communities have firefighting equipment? ----------

23) Are you a member of a Fire Protection Association? Yes (1) No (2)

24) If no, tell us why is it so----------

25) Do traditional leaders participate in the Disaster Management Advisory Forum of you district municipality?

26) Is firefighting your responsibility? Yes (1) No (2)

27) If no, whose responsibility you think it is?

28) As traditional leaders, how do you know if there is going to be Veldfire is your area

29) Do you also receive Veldfire Early Warning from your Disaster Centre? Yes (1) No (2)

30) If no. tell us why is it so?

31) In your view, who do you think community id the first responder to Veldfires in your land? Yes (1) No (2)

32) If no, tell us why you think so

APPENDIX 9: Permit A1

MOPANI DISTRICT MUNICIPALITY

Office of the Municipal Manager

Private Bag X9687
Giyani
0826

E-mail-MogotleR@mopani.gov.za

Government Buildings
Mopani District Building
Giyani Main Road
Tel: +27 15 811-6300
Fax: +27 15 812-4301

Enq: Romeo Mogotle

To Prof Mulala Danny Simatele
University of Witwatersrand
Global Change Institute
Private Bag 3
Wits
2030

Cc Mr Daniel Makananisa

Date **04 February 2020**

RE: PERMISSION TO CONDUCT RESEARCH

1. The above matter refers
2. This letters seeks to respond to your minute dated 21 January 2020 requesting permission to be granted in respect of Mr Makananisa Daniel to conduct research.
3. We hereby grant him permission to conduct research for his thesis titled**"Investigating the response readiness of the District Disaster Centres of the Limpopo province, a study of Limpopo Province"**. We believe that the opportunity granted will enable you fulfill the objectives of your research and get the necessary data you seek to get in our institution, and further believe that findings and recommendations of your research project will also benefit the municipality.
4. We hope you will find our respond in order and wish you all the best in your academic journey.

Regards

Mr. Q Kgatla
Acting Municipal Manager

APPENDIX 10: Permit A2

CAPRICORN
DISTRICT MUNICIPALITY

41 Biccard Street
P O Box 4100
POLOKWANE
0700

Tel: (015) 294 1000
Fax: (015) 291 4297
Web: www.cdm.org.za
E-mail: info@cdm.org.za

Reference No: 16/1 **Enquiries: PM Mbowe ni**

18 February 2020

Prof Mulala Danny Simatele
University of Witwatersrand
Global Change Institute
Private Bag 3
Wits
2030

Cc: Mr Daniel Makananisi

RE: REQUEST TO CONDUCT PILOT (PRE-TEST) QUESTIONNAIRES FOR PhD STUDIES

The above matter bears reference:

The Capricorn District Municipality (CDM) acknowledges receipt of your letter dated 23 January 2020 with its contents.

Further note that CDM (Emergency, Fire and Rescue units) will assist in your request.

For further details on this matter please contact the Community Services Department on 015 294 Ext 1253/1294

I trust that this will be received in order.

Yours Faithfully

NOKUTHULA MAZIBUKO
MUNICIPAL MANAGER

21/02/2020
DATE

0850

Bank Details:
ABSA Tzaneen
Savings: 911 786 9007

E:mail: pro@letabafire.co.za
admin@letabafire.co.za

076 549 5466

DAFF Registration: 1117/01
VAT: 4870241736

Web: http://www.letabafire.co.za Facebook: http://www.facebook.com/letabafire Twitter: @letabafire Instagram: Letaba Fire Protection Association

10 March 2020

To whom it may concern:

With this letter we as the Letaba Fire Protection Association welcome Mr Daniel Makananisa from Wits University for a Focus Group Discussion with myself Rouan Snyman (LFPA Fire Manager) and some LFPA members in relation to your research needed.

As discussed, this meeting will commence:

Date: 17 March 2020
Time: 11:00
Venue: Letaba FPA Operations centre
1 Waterval Airstrip
West Falia Estate
Politsi
Limpopo

For any other information, please do not hesitate to contact me directly.

Yours Truly

Rouan Snyman
Fire Manager
071 602 5982
manager@letabafire.co.za

LETABA
FIRE PROTECTION
ASSOCIATION
Prevent Veldfires

Fire line 076 844 1646
Office 076 550 2260/076 549 5466
Web: www.letabafire.co.za
Facebook: www.facebook.com/letabafire
Twitter: @letabafire

APPENDIX 12: Permit A4

WORKING ON FIRE PTY LTD
102 Blaauwberg Street, Ladanna, Polokwane, RSA
Company Registration: 2004/019641/07
VAT Number: 4200222935
Tel: +27 87 352 4836
Website: www.workingonfire.org

To Daniel Makananisa
Wits PhD Student

Dear student

We have received your letter indicating your intention to have discussion-meeting with ***Working on Fire (WoF)*** Teams to answer some the research questions for your studies.

We are pleased to tell you that your request has been granted.

We are further delighted to see a research like this one conducted at your University. We believe that the interest Wits has shown to have this research conducted, shows that indeed the world is taking a challenge of Veldfires seriously.

Our teams will be more than ready to provide information which we hope will be useful to your research.

Wishing you all the best in your studies

Working on Fire

Mr. Phaniel Nkuna

ASSISTANT GENERAL MANAGER