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AN INVESTIGATION OF EXPOSURE OF LIVELIHOOD ASSETS TO VELD FIRE HARZADS: A CAUTIONARY TALE OF MTUBATUBA LOCAL MUNICIPALITY, KWAZULU-NATAL, SOUTH AFRICA

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Abstract

Veld fires are a common phenomenon in the predominantly savanna ecosystems of Mtubatuba. Until now no studies have investigated the causes, and the human, natural, financial, social and physical impacts of veld fires in Mtubatuba. Yet such information is crucial for planning and implementation of fire prevention and control practices. Veld fires have both positive and negative impacts to the community and the environment. It is evident that, although fire is a natural phenomenon, the consequences of veld fires can have devastating effects on livelihood assets. The study utilized a questionnaire, observations of the phenomenon and personal engagement as a research methodology on the targeted households. The simple random sampling method was used, where a selected household were issued with a questionnaire and assistant to fill. This method was utilized because of the fact that the study area selected has no formal spatial settlement pattern, such as the organized linear streets found in urban areas.

A random sample of 120 households in ward 3 and ward 9 were drawn and a questionnaire was administered to the households and to one fire fighter from Mtubatuba fire station to collect information on veld fires. Veld fires cause serious social, economic and environmental damage. They lead to loss of social well-being, livelihoods and reduced environmental quality. This has been the case where gardens, sugarcane farms and commercial timber plantations were destroyed, grazing areas reduced to ashes and the natural environment destroyed including its natural medicinal plants and other natural resources. Veld fires in Mtubatuba ward 4 and ward 9 were mainly caused by human activities. The use of open fires for cooking and lighting in most areas without electricity, lack of access by fire services for firefighting during emergencies and the increasing rural-urban interface all contributed in increased veld fire risks and losses.

Based on the analysis of the study 92.7% of the houses were totally destroyed by fires initiated from veld fire incidents in each and every fire season, which later destroyed the livelihood assets. The community of Mtubatuba ward 4 and ward 9 were mostly affected by veld fires in winter compared to summer season. The respondents had no other means of fighting fires except relying on the traditional method of using tree branches as fire bitters. In terms of mainstreaming disaster management to the community, 99% of respondents agreed that there were no training programs

offered by the fire department to equip the community for self-reliance and no early warnings issued to them prior to incidents. About 69% of respondents reflected that there was occasionally loss of human life during veld fire incidents. During data collection eight cattle were found death burnt while grazing in a dry grass due to the persisted drought almost lasted for two years.

A bottom up approach can be adopted that can easily capture community dynamics and needs that can be addressed to reduce the impacts of veld fires. Since 60% of the respondents established that the issue of destruction of the environment by veld fires can be largely attributed to human activities. There is a recommendation for Mtubatuba fire department to involve community members in decision making. It is at this primary level that social and economic risks of veld fires can adequately be assessed and managed. At ward level, the approach must emphasize active involvement that strengthens capacity to cope with veld fires and improve on livelihood security. There is a need to identify other veld fire management systems throughout Mtubatuba and South Africa, their practice and adherence to veld fire regimes specific to their areas. Understanding an areaôs ecological function, social and economic vulnerabilities are important.

Declaration

I, the undersigned, hereby declare that the work contained in this dissertation is my own original work, that all sources utilized or quoted, have been indicated and acknowledged by means of complete references, and that this dissertation was not previously submitted by me or any other person at any other university for a degree. The views, opinions and suggestions expressed in this study should be attributed to the author only.

Signature: é é é é é é é é é é é é é é é .

Date: é é é é é é é é é é é é é é é é ..

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Glossary

Direct attack: A method of fire attack where wet or dry firefighting techniques are used. It involves suppression action right on the fire edge which then becomes the fire line (Teie, 2005: 110).

Disaster: Progressive or sudden, widespread or localised, natural or human-caused occurrence which causes or threatens to cause death, injury or damage to property, infrastructure or the environment, or disruption of the life of a community, and is of a magnitude that exceeds the ability of those affected by the disaster to cope with its effects using only their own resources (DM Act, No. 57 of 2002: 42).

Disaster Management: Continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures aimed at preventing or reducing the risk of disasters, mitigating the severity or consequences of disasters, emergency preparedness, a rapid and effective response to disasters and post disaster recovery and rehabilitation (DM Act, No 57 of 2002: 45).

Fire behaviour: The manner in which a fire reacts to the variables of fuel, weather and topography (Trollope, 1985: 92).

Firebreak: A natural or constructed barrier utilised to stop or check fires, or to provide a control line from which to work (Teie, 2005: 28).

Fire danger: A general term used to express an assessment of fixed and variable factors such as fire risks, fuels, weather and topography, which influences whether fires may start, spread or cause damage (Teie, 2005: 53).

Fire danger rating: A fire management system that integrates the effects of selected fire danger factors into one or more qualitative or numerical indices of current protection needs (Teie, 2005: 79).

Fire ecology: The study of the relationships between fire, the physical environment and living organisms (Teie, 2005: 86).

Fire hazard: A fuel complex, defined by volume, type condition, arrangement, and location that determines the degree of ease of ignition and of resistance to control (Teie, 2005: 97).

Fire management: All activities required for the protection of burnable forest and other vegetation values from fire, and the use of fire to meet land management goals and objectives. (Teie, 2005: 124).

Fire management plan: The systematic, technological, and administrative management process of determining the organisation, facilities, resources, and procedures required to protect people, property, and forest areas from fire and to use fire to accomplish forest management and other land use objectives (Teie, 2005: 131).

Fire preparedness: All activities undertaken in advance of veld fire occurrence to decrease its extent and severity and to ensure more effective fire suppression. (Teie, 2005: 133).

Fire prevention: All activities concerned with minimising the incidence of veld fires particularly those of human origin. (Teie, 2005: 135).

Fire Protection Associations: A local institution formed by landowners or their agents for the purpose of predicting, preventing, managing and extinguishing veld fires; established in terms of Section 3(1) of the National Veld and Forest Fire Act No. 101 of 1998.

Fire season: Period(s) of the year during which fires are likely to occur and affect resources sufficiently to warrant organised fire management activities (Teie, 2005: 137).

Fire weather: Weather conditions which influence fire ignition, behaviour, and suppression (Trollope, 1985: 58).

Fuel: Any material such as grass, leaf litter and live vegetation which can be ignited and sustain a fire. Fuel is usually measured in tonnes per hectare (Teie, 2005: 142).

Fuel load: The oven dry weight of fuel per unit area. Commonly expressed as tons per hectare; it is also known as fuel loading (Teie, 2005: 144).

Mitigation: Any risk management measure that reduces risk, including fuel reduction burning, other prevention measures, preparedness and so on (DM Act, No. 57 of 2002: 26).

Preparedness: All activities undertaken in advance of the occurrence of an incident to decrease the impact, extent and severity of the incident and to ensure more effective response activities. (DM Act, No. 57 of 2002: 28).

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CHAPTER ONE
OVERVIEW OF THE RESEARCH STUDY

1.1 Introduction

In the past, fire has been utilized traditionally as a management tool to control vegetation structure and composition, for hunting and to recycle nutrient supplements locked in live and dead biomass (CSIR 2010: 45). The utilizations have been a continuous process up to today especially in remote rural areas and savanna ecosystems of southern Africa (CSIR 2010: 46). Despite the fact that the improper utilization of fires or carelessness regularly prompt veld fires, which are blasts that escape control, destroying wide tracts of woodlands; grasslands and might result in the loss of lives and livelihood assets (business resources) (Rahlao 2009: 52). South Africa has huge landscapes of tropical and subtropical fire-prone savannas and fire-influenced forests that have been twisted by the longest history of human involvement with fire in the country (Bond *et al*, 2003: 251).

The hot summer and dry warm winters, experienced over the Mtubatuba area, combined with abundant grass fuels guarantee that veld fires are a regular feature of savanna landscapes (Bond *et al*, 2003: 251). At the homestead level, farmers are in charge of setting up fire breaks before the beginning of the dry season, which agrees with the fire season. The Fire Protection Association Regulations in South Africa were amended in 2003 and concentrated more on early detection, quick response and suppression (Magni 2009: 122). However, recently there has been a huge increase in the occurrences of uncontrolled veld fires which have delivered ample damage to agricultural land, indigenous forests, commercial timber plantations, rangelands and communal grazing zones (Magni 2009: 123). The uncontrolled veld fires are a threat to livelihoods (economic, environmental and social) assets because of their trail of destruction and direct impact on all livelihoods.

Other than the loss of biodiversity and economic losses, veld fires additionally reduce the aesthetic value of the natural land. In this way, there is a need for thorough understanding of the causes of livelihoods (economic, environmental and social) impacts and management of veld fires (NDMF 2005: 56). The Department of Agriculture Forest and Fisheries requires a risk assessment and to map risks of veld fires, according to the requirements as set out in the National Disaster Management Framework (NDMF 2005: 56). The Eastern Cape government on (e News channel) cautioned residents of the Eastern Cape on Sunday (01/25/2015) of strong winds and veld fires of the warning which were issued by South African Weather Services (SAWS). The high veld fire threat rating was expected in the north to western centre and along the coast in the Great Kei and Mnquma region.

The thunderstorms which bring lightning strikes and consequent fire and wind serve to spread the fire from one place to another. According to African Weather Services (SAWS) the risk of veld fires are linked to prolonged periods of almost no downpour, combined with warm and dry winds. Isimangaliso Wetland Park is the Coastal grasslands on the east bank of South Africa where the area is generally occupied with sugarcane fields, timber plantations and human settlements. At the point when the area was listed as a World Heritage site, there were more than eight thousand hectares of commercial forest plantations, planted in grasslands and the key tool to restoring these grasslands has been veld fires (Andrew 2005: 25-30). Andrew (2005: 25-30) argued that without fire, numerous areas of Mtubatuba would be vulnerable to encroachment by woody vegetation leading to a loss of valuable coastal grasslands and improve grazing for cattle.

The veld fires occurring in Mtubatuba area are generally known by destruction of livelihood assets (loss of sugarcane farms, commercial timber plantations of Mondi and Sappi, livestock and lost jobs). The local communities in their individual wards should take every precautionary measure to combat veld fires, and additionally be prepared to respond at short notification when such fires happen (Researcher's perspective).

1.2 Background

In each and every season of the year, the Mtubatuba community had been experiencing an increased number of veld and house fire incidents which affected mostly the following four (4) areas in two wards of the municipality area where a huge damage of livelihoods were experienced (Mtubatuba IDP 2012/14: 19).

Table 1: Mostly affected areas in a ward

No.	Ward no.	Ward name
1.	3	Khula
		Dukuduku
2.	9	Mfekayi
		Nkundusi

Due to the veld fires a number of human settlements, sugarcane farms, grazing land and commercial timber plantations owned by local residents, Sappi and Mondi were totally damaged by fire. On 26 August 2013, the rural areas of the Mtubatuba local municipality in the North-West of the municipal area experienced devastating veld fires, which caused huge lost in sugarcane farming infrastructure, grazing land, commercial timber plantations and livestock mounting to an estimated monetary loss of approximately R23 million (IDP, 2012/14: 27). Two people lost their livestock in the fires, and six people were injured (UMkhanyakude report, 2013: 42). However the veld fires of August 2013 were regarded as the most intense and devastating veld fire(s) in the recorded history of veld fires in the Mtubatuba fire department.

The causes of the veld fires were mostly ascribed to honey gatherers and others due to the strong wind that subsequently created short-circuit that set the veld on fire (UMkhanyakude report, 2013: 43). The veld fire shocks could destroy assets directly and also force individuals to abandon their home areas and set out their land prematurely as part of coping strategies. There would be shifts in some assets and employment opportunities especially in timber plantations and sugarcane farms the availability of jobs could be one of the challenging and continuing

sources of hardship for poor people in the affected communities (UMkhanyakude report 2013: 43-46). The community with more assets in Mtubatuba tended to have a greater range of options and capacity to switch between multiple strategies to secure their livelihoods. However, diversity of assets within the community would be an advantage to achieve different livelihood outcomes.

For instance, some people might consider a minimum level of social capital to be essential if they were to achieve a sense of well-being whereas in a rural area of different setting of an environment in the municipality wards people felt that they require certain levels of access to natural capital to provide security (Murray *et al,* 1999: 153-155). Natural capital is very essential to those who derive all or part of their livelihoods from resource-based activities such as farming and gathering in the forests. Nevertheless, its importance went beyond human imagination (Murray *et al,* 1999: 153-155). None of us would survive without the help of key environmental services and food produced from natural capital. Health (as appears as human capital) will tend to suffer in areas where air quality was poor as a result of natural disasters like veld fires (Murray *et al,* 1999: 153-155).

1.3 The study area

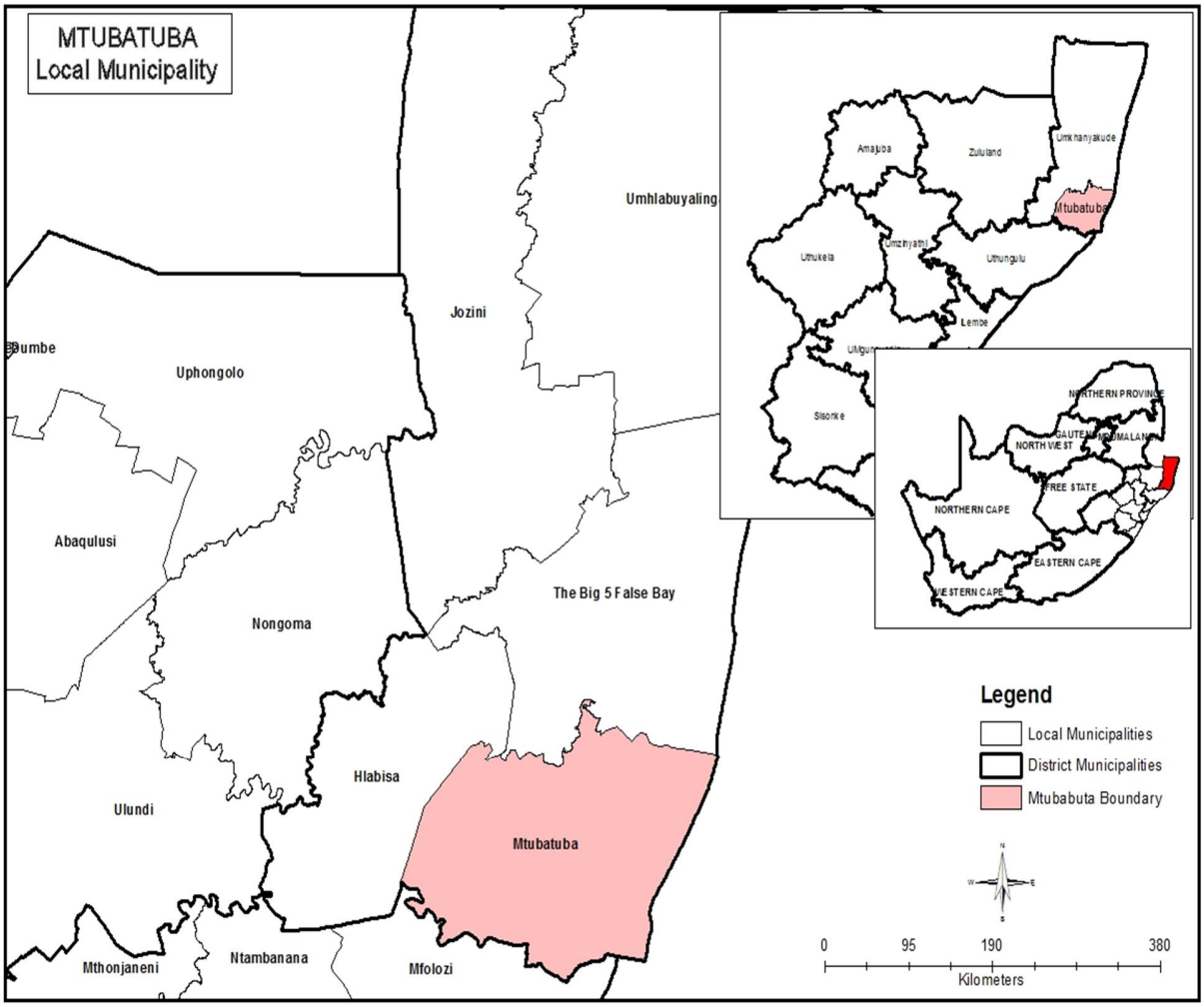

Fig 1: Map showing Mtubatuba Local Municipality as a focus study area.
(***Source:*** Adopted within uMkhanyakude District GIS office)

The Mtubatuba local municipality is situated in northern KwaZulu-Natal and is noted for its scenic beauty and rich biodiversity levels. The local municipality is home to the St Lucia and iSimangaliso Wetlands Park World Heritage sites and is known to attract tourists from all over the world. The Mtubatuba local municipality is also known for its game reserves; both private and state owned; marine protected areas; natural and commercial forests. The iSimangaliso Wetlands Park stretches along the northern Zululand coast from Mapelane in the south to Kosi Bay in the north (Mtubatuba IDP, 2014/15: 13). The Mtubatuba local municipality is

geographically situated under the Umfolozi region, along the N2 road of the Maputaland region, about 200 km away from the boarders of Swaziland. The area of Mtubatuba is 1970 km^2 in surface, with the population of 175 425 people living in the area.

The study area fell under the Mtubatuba local municipality. The local municipalities are responsible for providing services to their communities as local government (Mtubatuba IDP, 2014/15: 16). The major vegetation types in the rural areas of Mtubatuba include bush savanna grassland with, hypothelia and digitaria as the major grassland types (McDonald, 2003: 89). This area is cooler in the eastern side of the St Lucia beach and has an average to high rainfall. However on the other hand of the western side along the N2 road stretching towards the north the Mtubatuba local communities experience warm to hot temperatures and lower rainfall amounts compared to the upper part of the area (Mtubatuba IDP, 2013/2014: 53). Veld fires had negative consequences that conflicted with the public interest.

An example of negative impacts included loss of human settlements; property and critical infrastructure; damage to water catchment areas and destruction of commercially valuable timber plantations, sugarcane and grazing land. The smoke from veld fires could have interfered with road traffic visibility, air transportation and caused serious public health problems (Western Cape Veld & Forest Fire Strategy, 2012: 215). The analysis of veld fire impacts on socio-economic status focused on broad areas such as household livelihood resources; loss of lives and psychosocial impacts on communities. By nature, veld fires do not respect property or boundaries. Without preventive measures, veld fires continue to burn for as long as the weather is favorable and there is vegetation to burn. Anyone owning land holds the key responsibility to control fires on his or her own land. In any case, when fires burn in severe conditions, they quickly extended beyond any one's property and became a problem that cannot be handled by a single individual, but could only be controlled by joint coordinated efforts. Veld fires were a matter of regular concern to everyone (Nyamadzawo *et al*, 2013: 69).

1.4 Research problem and research questions

1.4.1 Research problem

The Mtubatuba local municipality consists of nineteen (19) wards which are more rural in nature. Commercial timber plantations are owned by local residents and other parts by private companies such as Mondi and Sappi. Commercial forests and sugarcane farming are the most dominant activities in the area and are poorly managed (Mtubatuba IDP 2014/15: 87). Large veld fires had been frequently reported to the Mtubatuba fire department especially in the winter season and less in summer (Mtubatuba IDP 2014/15: 88). These veld fires became a problem because they posed a threat to livelihood assets (economic; environmental and social assets) such as grazing land, commercial timber plantations, and sugarcane farms. Furthermore the household livelihood assets became more vulnerable to fire risks and also affected the community.

Veld fires lead to severe environmental degradation. More specifically, veld fires diminished land cover exposing the land to agents of accelerated soil erosion, changes in the hydrological cycle, increase in overland flow or surface run off and modifications in various ecological processes. Soil erosion leads to the siltation of rivers and dams thus reducing their water carrying capacity. This was likely to induce floods in low-lying areas (Kruger 2006: 126). Since the reports of devastating veld fires from the affected wards came in numbers to the fire department of the Mtubatuba local municipality, the protection of both the commercial timber plantations and sugarcane farms needed to be taken into consideration before the processing industries were at risk of insufficient supply. There were social vulnerability of structures such as human settlements that could be burnt and people that could be injured or lose their lives during veld fire incidents, therefore this study saved the need and purpose for investigation that led to mitigation measures (Kruger 2006: 144).

The veld fires caused injuries to the victims; loss of lives, loss of livelihood assets, health hazards, environmental deterioration and more over a threat to the tourism industry. However, veld fires were very destructive and occurred with significant frequency and intensity in many areas of Mtubatuba, the need still remain for the protection and sustainability of the commercial timber plantations (Mondi and Sappi), sugarcane farms, grazing land and farmlands that were all at risk because of these frequently devastating veld fires that were experienced seasonally (Mtubatuba IDP 2014/15: 64). In the above mentioned wards of the Mtubatuba local municipality, veld fires adversely influenced the subsistence farmland of the inhabitants of the community leaving them with hardship to survive. The absence of the required intervention to manage veld fires contributed much in the extent of damage caused by veld fires in the community of Mtubatuba (Macdonald 2003: 210).

The above mentioned negative impacts of veld fires posed severe environmental consequences and strain on natural resources. The issue of poor planning might be another factor which may affect the control and response to veld fires (Mtubatuba IDP 2014/15: 112). Therefore the purpose of the research was to investigate the impacts of veld fires on livelihood assets (commercial timber plantations; sugarcane farms; grazing land; human lives and settlements) and to advise in what needed to be done.

1.4.2 Research questions

The research questions focused on:

- What resources within the Mtubatuba fire department and the community were available to combat veld fires?
- Was there any planned on-going community awareness during fire season?
- What ecological conditions (weather, natural or alien vegetation and manmade activity) prompted the veld fires to occur and contributed to their intensity and spread?
- What community programmes or strategies were initiated for veld fire control and what firefighting methods had been adopted or utilized in combating veld fires?

1.5 The aim and the objectives of the research

1.5.1 Aim

The aim of the study was to research the effects of veld fires to livelihood assets (e.g. commercial timber plantations, sugarcane farms, environmental degradation, households fires, loss of lives and property) and encourage the fire unit within the municipality to develop its own veld fire management plan that would incorporate preparedness, prevention and mitigation measures for veld fires occurring in their locality.

1.5.2 Objectives

- To investigate the aspects that prompted veld fires and contributed to their intensity and spread on livelihood assets of the community.
- To investigate the availability of human capacity in dealing with veld fires and the prevailing fire management structures such as volunteers within the ward based level.
- To examine the magnitude of damage caused by veld fires on physical livelihood assets (e.g. household structures) and coping strategies of the community.
- To investigate veld fire impacts on economic assets (e.g. commercial timber plantations and sugarcane farms) and actions of remediation from owners and government.

1.6 Preliminary literature study

This section situated the study conducted in the context of previous research and livelihood material pertaining to livelihood assets (economic, cultural, human, physical, natural and social assets) and the impact of veld fires on the Mtubatuba community. This chapter also outline the conceptual framework of the chapters of the study. Whilst the main purpose of the preliminary literature review was to survey previous studies, it also introduced the concept of livelihood assets and veld fire paradigms. The CSIR method (CSIR 2010: 96) or strategy used to structure the literature review; the approach began by discussing the relevant scholarly material in the most general terms, and then gradually narrowed the focus of the discussion to come closer and closer to the topic or purpose of the present study.

1.6.1 The advantages of veld fires

According to Forsyth *et al*, (2010: 8) the effect of veld fires within ecosystems become an ecological process and part of natural ecological cycles. It has a fundamental role in sustaining biodiversity. When a veld fire is mistimed, or is too severe, it can result in ecosystem degradation. Without veld fire, many ecosystems would look quite different. Veld fires rejuvenate grasses and fynbos shrub lands and prevent the development of dense woodlands and forests.

1.6.2 The disadvantages of veld fires

The information on loss of life and injury owing to veld fires in the Mtubatuba local municipality and even in its district municipal (uMkhanyakude) was poor, but there was evidence within the fire department register book for incidents responded to in different wards of the municipality. Death rates ran to perhaps twenty to forty in bad veld fires per year. Social losses often accompanied these incidents, involving the loss of homes and livelihoods (Forsyth *et al*, 2010: 8-9).

1.6.3 Vulnerable social assets

Social vulnerability refers to the social structures like households and people that are affected in the event of a veld fire. This can be the amount of lives lost, people injured or traumatic experiences during a veld fire event. Health and life serves as a measure of social assets in the veld fire risk assessment and ósocial vulnerabilityô is described as those living below the average income levels within the district municipality, strongly associated with the rural settlements found within the Mtubatuba community. Documented data of the social impact such as deaths or injuries as a result of fires in Mtubatuba were not available and therefore local participants were utilized (Forsyth *et al*, 2010: 10).

1.6.4 Vulnerable economic assets

The exposed economic assets are items of economic value that are vulnerable to fire damage in the event of veld fires and these assets include infrastructure such as power lines, fodder, livestock, homesteads, resorts and plantation forests (Georg 2013: 53).
Economically significant areas that struggle to recover economically in the event of a fire are categorized and classified as shown in **Table 2** (Kruger *et al*, 2006: 89).

Serious financial loss, affecting a significant portion of the community; Requires external funding (e.g. from disaster management funds) to recover; Stock burnt	4 Major
Localized damage to property; Short-term external assistance required to recover; Some replacement of fences needed	3 Moderate
Minor financial loss; Short-term damage to individual assets; No external assistance required to recover	2 Minor
No damage to property; No economic impact on business; no damage to fences and water articulation systems (plastic pipes)	1 Insignificant

1.6.5 Vulnerable environmental assets

According to the CSIR (2010: 10) environmental vulnerability is the ecological and environmental impact that a veld fire can have on the area in case of a fire event. Some areas are ecologically or environmentally more sensitive than others. Fires can destroy certain ecosystems and species, and some biomes (such as grasslands) can quickly recover within a couple of months. A drought for example will impact upon natural capital and in turn reduce crop yields. In the longer term, a severe drought could impact on a wide range of capitals, including social and human as people emigrate. Climate change as a longer-term trend is seen as an important

factor that can affect such vulnerability for some populations and provide a framework to understand how people might adapt. This information on vegetation and environmental vulnerability contributed toward the classification of the categories of environmental and ecological consequences as shown in **Table 3** (Forsyth *et al*, 2010: 13).

Habitat destruction, temporary loss of species, or requiring several years to recover; Land degradation	4 Major
Serious impact on the environment that will take a few years to recover; Burn scars still Visible 5 years after burning; Stock losses.	3 Moderate
Discernable environmental impact; Assets/vegetation recovers rapidly; Vegetation back to normal the following season.	2 Minor
Minor impact on the environment; Vegetation back to previous condition within the same season provided normal precipitation	1 Insignificant

Preparedness shows the level of communities to prevent and deal with veld fires. Fire risk can be decreased with proper preparedness arrangements. Preparedness refers to the ability of the community to stop the hazard from occurring or be prepared for it (pre-fire event).

1.7 Research design

This research used the observation method through interaction with the household members at their ward base level. The qualitative research method was preferred because it revealed categorises, concepts or understanding that were internal to the households, or the domain or field being studied. Observations done during the research provided new insight to the households in the community.

It develops an understanding of peopleôs opinions about their own lives and the lives of others. It also helps the researcher to generate an in-depth account that would present a lively picture of the research participantsô reality. The qualitative data collection methods seem to be flexible and unstructured (Leedy *et al,* 2005: 121). Qualitative research utilises an inductive form of reasoning and understanding from patterns in the data. Seeks to understand phenomena, determines observations by information-richness of settings and modifies types of observations to enhance knowledge. The data is presented in the form of words, quotes from documents and transcripts. It further utilises a holistic unit of analysis, concentrating on the relationships between elements, concepts and uses words as the basis for analysing rather than numerical data (Edgar 2008: 253).

1.8 Research methodology

The study utilized questionnaires, observations of the phenomenon and personal engagement (with note taking) as a research methodology on the targeted households. The utilization of these three sources of data collection and methodologies resulted in the success of the research project.

1.8.1 Research approach

The research assistants together with the researcher administered the questionnaires to the households of the Mtubatuba local community and one fire fighter in the fire department. The areas in consent with the veld fires were observed for physical appearance. A number of households were randomly selected since there was no formal spatial settlement pattern to be followed, such as the organized linear streets found in urban areas.

1.8.2 Unit of measurement

Households were picked as the ñfamilyò or ñcenterò unit. The family units were groups of people, mostly relatives, sharing the same residence. They ate together and shared all livelihood assets or resources (Leedy *et al,* 2005: 126).

1.8.3 Data collection

The simple random sampling method was used, where a selected household were issued with a questionnaire and assistant to fill. The research assistant, during data collection, left two households in between to allow for an unbiased approach in the sampling process. This method was utilized because of the fact that the study area selected has no formal spatial settlement pattern, such as the organized linear streets found in urban areas. A random sample of 120 households in ward 3 and ward 4 (Mtubatuba) were drawn and a questionnaire was also administered to these households and one fire fighter for more information on veld fires (Leedy *et al*, 2005: 152).

1.8.4 Questionnaire

Qualitative data were collected using questionnaires. The questionnaire was administered to selected households and a fire fighter of the Mtubatuba fire department. The questionnaire contained both closed and open ended questions. The advantage of open-ended questions was that it provided the participants with the freedom to express them rather than being constrained by yes/no questions such as the general feelings on the matter and to get at specific aspects of the issues.

1.8.5 Data analysis

For analysis, a computer application, Microsoft Excel was used to draw tables and graphs. Firstly coding of the responses from the questionnaires were done and statistical tools such as the descriptive statistical tools, including frequencies were used. The frequencies helped in determining the frequencies of occurrence of particular aspects, included in the questionnaire (Rubin *et al,* 1995: 78).

1.9 Limitations and delimitations

1.9.1 Limitations

- Time was a major limiting factor to make a solid conclusion and references needed to be included in such a study.
- People might have exaggerated their responses, so as to make the situation look worse but it was very important to explain to each respondent the purpose of the study

1.9.2 Delimitations

The study limited its focus on the exposure of livelihoods assets to veld fires (social, economic and environmental). Inquiry was in the Mtubatuba local municipality (a family of uMkhanyakude district) and the selected households based on the sampling plan of the study; the findings and conclusions of the study are based on the primary information generated during the course of inquiry with the fire department and the households at the ward base level.

1.10 Significance of the study

The findings of this study intended to benefit the community of the Mtubatuba local municipality, fire department and ward councillors in identifying and addressing issues that were recommended as solutions or control measures in dealing with veld fires around the Mtubatuba local municipality.

1.11 Conclusion

There was a need to identify other veld fire management systems throughout South Africa, their practice and adherence to fire regimes specific to the areas mostly affected. The investigation was more on the ógreal effectô that climate change would have on South Africa and to implement new veld fire management adaption strategies. Furthermore part of the investigation was to find practical applications of new technologies in veld fires management in the Mtubatuba local community which might be beneficial even to the district municipality (Robert 2007: 66).

CHAPTER TWO
REVIEW OF RELATED LITERATURE AND THEORETICAL FRAMEWORK

2.1 Introduction

Southern Africa is one of the worldôs fire hotspots where masses of hectares burn every year. It is a region known for an environment that sustains burning, marked by distinct dry and wet seasons, and combined with low development which necessitates the use of fire in land use management, inadequate policies and institutional infrastructure for fire management, accounts for the high vulnerability to uncontrolled fires (Kruger & Matshate 2006: 35). In South Africa, veld fires cause severe loss of life, property and environment in most areas of the country which means that the associated risk of veld fires in South Africa is huge (Kruger, Forsyth & Matshate. 2006: 36). Veld fire risk consists of two parts; firstly the risk that arises from unwanted veld fires that cause damage to assets and secondly the risk arising in the environment where fire play an ecological role, but ecologically inappropriate fires occur (Kruger *et al*. 2006: 43).

The great challenge in addressing the topic was mainly because of the poor quality and coverage of the available information for the chosen study area. Taking for example, no previous studies ever conducted in Mtubatuba for people caught, injured and their properties destroyed in veld fires every twelve months. Statistics South Africa (StatsSA) reported that among the non-natural causes of death about 10% of all deaths in 2011 (as of the latest reporting year), over 76% were unexplained (Forsyth *et al*. 2010: 22). The communities in most areas of South Africa had been utilizing veld fires as an essential tool for natural resource management for many years (Greg 2001:41). Customarily, fire had been used as a management tool to control vegetation structure and composition, for hunting and to recycle nutrients locked in live and dead biomass. These utilizations had been continuing up to today particularly in the savanna ecosystems of southern Africa (Keeley & van Wilgen 2009: 52).

Nevertheless, indecent use of fires often led to veld fires, which were blazes that get out of control, destroying extensive tracts of indigenous forests, commercial timber plantations, sugarcane and grasslands. Moreover veld fires also resulted in the loss of property and human life (van Wilgen 2009: 65). In the dry winters which were commonly experienced over KwaZulu Natal, in combination with ample grass fuels and ready sources of ignition (both lightning and humans) ensured that fires were a regular feature of grassland landscapes (Keeley & van Wilgen 2009: 85). At the farm level, farmers should be responsible for establishing fire breaks before the start of the dry season (winter), which is considered as the fire season. Furthermore, most of commercial farms must be fenced to restrict human movement, thereby controlling veld fires associated with hunting and honey harvesting. The present system, put in place measures in dealing with veld fires aimed at mitigating and preventing the adverse effects of veld fires (Nyamadzawo 2013: 44).

Prior to the land reform programme commercial farmers occupied about 17 million hectares (ha), resettlement farmers 3.3 million (ha) and small-scale commercial farmers 1.2 million (ha). In the year 2001, the Government initiated a land reform program to acquire 13 million (ha) of the 18 million (ha) in large-scale agriculture to create two new categories of farming subsectors (Nyamadzawo 2013: 62). The land of about 15.6 million (ha) is now communally owned land, and the rest is a state land (Nyamadzawo 2013: 63). Nevertheless, lately there has been a huge increase in the incidences of uncontrolled veld fires which had inflicted substantial damage to agricultural land, national parks, indigenous forests, commercial timber plantations, sugarcane and communal grazing areas. Despite of the enacted acts that aimed at preventing and mitigating veld fires such as the National Veld and Forest Fire Act No. 101of 1998 and Environmental Management Act No. 107 of 2007. The Traditional Leaders Act No. 20 of 1998, veld fires remain a perennial problem (Nyamadzawo 2013: 66).

2.2 Review of veld fires

Veld fires are normally classified according to where they are burning and the temperature of the fire. They are classified as surface fires which burn along the ground or crown fires that burn the upper part of the trees. The intensity of burning can also be used for further classification of fires as cool or hot fires. Cool fires, are usually fires that occur early in the dry season (Trollope *et al.* 1990: 86). The period of early dry season is from late April to late June when there is still moisture in leaves and grass. Whilst on the other hand hot fires are experienced during the late dry season of August to October. Hot fires occur when grass and some trees have dried up because of the sunny conditions experienced in the period of August to October. Hot veld fires are a combination of surface fires and crown fires and in the process might completely wipe out all ground cover and even tree tops. On the other hand, cool fires leave a mosaic of burnt and un-burnt patches (Williams *et al.* 1998: 68).

2.3 Intercontinental veld fire statistics

In the Global Veld fire Statistics, an information newsletter was released by the Geneva Association in 2010, revealed just how big an impact veld fires has on the global community. The Global Veld fire Statistics itself showed the cost of direct fire loss to leading national GDPs throughout the world from the year 2005 to 2007. However, Austria had the highest loss of 0.27% of its GDP directly due to veld fire damages on livelihood assets. Other affected countries are as follows Belgium, Switzerland and Norway with losses of 0.2% - 0.25% and 0.22% of their GDPs. Looking at the southern hemisphere New Zealand and Australia had the uppermost loss of 0.2% and 0.09% respectively of its GDP lost due to veld fire damages (Anderson 2003: 231). The statistics showed veld fire-related deaths for every 100 000 persons in national populations between the year 2005 and 2007 and revealed that Finland had the highest veld fire-related death rate of 1.94 deaths per 100 000 persons, followed by Hungry, Japan and Poland with 1.84, 1.68, and 1.53 respectively.

However, in the southern hemisphere, New Zealand had the highest rate of 0.74 followed by Australia with a rate of 0.53 deaths per 100 000 persons (Alison 2011: 108). In 2005 the national veld fire death rate was 11.3 deaths per million, for example 1.33 per 100 000 persons in the United States. Therefore factors such as climate, poverty, education and demographics played a major role in these statistics (Anderson 2003: 246). However, in the United States of America reports from different organisations indicated that the threat of veld fires were increasing and the predictions also suggested that veld fires became more frequent and more dangerous with the global warming phenomenon. The Forest Fire Centres once mentioned in August 2009 that, longer and more severe fire seasons can be expected in the near future.

Other studies published in the Journals of Geophysical Research revealed that veld fires would increase by as much as 50% by 2050, judgement based from current veld fire trends in the United State of America. Around the globe temperatures are arising, forests become dryer than usual; this concludes that more severe veld fires are expected. The fire regimes and control thereof, are a major challenge (Anderson 2003: 252).

2.4 The manifestation of veld fires in Africa

In Africa veld fires for land management had been part of everyday life for thousands of years throughout history and are still so today. In each and every year the African landscapes are purposely set on fire to create and maintain farmland and grazing areas for livestock. The rural community uses fire for cooking; keeping their houses warm, to return nutrients to the soil, and to convert natural ecosystems to agricultural land. Therefore burning of areas shift from north to south over the course of a year in step with the continentôs rainy and dry seasons (DWAF 2003: 85).

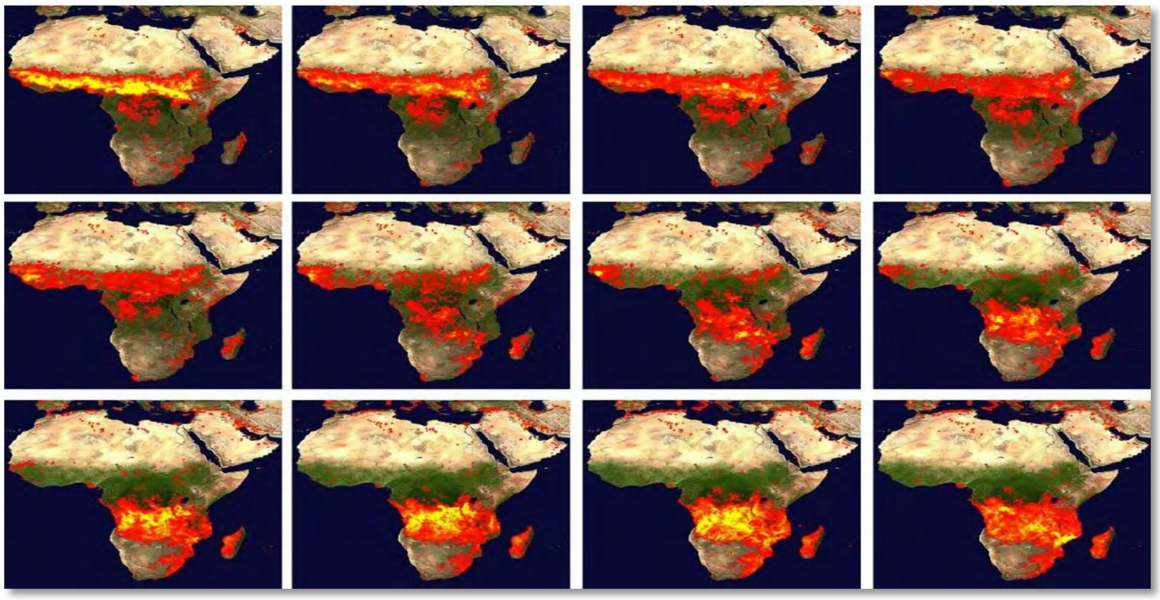

Figure 2: Trend of veld fires in Africa
(***Source*:** DWAF 2003: 89).

The map above illustrates the veld fires moving along the African regions throughout the year. In the map the red sections show the burning of veld fire prone areas. Therefore, looking at the desert regions in Northern Africa do not burn as there was little fuel or vegetation to support fire (DWAF 2003: 93). The veld fires were part of the natural cycle of the savannas of the continent and seasonally dry grasslands. In times where the fire-return interval was short, that might cause the land to become degraded and unusable for either farming or grazing. The land in arid areas was degraded due to the over-use of fire hence overgrazing could also create or form patches of desert. The massive degree of burning in Africa done each year created carbon dioxide and aerosol particles, both of which contributed to the global climate change phenomena (DWAF 2003: 102).

The control of veld fires in the savannas of Africa became more multifaceted in the coming future hence changes in global climate had both direct and indirect impacts on veld fires and their adverse effects; furthermore there was an increase in CO2 concentrations in the atmosphere that affected the balance between grasses and trees. The invasion by alien plants also had major impacts and increasing human population resulted in ever-increasing sources of ignition (Van Wilgen *et al*. 2004: 215). Therefore the development of veld fire management strategies in southern Africa over the past thousands years had reflected increasing levels of ecological understanding. Positive attitudes towards fire and its management practice have changed radically from the views of the early 1920s. Based on the above ideas, many critically important long-term burning experiments were initiated in the early 1950s and 1960s.

The ecological understanding continued to advance further and fires were finally recognised as a key ecosystem process that was both inevitable and necessary. Furthermore the advancement of fire management strategies and philosophies reflected the innovation of the mind-set (Van Wilgen *et al*. 2004:122). The ability for people to deal with dynamic ecosystem management challenges within the perspective of imperfect understanding should be determined by how good, and how fast, we could learn from our past experiences (Van Wilgen *et al*. 2004: 131).

2.5 Veld fires in South Africa

Historically veld fires were ignited mainly as a result of lightning. South Africa is one of the most prone countries to thunderstorms and lightning and considerable evidence is available on the high frequency of thunderstorms and lightning in eastern areas of Nquthu and Northern part of UMhlabuyalingana (Levine 1996: s.p.). Lightning fires occurred mainly in autumn and early spring (FPA Model Business plan 1998: 88). While recognizing the primary ignition role of lightning in causing vegetation fires in savannah areas of South Africa the stage had now been reached that in most regions humans have contributed more to fire ignition than lightning (Crutzen & Goldammer 1993: 112).

In the Kruger National Park the anthropogenic fires (fires caused by humans) turned into the predominant ignition source of fires in that type of savannah community (Troloppe 1993: 38). Anthropogenic fires are either because of negligence or an accident where the wind diverts a fire spark away from its point of origin. Dumping sites were considered the source of ignition of veld fires. Numerous run-away veld fires were ignited during controlled burning where people were busy with fire-breaks or the burning of crop residues (particularly irrigation farmers). Another major cause for veld fires in South Africa is arson where a fire is deliberately ignited as a form of vandalism (Troloppe 1993: 39). Fact of the matter is that veld fires form part of the eco-system management and should be managed in order to reduce the damage caused by fires on economic, environment and social assets (Troloppe 1993: 41).

The local community had been the key agent for maintaining veld fires that has created a variety of ecosystems. The belief is that many South African forest types, such as the commercial timber forests and other of same nature are of pyrogenic origin (Sameer 2002: 72). The reports that have extensive tracts of grassland in KwaZulu-Natal are due to a great veld fire that destroyed forests around 2012, following a severe drought declaration at UMkhanyakude District, the headquarters of the Mtubatuba local municipality (IDP 2015/16: 92). In South Africa, veld fires occur in low laying and high veld areas of the country, which experience a long dry season and high fuel loads (Sameer 2002: 74). Due to the 2015 July declaration of drought conditions in KwaZulu-Natal, forests were susceptible to veld fires, especially if there was a combination of human activities and a severe drought condition. In areas such as Mbonambi extensive veld fires occurred due to recurring droughts (Sameer 2002: 87).

Even though veld fires had occurred in South Africa for thousands of years and are an important factor in the development of terrestrial ecosystems, concerns about changes in fire regimes and their impacts are growing. For example, Sameer (2002: 89) noted the increasing population pressure and demand for agricultural, grazing and settlement land had brought new fire patterns to the land which is more detrimental to the forest environment (Sameer 2002: 96). The vegetation is transformed and degraded with negative impacts on biodiversity and whatever loss of forests to veld fires is undesirable, and the influence of veld fires on human life, property and

livelihood is more rigorous. Further concerns are that many human activities which triggered veld fires directly or indirectly contributed to global climate change (Combrinck 2003: 42).

The community also rely on veld fires as a land clearing and preparation tool to

- Encourage growth of new shoots so that livestock can be lured to the area
- Clear vegetation to increase visibility of snakes or other wild animals
- Suppress weeds and pests

On the 31st of August 2012 ôWorking on Fireô reported for South Africa: ñSome of the most devastating veld fires of the year raged through the north eastern parts of the country. Forestry plantations, agricultural land, buildings and livestock were destroyed. Huge areas of Sparse Arid Woodland and Moist Woodland were burnt in the same period (Forsyth *et al.* 2010: 219).

2.6 Veld fires in KwaZulu-Natal

Huge veld fires blown by gale-force wind burnt about six (6) people dead and destroyed thousands of hectares of agricultural and grazing land (News 24, 12 August 2010: 7). Working on Fire (WoF), a government-supported veld fire-fighting and prevention project, reported about 150 veld fires that had been raging the areas of KwaZulu-Natal. News 24 (2010: 8) reported about 20 to 40 rural households were damaged by veld fires. The KwaZulu-Natal farmers were feeling the effects of deadly veld fires that ripped through Isimangaliso wetland parts of Mtubatuba Heritage Site. Many significant impacts occurred, like the destruction of several farms which resulted in job losses for some workers. Almost 600 sheep and cows were killed and the animals that survived have little land left to graze on (News 24, 12 August 2010: 9). It was also reported that a runaway veld fires left a trail of destruction which resulted in the loss of livelihood and the destruction of property. The households were also evacuated from areas where fire damage was possible. The causes of the veld fires were unknown (News 24, 12 August 2010: 10).

2.7 Veld fires in uMkhanyakude District Municipality

The farmers on the Makhathini Farm in the uMkhanyakude District (Mtubatuba Municipality headquarters in KZN) lost a few tons of maize, a combined harvester and other farm equipment from veld fires in 2011(UKDM IDP 2014/15: 232). In addition, other emergent farmers in the same area also lost their crops both infield and when storage sheds were destroyed by veld fires. In general, the damage also increased food insecurity among households. However, in some cases other farmers lost livestock due to veld fires, and there had been complete destruction of rangelands to such an extent that livestock were left with no grazing area (UKDM IDP 2014/15: 233).

2.7.1 Veld fires in Mtubatuba Local Municipality

Mtubatuba is a region known for an environment that sustains burning, marked by distinct dry and wet periods, and combined with low development areas which necessitates the use of fire in land use management, inadequate policies and institutional infrastructure for fire management, accounts for the high vulnerability to uncontrolled fires (UKDM report 2014/15: 242). In its role of disaster management co-ordination, the Mtubatuba local municipality has a fire unit responsible for incidents in supporting the community in two (2) highly affected of nineteen wards of the municipality. The community of ward 3 and ward 4 are facing a persisting challenge of veld fires. The damage to commercial timber plantations, sugarcane farms, crop farms and grazing land caused by veld fires had brought hardship to the households who are employed and those who are beneficiaries in these farms (UKDM report 2014/15: 242). In the financial year 2014/15 the most occurred incidents were veld fires which contributed significantly in the destruction of commercial timber plantations and sugarcane farms of the community (UKDM report 2014/15: 245).

2.7.2 The five livelihood assets pentagon

The pentagons were developed to enable information about the communityôs assets to be presented visually, thereby bringing to life important inter-relationships between the various assets.

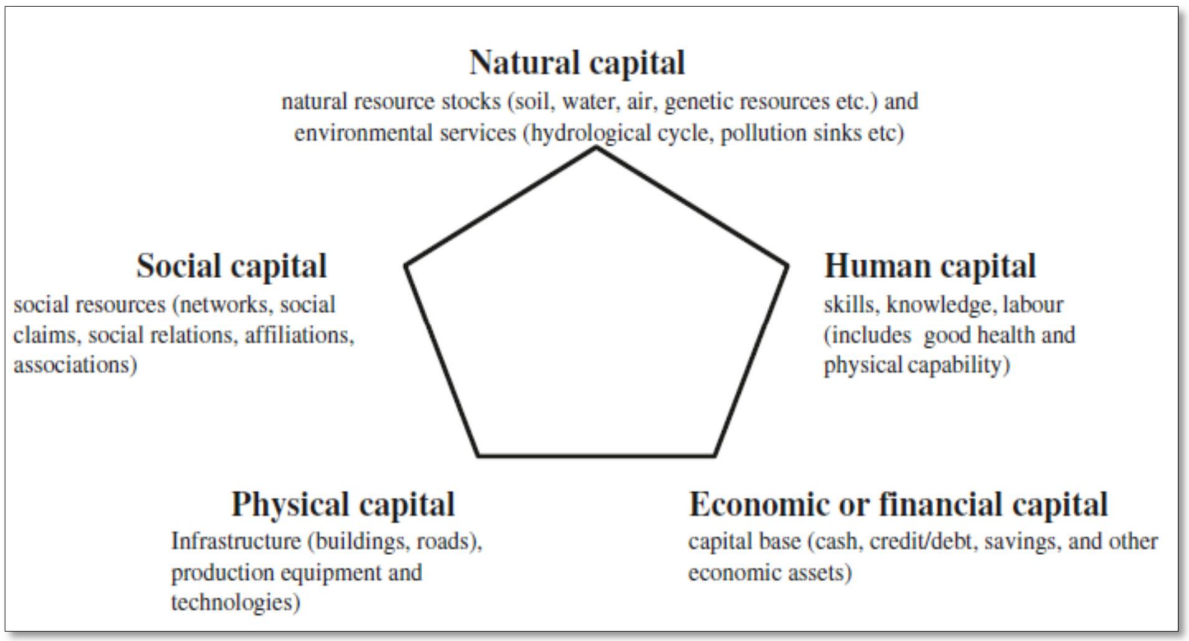

Figure 4: The five capitals of sustainable livelihood
(***Source:*** Scoones, 1998: 124)

The shape of the pentagon was used to show variation in the communityôs access to assets. The centre point of the pentagon represents zero access to assets while the outer perimeter represents maximum access to assets. It is important to note that a single physical asset could generate multiple benefits. If someone had secure access to land (natural capital) they might also be well-endowed with financial capital, as they were able to use the land for direct productive activities as well as collateral for loans (Emmanuel 2012: 13). Similarly, livestock may generate social capital for owners while at the same time being utilized as profitable physical capital (like animal traction). In order to develop a good understanding of these pentagons one had to look beyond the assets themselves and think about prevailing cultural practices and the types of structures and processes that transformed assets into livelihood outcomes. Pentagons could be useful as a focus

point to see how these served the needs of communities or likely trade-offs between different assets (Emmanuel 2012: 13).

2.8 The sustainable livelihoods assets framework

The livelihood framework is concerned first and foremost with people. It seeks to gain a precise and realistic understanding of peopleôs strengths (assets or resources) and how they attempt to convert these assets into positive livelihood outcomes. The approach is founded on a belief that people require a range of assets to achieve positive livelihood outcomes and living; no single category of assets on its own is sufficient to yield all livelihood outcomes that people seek. This is particularly for people with a low standard of living whose access to any given category of assets tends to be very limited (Morse & McNamara 2013: 12).

Morse & McNamara (2013: 15) states that livelihoods ñcomprises the capabilities, assets and activities Natural capital (natural resources, land, water required for a means of living: a livelihood is sustainable [when it can] cope and recover from stress and shocks, maintain or enhance its capabilities and assets, and provide, sustainable livelihoods for the next generation and which contributes net benefits to other livelihood at local and global levels in the long and short termsò.

The occurrence of a disaster leads to unsustainable livelihoods. However communities can mitigate, prepare and prevent disasters by drawing upon and combining five types of capital namely;

- Human capital (skills, knowledge, health and energy)
- Social capital (networks, groups, institutions)
- Physical capital (infrastructure, technology and equipment)
- Financial capital (savings, credit), fauna and flora) (Morse & McNamara 2013: 18).
- provided a checklist of important issues for each livelihood asset
- focused on the influences of each asset to the community

- Emphasised the multiple interactions between the various factors which affected livelihoods of the community.

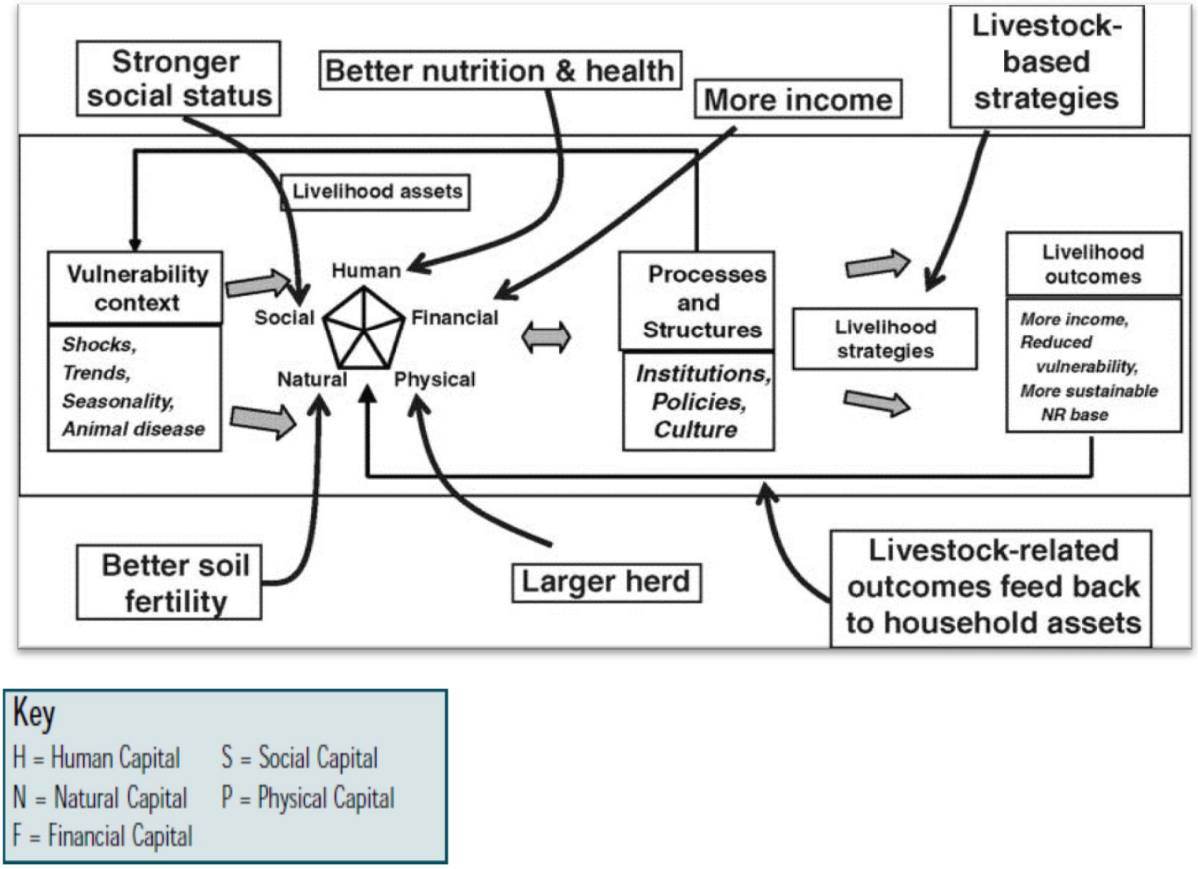

Figure 3: *Sustainable livelihood assets framework model*
(Morse & McNamara 2013: 56)

The framework aimed at helping each member of the community with different perspectives to engage in discussion about the main factors that affected livelihoods, the communityôs relative importance and the way in which they interacted with each other. This, in turn, helped in the identification of appropriate support for livelihoods (Morse & McNamara 2013: 28).

2.9 Vulnerability context

The vulnerability context framed the external environment in which people exist. The communityôs livelihoods and the wider availability of assets were primarily affected by critical trends as well as by shocks and seasonality**,** over which they have limited or no control. The factors that made up the vulnerability context were important because they had a direct impact upon the communityôs asset status and the options that were open to them in pursuit of beneficial livelihood outcomes (Morse & McNamara 2013: 32).

2.11 Human capital

The human capital is understood to include the skills and abilities of people, as well as the bodies of knowledge in order to increase our understanding. Human capital also addresses focus on assets to be inclusive, participatory and to be proactive in shaping the future of the community (Emmanuel 2012: 41). Human capital represented knowledge that together enables the community to pursue different livelihood strategies and objectives. At a household level human capital is a factor of the amount and quality of labour available. This varies according to household size and skill levels. Human capital appears in the generic framework as a livelihood asset, that is, as a building block of achieving livelihood outcomes. It is therefore necessary, though not on its own sufficient, for the achievement of positive livelihood outcomes (Emmanuel 2012: 45).

2.12 Impacts of veld fires on human health

The noticeable adverse effects of veld fires are destruction of property. However, the hazardous chemicals released from the burning of land fuels, has a significant impact on human health. Veld fire smoke is composed of carbon dioxide and water vapour. The inhalation of smoke from a veld fire could be a health hazard. In addition, the principle health concern is the inhalation of particulate matter and carbon monoxide (Lynn 2014: 59). The other widespread smoke components present in lower concentrations are carbon monoxide, formaldehyde and polyromantic hydrocarbons. Furthermore, the small particulates are suspended in the air which

come in solid form are also present in smoke. Apart from carbon dioxidesô high concentration in smoke, it poses low health risk due to its low toxicity. The carbon monoxide gas and fine particulate matter have been identified as the major health threats. However, other chemicals are considered to be significant hazards but are found in concentrations that are too low to cause detectable health effects (Lynn 2014: 65).

Veld fire smoke exposure to an individual depends on the length, severity, duration and closeness of the fire. In addition, fire fighters are at the greatest risk for intense and endless well-being impacts resulting from veld fire smoke exposure. Due to the fire-fighterôs occupational duties, they are frequently exposed to hazardous chemicals at a close proximity for longer periods of time (Lynn 2014: 78). The community surrounded by veld fires are exposed to lower concentrations of chemicals, but they are at a greater risk for indirect exposure through water or soil contamination. However, the exposure to residents is greatly dependent on individual susceptibility. Furthermore, vulnerable persons such as children, the elderly, smokers and pregnant women are at an increased risk due to already compromised body systems, even when the exposures are present at low chemical concentrations and for relatively short exposure periods (Lynn 2014: 85).

2.13 Capacitating human capital for the poor

In many cases it is necessary to develop a community training programme or awareness. The most appropriate mechanism for such support might be a fire training programme and awareness campaigns for the affected community. Sector programmes can adopt an integrated approach to human capital development, drawing on information gathered through livelihood analysis to ensure that efforts are focused where it is most needed (for example, on a devastated community) (Lynn 2014: 97).

2.14 Social capital

In the context of the sustainable livelihoods framework, this means the social resources upon which a community draw in pursuit of their livelihood objectives.

2.14.1 Social vulnerability

Social vulnerability refers to the social structures such as households and community that are affected in the event of a veld fire. This can be the amount of lives lost, people injured or traumatic experiences during a veld fire event. Documented data of the social impact such as deaths or injuries as a result of veld fires in Mtubatuba, if not available-therefore participants will be utilized (Finiza 2011: 108). At the household level, loss of shelter through veld fires had often left families traumatized (Finiza 2011: 113). The community exposed to the veld fires might experience grief and loss of property, such as the destruction of a home or damage to personal goods, can be a source of grief. The lack of shelter, the affected families may sleep in open space with no food and proper water and sanitation facilities and this may result in stress. The feelings of helplessness may arise among people whose lives and property are threatened by veld fires (Machilis 2002: 97).

In many African cultures, poor homeless people are often stigmatized, and indirectly resulted in negative social effects and psychosocial wellbeing. For example, loss of livelihood sources may result in complete disintegration of the family unit. However, for vulnerable smallholder farmers, loss of assets, housing and crop harvest further exacerbate their income security, which might usher them deep into a poverty cycle (Finiza 2011: 116). Furthermore, farmers would have lost their other source of income if the forests were destroyed by veld fires. Most of the community in rural areas depended on both non-forest and forest products derived from forests and woodlands and when they are destroyed by veld fires the economic cost of these veld fires are substantial. However, the stress could be ranging from temporary frustration, to temporary or permanent reduction of health-related quality of life to post-traumatic stress disorder (PTSD) feeling jumpy and disturbing memories (Finiza 2011: 121).

Social capital had a direct impact upon other types of capital:

- By improving the efficiency of economic relations, which meant a wealthier community with ôhigher levelsôof social capital.
- The development of knowledge and sharing of that knowledge gave a close relationship between social and human capital.

2.15 Natural capital

Keeley & van Wilgen (2009: 94) wrote that natural capital refers to those assets that abide in a location, including resources, amenities, and natural beauty. It might include parks, farm land, and features of the landscape or of nature. There is a wide variation in the resources that make up natural capital, from tangible private goods such as the commercial timber plantations, sugarcane farms and land used directly for production. Within the sustainable livelihoods framework, many of the shocks that devastated the livelihoods of the poor were themselves natural processes that destroyed natural capital (e.g. veld fires that destroyed natural forests, timber plantations and grazing land).

The consequence of repeated burns was damaging because it caused the extinction of some tree species and the replacement of vast areas of forest with grasslands (Keeley & van Wilgen 2009: 88). In the natural tropical forests, a single veld fire could reduce woody plant richness by a third to two-thirds depending on fire severity and could have negative impacts on a diverse range of faunal components. Veld fires could also damage the seed bank, seedlings and saplings and this might hinder recovery of the original species. Veld fires typically result in some mortality of individual seeds, stems and plants (Keeley & van Wilgen 2009: 94). Nevertheless, the scale of destruction was dependent upon a huge number of factors including fire intensity and species involved. Although trees in savannas were often thick barked but the regeneration of new plants was the main obstacle for maintaining populations as seedlings and saplings face frequent and severe fire damage in savannas.

Given that fires occurred several times in a decade, seedlings would need to acquire the ability to re-sprout rapidly (Keeley 2009: 102). Veld fires resulted in the loss of key organisms in forest ecosystems, fruit-eating birds, pollinators, decomposers, amphibians and reptiles resulting in a overall decline in these species. For example, the loss of forest food products such as monkey fruits during the dry season resulted in the animals depending in these fruits to migrate to other areas or invading agricultural crops. In addition, veld fires also destroyed leaf litter and its associated arthropod community, further reducing food palatable and availability for omnivores and carnivores (Keeley 2009: 111). However the impacts of veld fires were not always negative as fires could also improve the growth of green grass which provides grazing for animals in the dry season, removal of old and normally less palatable dry plant material, the control and reduction of bush encroachment, the stimulation of germination of some useful species of grass, trees and also the limitation of animal parasites (WWF 2001: 86).

The surviving seeds might be stimulated to germinate after a fire and many woody plants in savannas produce multiple coppice shoots to replace those lost or damaged through veld fires. There were few studies on the effects of veld fires on forest biodiversity in South Africa (Nyamadzawo 2013: 94). Clearly, natural capital is very important to those who derive all or part of their livelihoods from resource-based activities (farming, fishing, gathering in forests, mineral extraction etc.). None of us would survive without the help of key environmental services and food produced from natural capital. Health (human capital) tended to suffer in areas where air quality is poor as a result of natural disasters (e.g. veld fires). And although our understanding of linkages between resources remains limited, we knew that we depended, for our health and well-being, upon the continued functioning of complex ecosystems (which were often undervalued until the adverse effects of disturbing them become apparent) (Nyamadzawo 2013: 96).

2.16 Physical capital

Physical capital involves the fundamental structures and producer goods expected to support livelihoods (Emmanuel 2011: 43).

- Structures consist of some changes after being affected by veld fires to the physical environment that helped the community to meet their basic needs and to be more productive.
- Producer goods (indigenous forests, commercial timber plantation, sugarcane etc.) were the tools and equipment that the community utilized to function more productively

The following components of structures are usually essential for sustainable livelihoods:

- secure shelter and buildings;
- adequate water supply and sanitation

Structures (houses) are commonly a community good or service that is used with or without direct payment. Exceptions include shelter, which is often privately owned. The emphasis is therefore on physical assets providing a level of service to the livelihood of the community that not only meets the immediate requirements of each user but is affordable in the long term. It can also be important to provide simultaneous support to skill and capacity development to ensure effective management by local communities (Emmanuel 2011: 48).

2.17 Financial capital

Financial asset refers to the financial resources available to the community as financial muscles to support their livelihood and to accumulate wealth for future community development. In many instances financial capital became the key focus of community efforts. For example, a household member of the community might seek assistance to rebuild a burnt house or rehabilitation of a public facility. Financial capital comprises the important availability of cash or equivalent that enables the community to adopt different livelihood strategies (Kollmair & Gamper 2002: 56).

2.17.1 There are two main sources of financial capital

- ***Available stocks:*** Savings are the preferred type of financial capital because they do not have liabilities attached and usually do not entail reliance on others. They can be held in form of liquid assets such as livestock and commercial farms (Kollmair & Gamper 2002: 58).
- ***Regular inflows of money:*** Excluding earned income, the most common types of inflows are pensions. In order to make a positive contribution to financial capital these inflows must be reliable but a complete reliability can never be guaranteed since working in farms does not provide such (Kollmair & Gamper 2002: 69).

Financial capital is probably the most versatile of the five categories of assets.

- It can be converted ï with varying degrees of ease, depending upon *Transforming Structures and Processes* ï into other types of capital.
- It can be used for direct achievement of livelihood outcomes ï for example when food is purchased to reduce food insecurity after damage by fires.

However, it is also the asset that tends to be the least available to the poor. Indeed, it is because the poor lack financial capital that other types of capital are so important to them (Kollmair & Gamper 2002: 79).

2.17.2 Economic vulnerability

Highly productive or economically significant areas that struggle to recover economically in the event of a veld fire should be mapped. The timber plantations owned by Mondi and Sappi employs many skilled and unskilled people from the community directly at its peak of harvest in ward 4. The destruction of timber plantations by fires had direct consequences on the jobs of the local community and source of income. Much of the economic loss was not quantifiable in monetary terms (Sappi report 2011: 56). However, in many cases, veld fires caused heavy financial loss in terms of people (within the community) losing their homes and property. The biggest loss from veld fires was felt by the local community who depended on these commercial timber plantations and sugarcane farms for jobs (Sappi report 2011: 58).

Most of the rural community in ward 4 rely heavily on job employment from commercial timber plantations whereas the ward 3 community rely on sugarcane farms, thus it can be assumed that their income is dependent on these livelihood assets. However, smoke and "haze" from veld fires may cause respiratory problems to the community. Respiratory diseases such as asthma, skin and eye diseases linked to veld fires have better chance of occurrence. The economic impacts of fires were huge, though they were largely un-quantified, thus more of such studies were needed for further discoveries (Sappi report 2011: 67).

2.18 Environmental parameters

The veld fire behaviour is affected by fuel, weather characteristics, and topography. Thus, weather influences veld fires through wind and moisture. Whenever the wind creases the veld, fire spread in the wind direction, higher temperature makes the fire burn faster, while higher amounts of rain and snow might slow it down or extinguish it altogether (Lynn, 2014:98). Weather involving fast wind changes is dangerous, since they could suddenly change the veld fire direction and behaviour. Such weather includes cold fronts, thunderstorm downdrafts, sea and land breeze, and diurnal slope winds (Lynn 2014: 99).

Veld fire fuel includes grass, wood and anything else that could be burnt. The small dry twigs burn faster while large logs burn slower; dry fuel ignites more easily and burns faster than wet fuel. Topography factors that influenced veld fires included the orientation toward the sun, which influence the amount of energy received from the sun and the slope (Lynn 2014: 120). Rain increases the fuel moisture; high relative humidity slows the drying of the fuel, while wind could make fuel dry faster. Wind could change the fire-accelerating effect of slopes to effects such as down slope windstorms. However, fuel properties may vary with topography as plant density varies with elevation with respect to the sun (Lynn 2014: 126). The heat and moisture created by the veld fires feed back into the atmosphere, creating intense wind that drive the fire behaviour. Therefore, heat produced by the veld fire changes the temperature of the atmosphere and creates

strong updrafts, which could change the direction of surface wind. The water vapour released by the fire changes the moisture balance of the atmosphere (Lynn 2014: 152).

2.18.1 Weather related factors

The weather related factors such as drought, heat waves, climate change such as El Nino, and regional weather patterns such as high-pressure ridges could increase the risk and change the behaviour of veld fires radically. The prolonged years of precipitation followed by warm periods could encourage more widespread fires and longer fire seasons (Alison 2011: 224). A single element does not always cause an increase in veld fire activity. For example, veld fires would not occur during a drought period alone, unless accompanied by other factors, such as lightning and strong winds (Alison 2011: 235). The veld fire intensity increased during daytime hours. Whereas the burn rates of smouldering logs are up to five times greater during the day due to lower humidity, increased temperatures, and increased wind speeds. The sun rays warm the ground during the day which creates air currents that travel uphill.

However at night the land cools, creating air currents that travel downhill (Alison 2011: 265). Veld fires are fanned by these winds and often follow the air currents over hills and through valleys. Veld fire suppression operations in South Africa revolve around a 24-hour fire day that begins at 10:00 a.m. due to the predictable increase in intensity resulting from the daytime heat (Alison 2011: 266).

The vertical raise of a severe thunderstorm could be enhanced in the area of a large veld fire, which could drive smoke, soot, and other particulate matter as high as the lower stratosphere. In the past years, the prevailing scientific theories held that most particles in the stratosphere came from volcanoes, but smoke and other veld fire emissions have been detected from the lower stratosphere. The increase in the fire by-products in the stratosphere can increase ozone concentration beyond safe levels. Veld fires could affect climate and weather and have major impacts on atmospheric pollution which indirectly affect human health (Alison 2011: 342).

2.18.2 Intensity

The intensity of a veld fire refers to the size and the heat of a fire at a specific point. The intensity is directly correlated with the fuel load or type and size of vegetation if all other factors such as wind and temperature remain constant. Fuel load refers to the amount or density of the vegetation. If there is high density of vegetation like a forest or dense grassland and a fire event occurs, flames are expected to be very high which means that there is a high fuel load. In the case of lower density vegetation like the Karoo, the intensity of the flames is expected to be much lower because there is little vegetation or ñ*fuel"* for the fire to burn. Fuel load is measured in kg/ha. Other factors apart from fuel load that also influence the intensity of a veld fire is the age of the grass. Older grasses might burn with more intensity than younger or newer grasses (Willis, van Wilgen, Tolhurst, Everson, D' Abreton, & Flemming 2001: 86).

2.18.3 Fuels for veld fires

The basic factors which determine the conditions whether a veld fire would occur include the presence of fuel, oxygen and a source of ignition. Fuel is live and dead vegetation that accumulate over time. The lifeless leaves, twigs and bark build up as they fall from trees, but some of these dead materials are decomposed by insects. Fuel can be characterised by type, size, quantity, arrangement and moisture content (Parks & Wildlife 2013: 275).

The most common types of fuels include:

- grass
- forest-litter lying on the ground
- small-shrubs
- trees; logs; stumps and bark

The matter of concern is fuel size which is classified as fine or heavy. Fine fuels are matters such as grasses and small twigs. Whereas heavy fuels include branches, logs and stumps. Heavy fuels do not contribute to rate of spread or flame size, but add significantly to the total amount of heat released and make fire suppression more difficult (Parks & Wildlife 2013: 282). The most

important part to be considered is the arrangement of fuel that can affect fire behaviour. Fuel that is considered tightly packed is less likely to burn due to a lack of oxygen, whereas loosely arranged fuel burn with more ferocity due to more oxygen. Furthermore fuel means larger flames and greater fire intensity (Parks & Wildlife 2013: 311).

It takes about five to eight years for fuel loads, in most forest types, to build up to a point where fire intensity becomes dangerous under summer conditions. In low fuel areas where veld fires can be easily controlled and fire runs in high fuel areas be minimised, enables safe and effective fire suppression operations (Parks & Wildlife 2013: 324). Patch burning is intended to provide protection to the environment and to communities, and is usually conducted in spring and autumn when weather is mild and fire behaviour is moderate and easier to manage (Parks & Wildlife 2013: 372).

2.18.4 Fuel moisture

The dry fuel burn quickly compared to damp or wet fuel that may not burn at all. As a matter of fact, the time given that rainfall and the amount of rain received is a significant consideration in assessing veld fire danger. It is also a measure of drought factor or moisture deficit and will also be used as an indicator of extreme veld fire weather conditions (WWF 2001: 54).

2.18.5 Wind speed

The wind speed acts to drive a fire by blowing the flames into fresh fuel, bringing it to ignition point and providing a continuous supply of oxygen. However, wind also promotes the rapid spread of fire by spotting, which is the ignition of new fires by burning embers lofted into the air by wind. The wind speed has a threshold of around 12 to 15km/h which makes a significant difference in the behaviour of veld fires in the open space (WWF 2001: 76). Furthermore when wind speed is below the threshold, fires with heavy fuel loads burn slowly. However, even a slight increase in wind speed above the threshold results in a significant increase in fire behaviour and advancement (WWF 2001: 82).

2.18.6 Ambient temperature

The higher the temperature the more likely it is that a fire can start or continue to burn. This is because the fuel is closer to its ignition point at high temperatures and pre-heated fuel loads burn faster (DWAF 2003: 85).

2.18.7 Relative humidity

The dry air plays a major role in promoting greater fire intensity than moist air. Vegetation becomes more flammable at a low humidity because they release their moisture more easily (DWAF 2003: 96).

2.18.8 Slope angle

Veld fires pre-heat their fuel source through radiation and convection. As a result of the heat transfer effects, veld fires accelerate when travelling uphill and decelerate when travelling downhill. Therefore the steepness of the slope plays an important role in the rate of fire spread. As a matter of fact the speed of a fire front advancing can double with every 10 degree increase in a slope so that on a 20 degree slope, the speed of advancement is four times greater than on flat ground (DWAF 2003: 112).

2.19 The advantages of veld fires

The veld fires within ecosystems are ecological processes and part of natural ecological cycles. Veld fires have a fundamental role in sustaining biodiversity. However, when fire is mistimed, occurring too frequently or is too severe, it can result in ecosystem degradation. However, without fire, many ecosystems would look quite different. Veld fires rejuvenate grasses, fynbos and shrub lands and also prevent the development of dense woodlands and forests (Bond 1997: 36). Veld fires have been frequently present in most southern African landscapes for millions of years. The indigenous species would not have persisted if they could not cope with fires. In addition, current interpretations of the role of fire recognize that it has been a major factor in the

evolution of plant species in fire-prone areas, and that many component plant species require fire to exist.

Maintaining fire as an ecosystem process is an important aspect of ecosystem management and, conversely, excluding fire can damage ecosystems (Bond 1997: 48). Veld fires are believed to be an ecological imperative in many of South Africaôs indigenous, fire- prone ecosystems such as grassland, savannah and fynbos areas (Bond 1997: 78). In addition veld fires are known to be an important factor in determining plant community composition and distribution. There are many examples of plant, and even animal, species that are fire dependent. The adaptations they exhibit range from tolerance to dependence (Bond 1997: 84).

Such examples include:

- Sprouting, where a large proportion of plants in fire-prone areas have the ability to sprout after fire, either from below-ground roots or from buds protected by a fire-resistant bark.
- Fire typically kills the parent plants, but this releases the seeds and they germinate during the following rainy season. Furthermore fires are essential for such species ï without fire, the plants lose energy and die. The seeds cannot successfully germinate and establish in the dense, old vegetation. They require the competing plants to be removed by fire. They lay their eggs underground before the fire season and the eggs hatch after the fire season has passed. This enables the species to survive even though the individuals often are killed by fires (CSIR report 2010: 154).
- Veld fires-stimulate flowering to occur in many species which are stimulated to flower, often in masses, following fires. However, veld fires thus offer the best opportunity for seed production and germination of these plants (CSIR report 2010: 156).
- Dependence on fire-induced nutrient flushes, where animals, such as the Roan antelope, calve in the middle of the dry season, when green grass is scarce. The females need the protein flush that follows a fire to provide enough milk for their calves (CSIR report 2010: 157).

- Some birds, such as the wattle plover, require the burned areas as nesting sites, and have eggs camouflaged as charcoal (CSIR report 2010: 161).
- The build-up of debris and forest litter over time can choke undergrowth and compete with the trees for nutrients and water. Low intensity veld fires often clear the forest floors without causing significant harm to the trees themselves. Veld fires can also rid the forest of insect infestations and diseases (Scott 2001: 46).
- Veld fires are natural and have been part of the normal process for millions of years. They are used to manage grazing, natural habitats, and to help prevent uncontrolled fires as veld fires can be a risk to life, property and the environment (Scott 2001: 48).
- Veld fires can often be beneficial in protecting biodiversity and maintaining ecosystem goods and services; managers of protected areas as well as farmers would often allow veld fires to continue, as long as they are confined to the desired areas, for their ecosystem benefits. Those who manage veld fires employ prescribed burns for the same purpose (Scott 2001: 52).

2.20 The disadvantages of veld fires

In South Africa the information on loss of life and injury owing to veld fires is poor, but there is evidence that death rates ran to perhaps hundreds in bad veld fires in some years. The social losses regularly accompany these incidents, involving at least the loss of homes and livelihoods (Forsyth *et al*. 2010: 96). Veld fires are a very destructive phenomenon which occurs throughout the world and South Africa is no exception. However, losses have been increasing exponentially during the past years. In the year 2007, between January to August a total of 61,700 ha of commercial timber plantations and indigenous forests were burnt in KwaZulu-Natal and Mpumalanga. The estimated value of standing commercial timber plantations burnt amounted to R1.33 billion (Forsyth *et al.* 2010: 104). The impact was huge and accompanied by the closure of manufacturing capacity, loss of rural jobs, and many other adverse effects (Forsyth *et al.* 2010:109).

The most affected victims were emergent farmers who lost their livelihoods, commercial farmers lost livestock, and fodder banks, machinery and equipment, and the ecotourism industry lost resorts and wildlife. The local community also suffered periodical loss of important resources, such as thatch grass, in veld fires (Forsyth *et al.* 2010:115). Veld fires cause environmental loss if untimely where they occur on transformed or degraded land such as plant invasions. The extreme veld fires of August 2007 in plantations in the uMkhanyakude district (Mtubatuba headquarters) reached intensity levels such that coarse fuels on the ground burnt entirely, with the heat destroying the structure of surface soil horizons; excessive erosion followed during the rainy season, resulting in loss of soil fertility and sedimentation of river channels and wetlands downstream (Finiza 2011: 52).

2.21 Legislation

Under the provision of the National Veld and Forest Fire Act of 1998, the responsibility for the start or spread of a veld fire rests with the land-user. The Act promotes the formation of Fire Protection Associations (FPAs). Therefore it is necessary for all public landowners to be members of a local FPA and private landowners are encouraged to join (NVFFA Act 101 of 1998). The national co-ordination of firefighting emergencies is enabled by the Disaster Management Act 57 of 2002, which supplies a clear hierarchical structure outlining the powers and duties of the authorities at national, provincial, and local level. It also provides policy and a framework within which disaster management centres, plans, and strategies can be established (DM Act No. 57 of 2002: 32).

2.21.1 Previous policy and law

The native people in South Africa had customary arrangements about the control and use of fire for centuries. However, the period after the arrival of Europeans at the Cape in the seventeenth century, these settlers responded to the risks and mismanagement of veld fires by issuing decrees against the starting of veld fires. The first statute designed to control veld fires was the Cape Colonyôs Forest and Herbage Preservation Act of 1859 (Kruger 2010: 223). This was superseded by the Forest Act of 1888, which also provided for the prevention and combating of

veld fires. A series of statutes related to forests followed. Requirements for firebreaks date back to the last quarter of the nineteenth century. The Natal Act of 1895 required firebreaks 30 feet wide on either side of the common boundaries in about 40 districts. Statutory law governing veld fires broadened, for example with the passage of the Soil Conservation Act of 1946 (later superseded by the Conservation of Agricultural Resources Act) and the Mountain Catchment Areas Act (Kruger 2010: 119).

The Forest Act of 1984 captured much of the historical developments regarding the prevention and combating of veld fires. Furthermore, the act included provisions for the clearing of firebreaks on common boundaries, prohibitions on fires in the open air during periods of high fire hazard, and the establishment of fire control committees. Nevertheless, the provisions of the Forest Act reflected a historical situation that no longer exists. It was written at a time when national government had substantial capacity for management throughout most of South Africa. Since then, much of the capacity had been transferred, for example, to the provinces by devolution in 1986 and to the State Corporation SAFCOL (South African Forestry Company Limited) in 1994 (Kruger 2010: 134).

2.21.2 The key policy underlying the act

In previous policies and law, indigenous people had customary arrangements about the control and use of fire for centuries, which they still have today. The 17th century European settlers responded to risks and mismanagement of veld fires by issuing decrees against the starting of veld fires. Over time, laws focused on preventing fires in forests, and a split grew between the management of fires on forest land and those on pastoral or grazing land. This was evident in the old Forest Act of 1984. The new Act (Act No. 101 of 1998: 46) deals with veld fires on all types of land in rural areas (Scott 2001: 79). There has been a process of policy development since 1994 which has ultimately led to the development of the new National Veld and Forest Fire Act (Act No. 101 of 1998: 48). Veld fire provisions were removed from the National Forests Act and drafted into a separate Act. Fire prevention and suppression is now a national, provincial and local government competency within the South African Constitution (Scott 2001: 92).

The purpose of the Act (Act No. 101 of 1998: 52) is to prevent and combat veld, forest and mountain fires throughout South Africa. The Act (Act 101 of 1998) is designed to promote the most effective way for achieving its purposes, which is essentially to organise local level management to prevent and combat veld fires (Scott 2001:108). The Act (Act No. 101 of 1998: 56) sets out minimum enforceable standards which must be achieved, such as firebreaks, fire preparedness, and rules, allowing for local organisations within a national framework of minimum standards. The Actôs intention is to promote institutions and arrangements that accommodate all interests and statutes and where forestry interests are reconciled with the interests of other sectors (CSIR 2010: 98).

2.21.3 Structural layout that governed veld fire management

The Veld Fire Act (Act No. 101 of 1998: 58) is the Act that constitutes fire management in South Africa. This Act aims at veld fire (and unwanted veld fire) management through the prevention and combating of veld, forest and mountain fires. The Veld Fire Act (Act No. 101 of 1998: 60) replaced the relevant provisions in the old Forest Fire Act regarding veld fire management, and introduced some important innovations that fill the gaps between diverse statutes affecting veld fire management (CSIR 2010: 120). The Veld Fire Actôs (Act No. 101 of 1998: 62) major aim is the regulation of veld fires but it also plays a role in veld fire management generally. The Act (Act No. 101 of 1998: 64) aims to control the spread of veld fires by imposing obligations on landowners to prepare and maintain firebreaks. The Act applies both to preventing the spread of a veld fire through good management or operational practices and to extinguishing veld fires. The Veld Fire Act (Act No. 101 of 1998: 68) provides explicitly for compliance with environmental requirements, as well as for the management of risk to life and property. It links natural resource management by property owners collectively or individually to the integrated veld fire management system (Scott 2001: 225).

2.21.4 The responsibilities of individual under the act

Individual responsibility plays a huge role in the veld fire management requirements. However, landowners can join Fire Protection Associations (FPAs) which are co-operative arrangements to prevent and manage veld fires. The Act places an individual duty on each and every landowner, where there are risks of veld fires, to take certain minimum precautions to prevent and combat veld fires (Forsyth *et al.* 2000: 235).

For example, landowners must:

- Prepare boundary firebreaks where there is a risk of fire;
- They must have equipment, trained personnel and protective clothing;
- Have a responsible person appointed to act on his/her behalf in case of fire; and
- Fight fires in his/her own and on adjoining land where the fires threaten life, property or the environment (Kruger 2010: 87). Under the fire danger rating system, no individual, whether a land owner or not, may light fires in the open air when the danger rating is high.

The Constitution mandates local government to:

- Provide democratic and accountable government for local communities;
- Ensure the provision of services to communities in a sustainable manner;
- Promote a safe and healthy environment; and
- Encourage the involvement of communities and community organisations in the matters of local government (Kruger 2010: 125).

Communities

- Land controlled by a community could be private land (where the community owns it), or State land held in trust. Most land controlled by communities is held in trust by the State or the Ingonyama Trust.
- The National Veld and Forest Fire Act 101 of 1998 states that where land is controlled by a community, regardless of the ownership of the land, the executive body of that community is the owner.

- The executive body can exist in terms of its constitution (where the community has formed a communal property association and owns the land) or any law (for example, where a tribal authority was appointed by law) or customary law (where a chief or headman and the tribal elders may control the land).
- Several different communities might control different portions of a single piece of State land held in trust.

2.22 Conclusion

The veld fire conditions has gotten worse during the past 10 years in South Africa**,** meaning the current veld and forest fire Act and other related legislative frameworks on fire control and management must effectively enforce compliance and promote the use of prescribed burning. It is believed that South Africa has done a great job by adopting the use of National Veld and Forest Fire Act which provides systems to predict and prevent uncontrolled veld fires. Hence, the same Act also encourages landowners and communities to accept the responsibility of managing veld fires in their areas (NVFF No. 101 of 1998: 168).

CHAPTER THREE
RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

The focus of this chapter was based on the research approach; research design; qualitative research; population; data collection; data collection tools; direct observation; primary data; secondary data; data analysis; validity and reliability; ethical consideration and a brief significance of the study was described.

3.2 Research approach

The researcher focused on the experiences from the participantsô perspective based on environmental, economic, physical, natural and social impacts of veld fire incidents. Primary data was obtained through administration of questionnaires, note taking and observations of the status on the ground. Although there were no current sources of data of the same study previously conducted of the published or unpublished theses or reports. Secondary data was obtained from both published and unpublished material available at the Unisa and University of Zululand library, on the internet and also through publications of UN- Agencies and Local Government Authorities (Municipality libraries).

To ensure the success of the study, extensive consultations with community elders (e.g. ward councillors and Indunas were done to source information and win their trust and support during the survey. Two research assistants enrolled at the University of The Free State and based in KwaZulu Natal assisted in data collection in the target population in the target wards of the Mtubatuba local municipality. A training seminar was conducted for the questionnaire administration and the community ward councillors and induna were invited to the seminars. The seminar with questionnaire administrators focused orientating the research assistants to the aim and objectives of the study.

3.3 Research design

The research outline filled in as an orderly arrangement laying out the study, the researcher`s strategies for gathering points of interest on how the study touched base at its decisions and the impediments of the investigation. Research design utilized as the consistent structure that guarantees that all gathered proof disposes of inclination while assessing hypotheses and touching base at conclusion (Wyk 2012: 146). This distinct search depicted what as of now exists in the association and attempted to answer the inquiry of the research questions. The reason for descriptive research was to observe, describe and keep reports. Edgar (2008: 230: 62) stated that supplementing qualitative data collected with instruments and observation techniques could clarify the meaning of particular measures and the nature of causal influences of the research question(s).

3.4 Qualitative research

A qualitative approach was utilized to review available resources relevant to the expressed aims and objectives of this study followed by designing of a questionnaire and an observation checklist. Burns & Grove (2003: 28) described a qualitative approach as a systematic subjective approach used to explore the behaviour, perspectives, feelings and life experiences of people and situations that relate to environmental, economic, physical and social strength and emphasise the understanding of these elements that give them meaning. Mouton (2003: 92) further stated that qualitative research focuses on the experiences of people as well as stressing the uniqueness of the individual challenges faced on daily bases.

3.4.1 Focuses of qualitative research

Pursues answers to a problem

- Steadily uses a predefined set of measures to answer the problem
- Collects evidence
- Produces findings that are applicable beyond the immediate boundaries of the study.

3.5 Population

The total population of Mtubatuba is 175425 according to the Statistics South Africa Survey Report (2011: 15). Since the area is rural and no formal or linear pattern of building houses. The researcher collected 82 questionnaires of 110 anticipated questionnaires and this also include one (1) fire fighter from the Mtubatuba fire station unit. This is because some households were not found due to work and commitments during the period of data collection. The sample is thought to be relevant and beyond what many would consider a possible representative of the study population. Therefore in simple terms, sampling is a procedure that is undertaken to obtain information of an entire population by just examining a part of the entire population (Gosh, 2001: 236).

3.6 Sampling

Sampling refers to the process of selecting research participants (Lunsdford 1990: 221). A sample is only a portion of elements in a population. It is not practical to include all the members of the community in a research project, hence the need for sampling. The anticipated sample of Mtubatuba was 110 questionnaires but only 82 were administered and this also included one (1) fire fighter from the Mtubatuba fire station unit. It defines the selected groups of elements, that is, individuals or groups. Two households were left in between to allow the un-biasness of the sample.

3.6.1 Characteristics of sampling

- The total sample is not drawn in advance just like in the case of quantitative research. The sample size is not concluded before the study commences but rather might change as the study progress.
- Each sampling unit is chosen when the information of the previous unit has been examined. An extra sampling unit is required if the previous unit gives insufficient information or if differentiating information is required.

3.7 Data collection

The information for the research incorporated the cause of the veld fire occurrences, the effects of veld fires on household assets and the adverse impacts of veld fires on environmental, economic, physical and social assets that consequently influence the households. The study also sought to find out the interventions the household members and the municipal fire station unit put in place in combating veld fires. A well-structured questionnaire administered tries to collate all the information about the veld fires as it revealed above.

3.8 Questionnaire

The qualitative data was collected using four types of collection tools in this research namely semi-structured questionnaire, note taking, observations and informal interactions with the participants. The questionnaire consisted of both open and closed-ended questions. The research assistants were all Zulu speakers and the employees of the Department of Cooperative Governance and Traditional Affairs (COGTA), deployed to work in the community of the uMkhanyakude District the head quarter of the Mtubatuba local municipality. They were oriented on the questionnaire and a quick overview explanation was given on the questions in the questionnaire. The research assistants were tasked with administering the questionnaire and to be in a position to explain the questions in Zulu to the respondents.

The advantage of open-ended questions provide the participants the freedom to express themselves rather than being constrained by yes/no questions such as general feelings on the matter and to get at specific aspects of the issue. The questionnaires were administered to collect environmental and socio-economic data of the residents as well as the hazards and vulnerabilities their livelihood assets are exposed to.

3.8.1 Characteristics of a questionnaire

Wiley (2012: 175) identified the characteristics of the questionnaire as follows:

- It is less expensive than conducting personal interviews
- Data on a wide scope of topics might be gathered within a limited period of time.
- The organization of data is standard for all subjects and is free of the questioner's mood.
- Each participant enters his/her response on the questionnaire, saving the researcher`s time, compared to the time required to conduct personal interviews.
- Respondents feel that they remain anonymous and can express themselves in their own words without fear of identification.

3.8.2 Direct observation

Observations are ways of gathering data by watching behaviour or noting physical characteristics in their natural setting (Mouton 2003: 20-26). Direct observation aided by photographs formed part of the research activity. Observations will be used to gather information on the effects of veld fires on livelihood assets such as commercial timber plantations, sugarcane, household structures, grazing area and property. Research assistants were informed of the importance of the research activity. A general brief of the expectations were given by the researcher to the observers to ensure quality of data collected. Observations were done on a daily basis during data collection. The observations covered issues on incidental fires, people seen clearing land using fire, constructing fire guards, collecting thatch grass and collection of honey juice among others. This is relevant so as to cover all areas and record the required data within the available timeframe. The data were summarized using notes and recordings attained during the observation period.

3.8.4 Note Taking

According to Wheeler (2002: 237) note taking is an important activity, but it might disturb the participants. To limit this, the researcher informed the participants that notes should be taken during the personal interactions. A non-participant took notes so that the non-verbal behaviour of

the participants as well as the researcherôs reactions and comments could be recorded (Wheeler 2002: 237).

3.9 Data collection procedures

Research assistants together with the principal researcher visited each household at the ward base level leaving two households in between to allow for unbiased data collection. The method was used because of the fact that the study area selected has no formal spatial settlement pattern, such as the organized linear streets found in urban areas. Research assistants firstly introduced themselves to the households and explained their intentions after which the questionnaires were completed by each household member or a person who qualifies in that homestead. Where households had some difficulties with the questionnaire the research assistants assisted with an explanation of the question in Zulu. One questionnaire was administered by the researcher to the fire fighter of the Mtubatuba fire station to seek more information on veld fires and the resources available to deal with veld fires. This is due to the time constraints of completing the project (Leedy *et al*, 2005: 66).

Data was obtained directly from individuals using a questionnaire, informal interactions, note taking and direct field observations. Data collected from the individuals formed part of the primary data since primary data is data obtained directly from the information source which has not undergone analysis (ACAPS 2012: 231). On the other hand, secondary data which is regarded as an analysis of data that has already been gathered for other purposes were also used in the research (ACAPS 2012: 235).

3.9.1 Primary data

Primary sources of data are the first occurrence of a piece of work. Therefore the main instrument used to gather the primary data on veld fire incident occurrences at the ward based level was the questionnaires which were administered during data collection; the informal interactions with the participants; note taking and direct field observations.

Closed questions collected information on sex, history of veld fires, ways of mitigating veld fires and knowledge of the people on veld fires. Open ended questions gave the respondents freedom to answer in their own words and clarify issues. These questionnaires were administered to the respondents on a face to face basis. (Management College of South Africa 2012: 41).

3.9.2 Secondary data

The researcher will utilize auxiliary information to get data on veld fires and fire administration activities. The information will be gathered from published books, journal articles, reports, conference reports, unpublished dissertations, theses natural resource management records and individual correspondence and ranger service records on the internet. The researcher utilized optional information to supplement essential information and on the grounds that auxiliary information is less costly and less tedious. Based on literature done, there is no related reports, unpublished dissertations or theses ever conducted of such nature of study in the Mtubatuba local municipality.

3.10 Data analysis method

A computer application Microsoft Excel was used for data analysis to draw tables and graphs and comparing responses. Firstly coding of the responses in the questionnaires were done and statistical tools such as the descriptive statistical tools, including pivot charts and tables were used. The frequencies help in determining the frequency of occurrence of particular aspects, included in the questionnaire (Rubin *et al,* 1995: 210). Data analysis is the procedure for systematic application of statistical and logical techniques to describe, categorize, illustrate, summarize and evaluate data (Shammo & Rensik 2003: 322). The data obtained from questionnaires were subject for analysis. The researcher tabulated the data and grouped the number of respondents who were responding in a similar manner in the same group. After grouping similar responses in the same groups, data was then presented using graphs and frequency tables in order to show the percentage change of frequency of veld fires.

The researcher read through all the data and organized comments into similar categories in order to analyse comments which showed data that is not numerical in nature. The researcher grouped the qualitative data through labelling. The results obtained from direct field observation and informal interactions pertaining to fire management and prevention practices were presented through the use of descriptions.

3.11 Validity and reliability of the study

The British Psychological Society (2009: 55) stated that there is a civil argument on utilizing legitimacy and unwavering quality when using qualitative research methods. An ethical survey was conducted on a university website before the collection of data and the ethics letter was obtained from the university ethics clearance committee.

3.12 Ethical considerations

The respondents participated in the administration of questionnaires on a voluntary basis. Throughout the study, the research assistants on their administration of the questionnaires ensured that all participants took part on a strictly voluntary basis. Participants were encouraged to offer data freely on the basis that the confidentiality of their views is guaranteed if so required.

3.13 Conclusion

This chapter provided the reader with insight into the research design and the purpose of the research methodologies used to maximise valid answers to a research question of the phenomenon being studied and the objectives of the study. This was achieved by using a non-experimental, qualitative, exploratory-descriptive approach that is contextual.

CHAPTER FOUR

RESEARCH FINDINGS

4.1 Introduction

This chapter presents data analysis whereby graphs and tables were used to analyse and interpret all questionnaires answered when collecting data. Out of 110 anticipated questionnaires only 74.5% (N= 82) were administered to the households in Mtubatuba and analysed. This included one (1) questionnaire administered to the fire fighter from the Mtubatuba fire station for comparisons of responses. This is because some households were not found in their homes due to the local government elections and work commitments which coincided with data collection dates. Questionnaires were given out by the researcher and research assistants and collected soon after that.

4.2 Biographical data

Table 4: Gender distribution

Gender	Number of respondents	Percent
Male	51	62.2
Female	31	37.8
TOTAL	82	100

Out of 81 total respondents (households) and one (1) Fire fighter who voluntarily participated in this research, 62.2% were male and 37.8% female.

Table 5: Main source of income

Source	Number of respondents	Percent
Crop production	18	21.9
Gardening	40	48.9
Livestock production	12	14.6
Other	12	14.6
TOTAL	82	100

Based on table 5 above 48.9% of respondents derived their income for living and support for their families through gardening; 21.9% of respondents generate their income through crop production; 14.6% generate their income from livestock production and 14.6% is for other sources of income.

Table 6: Respondents dwelling period

Period in years	Number of respondents	Percent
0-5 years	24	29.3
6-10 years	9	10.9
Above 10 years	49	59.8
TOTAL	82	100

Table 6 reflects that 59.8% of respondents have stayed in Mtubatuba for 10 years and above; 29.3% of respondents have been in Mtubatuba for the period between 0-5 years and 10.9% of respondents have been in Mtubatuba for the period between 6-10 years.

Table 7: Veld fire seasons

Seasons	Number of respondents	Percent
Summer	22	26.8
Autumn	3	3.7
Winter	57	69.5
TOTAL	82	100

According to table 7, the numbers of veld fires were high in winter season, 69.5%. In summer season 26.8 % and in autumn 3.7% of fires. This implies that, the community of Mtubatuba ward 4 and ward 7 were mostly affected by veld fires in winter compared to summer and autumn.

4.3 Historical impact of veld fires to livelihood assets

Table 8: Houses destroyed

Destroyed	Number of respondents	Percent
Yes	76	92.7
No	6	7.3
TOTAL	82	100

Out of 82 total respondents, 92.7% reflected that houses were totally destroyed by fires initiated from veld fire incidents in each and every fire season, which later destroyed the livelihood assets in both ward 4 and ward 7. Only 7.3% reflected that no houses were destroyed during veld fire disasters.

A house and a car was burnt by fire as shown in the figure above and the fire was said to be initiated as a veld fire then resulted to a house fire.

Figure 5: A damaged *rondavel* and *a flat*
(***Source:*** cascaded from Mtubatuba fire station 2016)

In figure 6 below, 66% reflected that no assistance was offered by the department of human settlement to affected communities in Mtubatuba. Only 34% of the respondents agreed that human settlement do assist with rebuilding of housing structures.

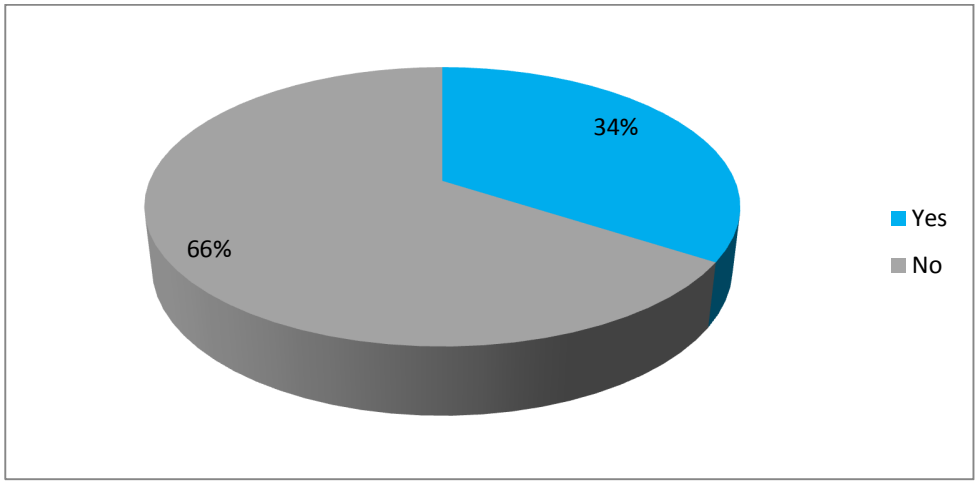

Figure 6: Assistance offered by human settlement

In figure 7 below, 69% of respondents reflected no loss of life during veld fire incidents; whereas 6% said yes to loss of life during veld fire incidents; 15% of respondents reflected that there were occasionally loss of life occurred and 10% of respondents do not know of what happened and never been to a situation where life was lost in the veld fire incidents.

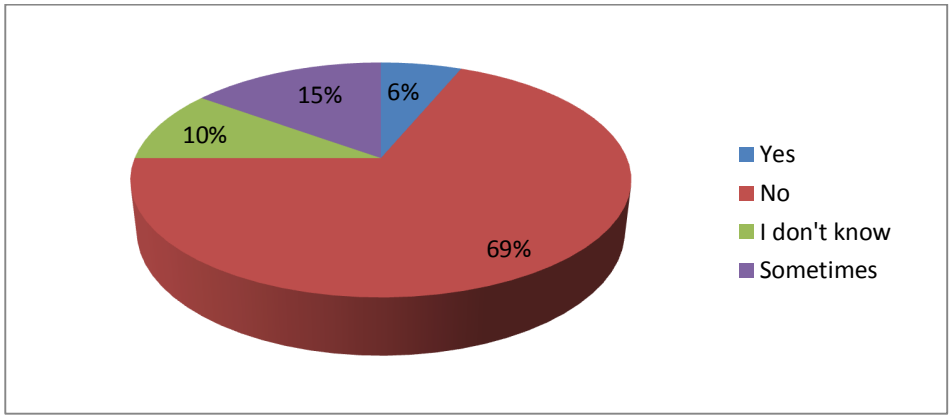

Figure 7: Loss of human life

In figure 8 below, 37% of respondents reflected yes to the loss of livestock in veld fire incidents; whereas 34% additionally witnessed the loss of livestock during veld fire incidents in some cases; 25% of respondents reflected no loss of livestock occurred in these veld fire incidents and 4% of respondents did not knew of what happened during those veld fire incidents.

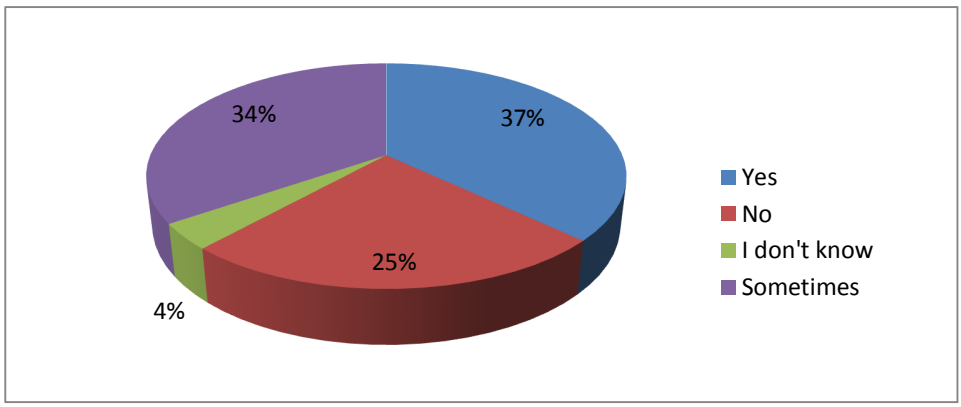

Figure 8: Loss of livestock

In a figure 9 below is a veld fire incident where eight cattle were burnt to death while grazing in a dry grass due to the persisting drought which had almost lasted for two years.

Figure 9: Loss of livestock
(***Source:*** Researcher 2016)

In figure 10 below 71% of respondents concurred that there was a destruction of gardens and grazing land; 25% really do not know of any destruction to the gardens and grazing land; 4% of respondents reflected no destruction of gardens and grazing land occurred during veld fire incidents.

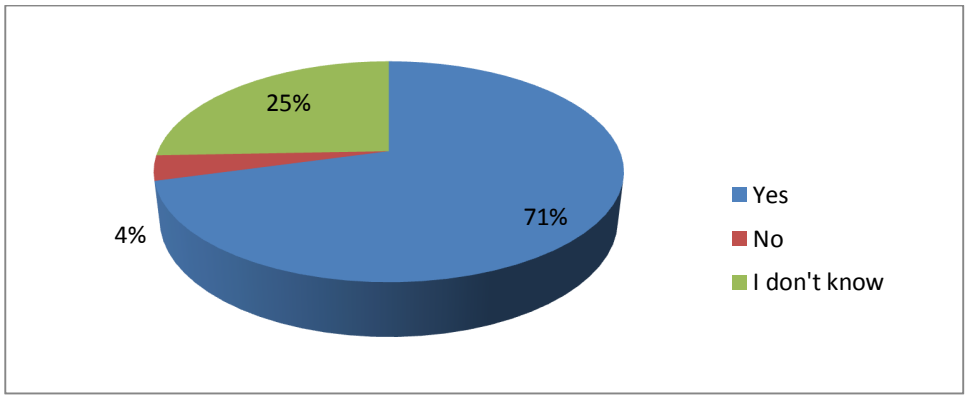

Figure 10: Destruction of gardens and grazing land

Veld fires occurred in the Dukuduku area, Mtubatuba ward 4 in July 2016. The cause was said to be the land preparation from personal communication with the fire fighters.

Figure 11: Loss of grazing land
(***Source:*** Researcher 2016)

Figure 12 below reflected 53% of no firebreaks ever conducted before the start of each fire season to reduce the severity and the impact of veld fire incidents; 40% do not know whether firebreaks are conducted prior to each fire season and 7% agreed that firebreaks were conducted prior to fire season. This concludes that firebreaks were not done but only few were conducted in selected areas of Mtubatuba.

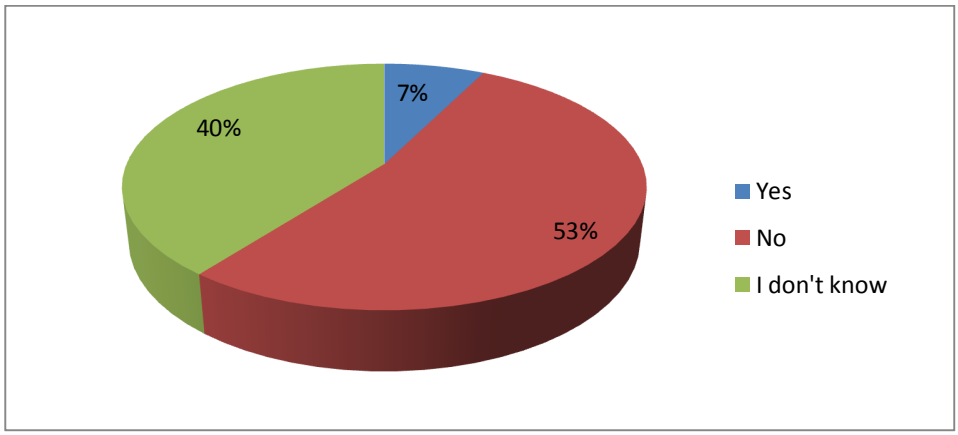

Figure 12: Firebreaks conducted

4.4 The available human capital to combat veld fires

Table 9: Disaster management volunteers

Volunteer	Number of respondents	Percent
Yes	3	3.6
No	30	36.6
Don't know	49	59.8
TOTAL	82	100

Out of 82 respondents, 59.8% and 36.6% respectively reflected no knowledge of volunteers around their wards to assist during disasters. Only 3.6% indicated that they sometimes get helped by safety teams working around their households.

Table 10: Community participation during fire breaks construction

Fire breaks	Number of respondents	Percent
No	70	85.4
Sometimes	12	14.6
TOTAL	82	100

As indicated by table 10, of 82 respondents 85.4% reflected no community participation in firebreaks construction and 14.6% reflected some instances of participation in firebreaks construction which does not form major cohesion of the community.

Table 11: Firefighting equipment donated to the community

Equipment	Number respondents	Percent
No	79	96.3
Don't know	3	3.7
TOTAL	82	100

Out of 82 respondents of 96.3% and 3.7% respectively reflected no knowledge of firefighting equipment donated to the community to be utilized during fire incidents. The responders had no other means of fighting fires except relying to the traditional method of using tree branches as fire bitters.

Table 12: Location of fire department

Fire department	Number of respondents	Percent
Yes	70	85.4
No	12	14.6
TOTAL	82	100

The 85.4% of respondents agreed to have knowledge of where the fire department is located and only 14.6% showed no knowledge of where the fire department is located.

In the figure below 99% of respondents agreed to have knowledge of the location of the call centre where incidents were reported and only 1% of the respondents had no knowledge of the location of the call centre.

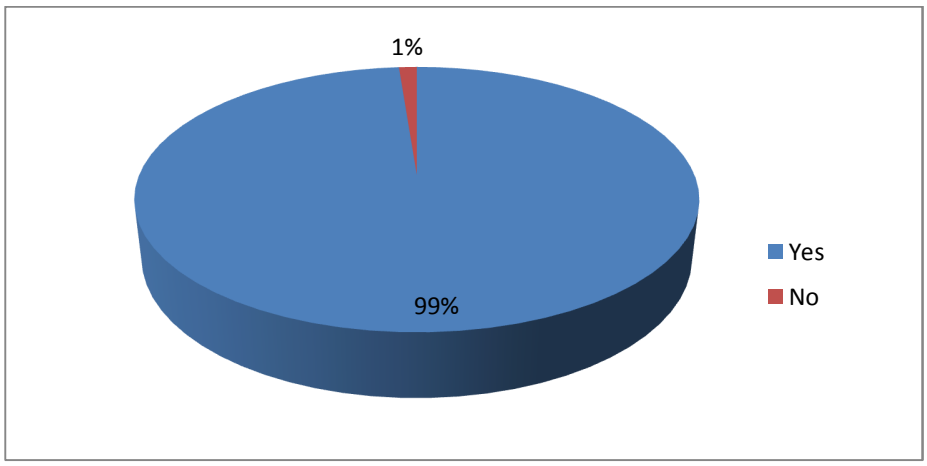

Figure 13: Available call centre to report incidents

The figure below reflected 67% of respondents concurred to have known the emergency call number which they can use to report incidents and only 33% of the respondents had no knowledge of the emergency call number.

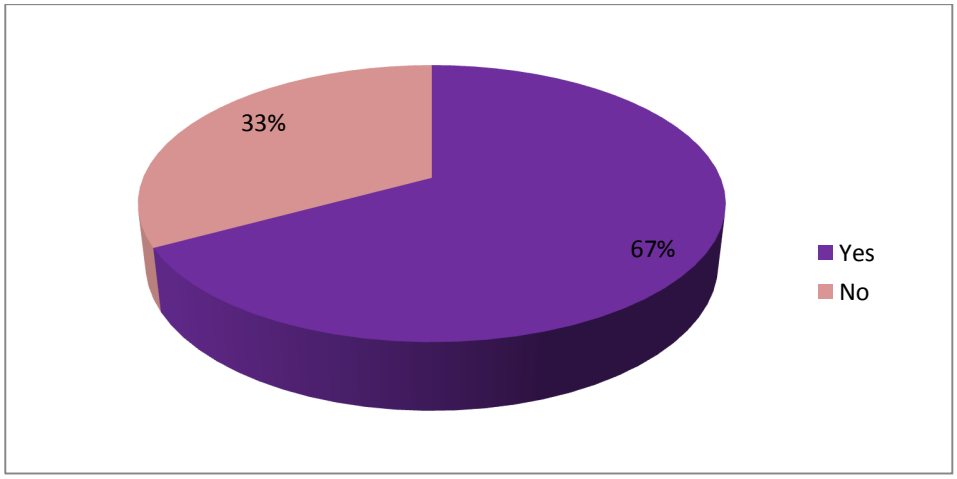

Figure 14: Emergency call number

Figure 15 below reflected that 56% of respondents agreed to the medium response; though 29% agreed to low response to fire incidents and 15% of response agreed to high level of response to fire incidents in the community.

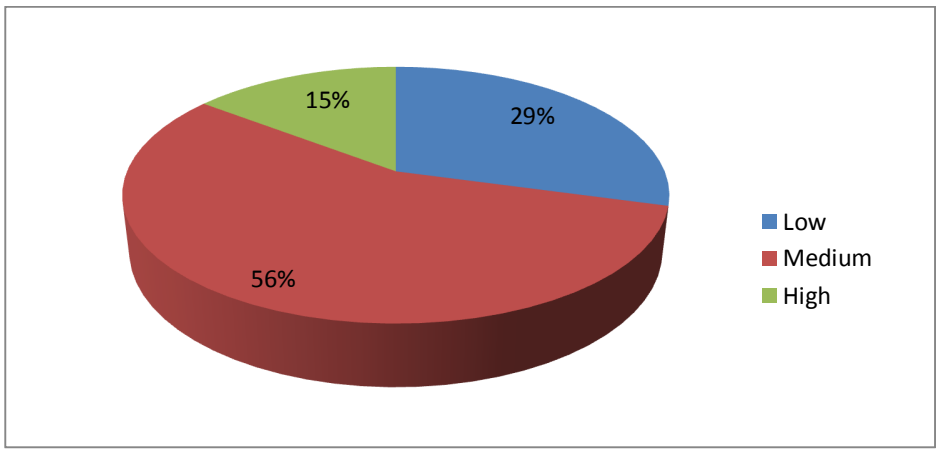

Figure 15: Rate of rapid response of fire department to the fires

4.1 Capacity building programs

In figure 16 below about 99% of respondents agreed that there were no training programs offered by the fire department to equip the community for self-reliance and only 1% of the respondents knew about volunteer training programs.

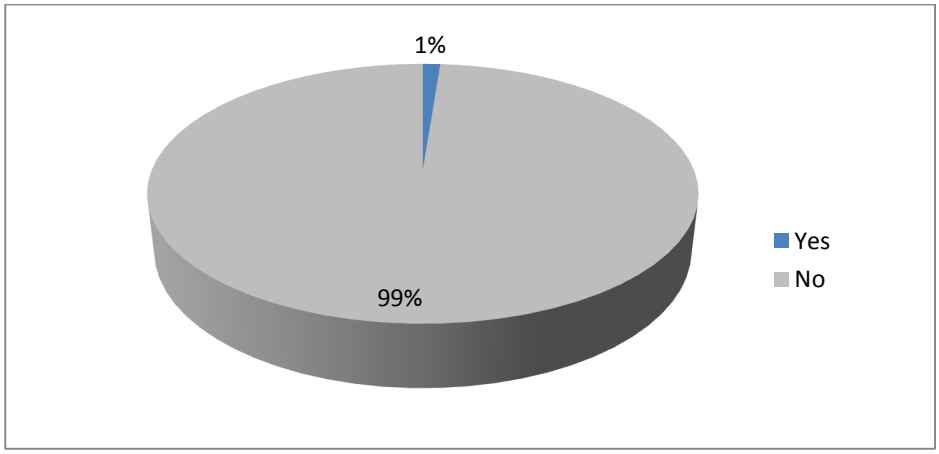

Figure 16: Volunteer training programs offered by fire department

In figure 17 below about 95% of respondents agreed that there were no safety educational programs offered by fire department to capacitate the understanding of the community on veld fire related issues and only 5% of the respondents knew about safety educational programs.

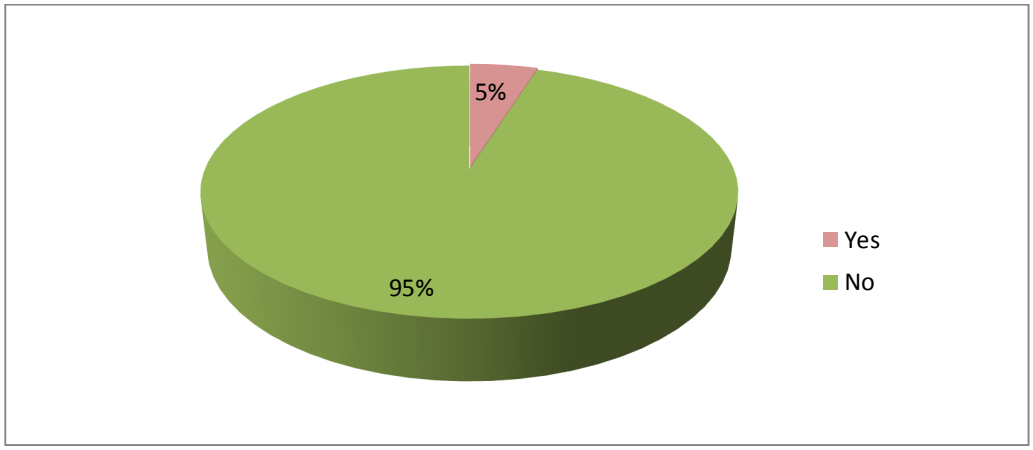

Figure 17: Safety educational programs

Table 13: Early warnings

Issued	Number of respondents	Percent
Yes	3	3.7
No	79	96.3
TOTAL	82	100

Table 13 reflected that 96.3% of participants showed no knowledge of any early warnings issued to them prior to incidents and only 3.7% received early warnings in the form of word of mouth from a ward councillor or Induna.

Table 14: Relocation from high to low fire risk areas

Relocated	Number of respondents	Percent
Yes	2	2.4
No	80	97.6
TOTAL	82	100

Table 14 reflected that 97.6% of participants said no relocation from high fire risk to low risk areas after veld fire incident and only 2.4% agreed that people do get relocated from high fire risk to low risk areas.

Table 15: Compensation from government institutions

Compensated	Number of respondents	Percent
Yes	25	30.5
No	45	54.9
Don't know	12	14.6
TOTAL	82	100

Out of 82 respondents of 54.9% and 14.6% respectively reflected no to any government compensation ever received to assist the victims. Only 30.5% agreed to have been assisted by government institutions after disasters.

Figure 18 below reflected that 82% of respondents agreed that they do not know whether there were damages to the network or power cables and only 18% of the respondents were aware about damages to the network or power cables.

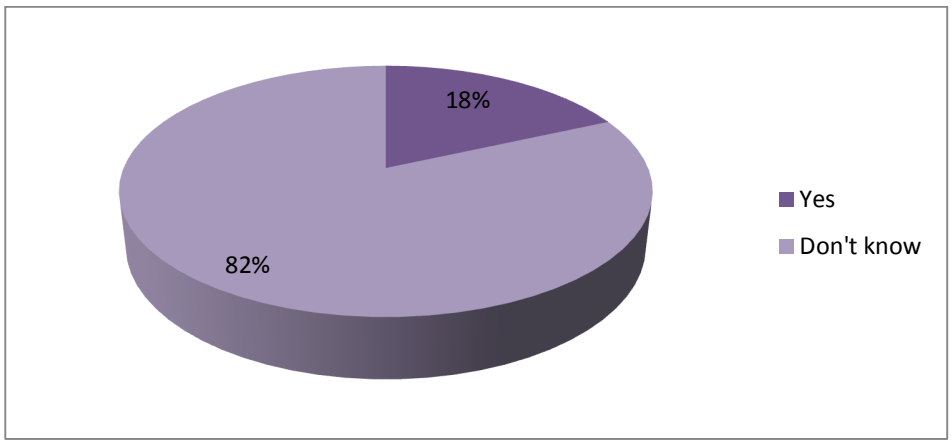

Figure 18: Damages to network and power cables

Fire and Rescue service, Traffic police and South African Police Services in figure below responded to the veld fire incident. The fires occurred over a 15 hectare commercial timber plantations along which Eskom power cables are passing.

Figure 19: Burning timber plantations
(***Source:*** cascaded from Mtubatuba fire station 2016)

4.5 Compliance and enforcement measures

In figure 20 below 96% and 4% respectively of respondents had no knowledge of any existing veld fire committee.

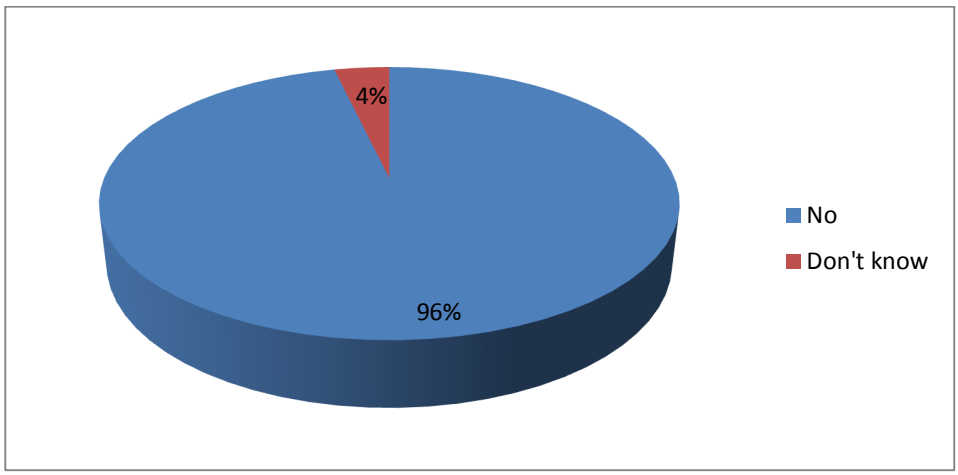

Figure 20: Veld fire committee

In figure 21 below 67% and 33% respectively of respondents agreed that timber plantations and sugarcane farms were destroyed by veld fires.

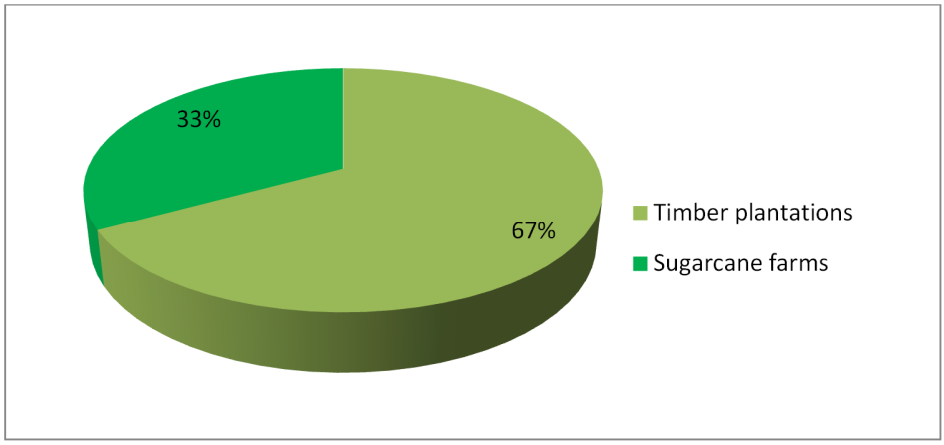

Figure 21: Vulnerable commercial plantations

Figure 22 below shows Mondi commercial timber plantations overwhelmed by veld fires at Khula Village in Mtubatuba and the local emergency team responded to rescue the plantations.

Figure 22: Loss of commercial timber plantation to veld fires
(***Source:*** cascaded from Mtubatuba fire station 2016)

4.6 Conclusion

The analysed data was collected from the study area of Mtubatuba (ward 4 and ward 9). Thus, the utilized data analysis Pivot method made it easier and simpler for the researcher to capture, analyse and interpret the collected data. Veld fires lead to loss of social well-being, livelihoods and reduced environmental quality. This has been the case where gardens have been destroyed, grazing areas reduced to ashes, cattle are burnt to death and the natural environment destroyed including its natural medicinal plants and other natural resources.

CHAPTER FIVE
DISCUSSION OF RESULTS

5.1 Introduction

This chapter discusses the results findings from the collected data. Its purpose is to link the relationship between the existing information by other authors and the actual findings of the research study. It further discusses the causes of veld fires, the effect of climate change, fire regimes, the veld fire season, veld fire data records, veld fire management benchmark and training of personnel.

5.2 Discussions of results

Based on the analysis of the results about 92.7% of the houses were totally destroyed by fires initiated from veld fire incidents in each and every fire season, which later destroyed the livelihood assets. The community of Mtubatuba ward 4 and ward 9 were mostly affected by veld fires in winter compared to summer season. The respondents had no other means of fighting fires except relying on the traditional method of using tree branches as fire bitters. In terms of mainstreaming disaster management to the community, 99% of respondents agreed that there were no training programs offered by the fire department to equip the community for self-reliance and no early warnings issued to them prior to incidents. About 69% of respondents reflected that there was occasionally loss of human life during veld fire incidents. During the data collection eight cattle were found death burnt while grazing in a dry grass due to the persisted drought which almost lasted for two years.

In view of the community risk reduction of firebreaks that needs to be conducted by the fire department in partnership with the community about 53% of the respondent reflected that no firebreaks ever conducted before the start of each fire season to reduce the severity and the impact of veld fire incidents; hence no volunteers around their wards to assist during disasters. About 96.3% of respondents reflected no firefighting equipment donated to the community to be utilized during fire incidents. According to the analysis 48.9% of respondents derived their

income for living and support for their families through gardening and 21.9% of respondents generate their income through crop production and few in livestock production. The designated department of human settlement to assist during disasters has a delaying process to accommodate the need of the victims.

5.2.1 Causes of veld fires

Most of the South African vegetation types are fire prone. The vegetation types are most likely to burn due to human activities like malicious intent, honey gathering, burning for grazing, prescribed burning or due to natural causes (e.g. lightning strikes) mostly during the winter months (WOF 2003: 69). According to the WOF newsletter over 90% of veld fires are caused by human negligence and poor land management. The findings of the study reflect that most veld fire cases were caused by unauthorized burning and poor land management. Effective veld fire prevention begins with the identification of the problem areas. Knowing the exact causes of veld fires are of great importance for management cognizance in addressing the prevention and control measures. Incidental burns caused by negligence accounted for the largest 69.51% of veld fires during the winter period, with 26.83% occurring in the summer season. The most affected households were in ward 4 and ward 7 of Mtubatuba. Naturally caused veld fires were responsible for 19% and the smallest contributor is 7%.

As per data sources on the South African Weather Service (2011: 125) the high trend in naturally caused fires corresponded directly with the highest annual rainfall recorded for that year. The average rainfall per month in 2011 was 83 mm per month and the highest recorded was 105.2 mm per month for August 2011 (South African Weather Service 2011: 136). This indicated a direct trend between weather patterns (rainfall) and veld fire occurrence. Man-made fires do not show any particular trends. In 2012 and 2013, 30% and 29% respectively of fires were caused by people, which was 6% and 7 % respectively higher than normal. This might be attributed to controlled burns getting out of hand due to the prevailing weather conditions. With this in mind perhaps controlled burns were implemented prematurely and as a result more operational burns

occurred in this year. Without reliable climatic data available for 2011 it was difficult to conclude as to why this might have been the case (South African Weather Service 2011: 168).

5.2.2 The effects of climate change

There is insufficient and inconclusive knowledge about the true effect that climate change would have throughout South Africa. It has been noticed that fire seasons are extending and that the shift in rainfall patterns caused some areas of South Africa to become more vulnerable to the effects of veld fire (Bowman 2009: 243). There is a substantial increase in veld fire risks in Mtubatuba. In general the effects are variable, with fire-prone areas increasing in some areas of the ward and decreasing in other areas of the ward. The data discussed in the previous chapter revealed more veld fires and impacts in the winter season as compared to the summer season. At the current stage drought is one of the driving factors of veld fires in Mtubatuba as everything is dry and it is unsure how long and where this will phenomena lead. A definite indication that more veld fires were occurring even with the shift from winter to summer season still manifest.

5.2.3 Veld fire regimes

Veld fire regimes are ecological drivers and they shape the functioning, structure and composition of the environment. If the frequency, intensity, type, season or size of veld fires diverge from the natural range of variation under which the ecosystem evolved, the environmental structure and processes change. The alteration of key elements of a veld fire regime can cause current or long-term conditions that threaten the persistence of indigenous plant and animal populations associated with that veld fire regime. In some cases the change can be rapid, such as when too-frequent veld fires exterminate tall Protea shrubs, changing a tall fynbos shrub land into short-shrub land in just one or two veld fires. In others it can take a long time, such as changes in the shape and size of a forest patch with strongly fire-resistant dominant trees (Scott 2001: 86).

Veld fires in the summer seasons have different outcomes compared to veld fires in the winter seasons, but winter season veld fires hardly differ amongst themselves. As a result, the rules for lighting or permitting veld fires have become much less restrictive. Thus, the ecological hazard of altered veld fire regimes arises only with substantial departures from the ecological norm. There is also good evidence that natural veld fire regimes vary in return period, season of ignition, intensity and size of fire and that this variation is important for maintaining the diversity of species of plants and animal species. Applying a fixed regime benefits some species, and disadvantages others (Forsyth 2010: 215).The Fynbos environment, unlike savannah and grasslands, are sensitive to certain changes in veld fire recurrence intervals. They have species which survive veld fires only as seeds and take several years to flower and produce sufficient seeds to re-establish viable populations after fires. The minimum intervals between veld fires can be longer than the time needed for the fynbos to accumulate sufficient fuel to burn (Forsyth *et al.* 2010: 232).

Veld fire regimes can be the history of veld fires in a particular vegetation type or area, including the intensity and season of burning; it is the combination of elements that typifies fires in a given region, under assumed natural conditions. Veld fire regimes are described using frequency, intensity, season, severity, type, size and source of ignition. In true meaning the important elements to understand any veld fire would entail knowing how often they occur, what time of the year are they most prevalent and how severe are the effects of the veld fire (Forsyth 2010: 215).

5.2.4 Veld fire Season in Mtubatuba

The study findings prevailed that the occurrence of veld fires were at any time of the year but most veld fires occurred in winter and early summer (Combrinck 2003: 143). Data was captured from each veld fire that occurred in Mtubatuba and data received from the Mtubatuba fire department had been included in the analysis and revealed some interesting trends about veld fires in Mtubatuba ward 4 and ward 7. Dominant sources of ignition can cause shifts in veld fire season and frequency. In spite of having veld fire burning regimes in place, veld fires still dominate the burning cycles in fynbos areas.

Climatic cycles, in which veld fires occurred more extensively during periods of high temperatures and rainfall, were largely unaffected by the absence or presence of veld fire control measures. The correlation analysis with veld fire records showed that modern fynbos were dominated by veld fires, which account for more than 80% of the total area burnt, and that prescribed burning had played a relatively small role in contributing to these modern veld fire regimes. Veld fire regimes are more difficult to study than fire events, as there is a need to evaluate responses in relation to fire history (CSIR 2010: 183).

5.2.5 Veld fire data records

Record keeping of incidents in the Mtubatuba fire department is poor since there is no developed system for incident logging except for the manual log book used to record incidents by call centre operators. Better data regarding incidents would assist research and to plan for better management practices in the future. Understanding what went wrong in the past is the starting point to improving management practices for the future.

5.2.6 Veld fire management benchmarks

Combrinck, (2003: 243) described certain benchmarks that should be put in place in order to determine whether or not veld fire management goals are being achieved. These include:

- Monitoring alien plant clearing. The success of control operations depends on the nature of the species and the treatment. In addition, the implementation of surveys that detect any new invasions.
- Monitoring vegetation and indicator species. The items that are measured must be consistent, repeatable and provide a standard for comparisons when necessary. The monitoring includes surveys of indicator species to determine whether the vegetation is mature enough to burn, and surveys to measure regeneration success of suitable indicator species. This helps determine whether or not the indicator species have been restored in their correct ratios.
- Thresholds of potential concern, which have been defined as ‘those upper and lower levels along a continuum of change of a selected environmental indicator which, when

reached, prompts an assessment of the causes which led to such an extent of change and results in either management action to moderate such causes or re-calibration of the threshold to a more realistic or meaningful levelô(Combrinck 2003: 248).

5.2.7 Veld fire prevention programmes

The results revealed that the fire department conducted its fire awareness campaigns at schools. The FAO (2006: 58) spells out that a well- informed community should be more likely to use fire carefully and adhere to policy and legal boundaries thus assisting in the prevention, detection and reporting of veld fires. One of the practical management introduced by working on fire was a fire wise pamphlet for the benefit of the community in preparation of veld fires in the fire season and the campaign was launched in 2006. The content of the pamphlet illustrated pictures of a house not protected against fire and burning down in a veld fire, while another house that was protected against fire do not burn. The fire wise programme aimed at encouraging communities to work together in preventing veld fires from hurting families and burning down houses. The cost of educating a community in the prevention of veld fire is significantly less than the overall devastation and damage caused by uncontrolled veld fires (FAO 2006: 65). The pamphlets further included the fire danger index and the safety tips on assessing the risk to households.

An effective community awareness programme can help to prevent unwanted veld fires, build trust in the community for the fire management programme, and inform citizens of their responsibility in using fire wisely and carefully, including education and awareness programmes to school children with a structured set of lessons. Learning objectives should assist to spread the message on fire prevention and proper use of fire to the community, for example, the City of Tshwane had implemented a disaster management primary school guide pack which is included in the school curriculum; they structured lessons and learning objectives on fire spreading and prevention measures but the traditional knowledge of the community had a long way in providing knowledge. A community that is knowledgeable of the roles and uses of fire and the need for the community to participate in the protection of life, property and resources should be an effective partner in the total fire management programmes.

5.2.8 Training of personnel and the community

All levels of personnel and the community need to receive training based on veld fire management. According to the findings it can be concluded that properly trained and equipped personnel and the community can increase the effectiveness of any response and awareness programmes. Training is, therefore crucial towards prevention, mitigation, preparedness and readiness to veld fire management. In addition, the safety of fire fighters is dependent on their understanding of fire characteristics and the local weather. However, training in the effective use of equipment and fire suppression techniques is also important, while for supervisors and managers, it can help them better understand and effectively deploy a complex range of resources. For example, a lack of training to personnel can result in more fatalities during operations. It is crucial for a well-developed veld fire management plan to consider the safety of fire personnel and also ensure that training forms part of the preparedness plan (FAO 2006: 65).

5.3 Conclusion

The findings indicate that the fire department is not part of the Fire Protection Association (FPA) which can assist the community with fire prevention programmes and protection plans that include the inspection of firebreaks and awareness. It also has a call centre and an emergency number that is known to the community. The findings also revealed a 100% standby system for fire fighter availability. The fire department has no 2way radios installed in their emergency vehicles for emergency situations, only cell phones are used for communication. The unit also uses clear and simple language for communication that other role players can understand.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Introduction

Throughout our history, veld fires have inflicted a heavy cost in human, infrastructure, and damage to the environment in a manner capable of undermining socio-economic development. This chapter offers potential solutions for improving veld fire management in the Mtubatuba local community specifically ward 4 and ward 7. Shortfalls in the current fire management practice were identified through literature, highlighted and discussed. Subsequent to expressing the key findings of the research, the limitations of this research paper are discussed and areas for future research identified.

6.2 Conclusions from the study

Veld fires cause serious social, economic and environmental damage. They lead to loss of social well-being, livelihoods and reduced environmental quality. This has been the case where gardens, sugarcane farms and timber plantations were destroyed, grazing areas reduced to ashes and the natural environment destroyed including its natural medicinal plants and other natural resources. Veld fires in Mtubatuba ward 4 and ward 7 were mainly caused by human activities. Wood scalping, smoking bees, land clearance, creation of fire breaks and burning of grazing land has resulted in the total cause of the veld fires. It is therefore possible to prevent veld fires since the occurrence of veld fires attributed to natural causes only account for 1%. The research study was able to answer the identified research objectives and also propose remedial actions that will assist in articulating the problem.

The use of open fires for cooking and lighting in most areas without electricity, lack of access by fire services for firefighting during emergencies and the increasing rural-urban interface all contribute in increased veld fire risks and losses. The use of thatch for roofing in traditional dwellings and the close proximity of these structures to fire-prone vegetation especially in rural

areas also increase the risk of veld fires. Concerted efforts are required to ensure effective provision of this critical service to our communities. While this function is a municipal function in terms of the Constitution (Act No.108 of 1996: 86) the National and the Provincial government also has a support and oversight role.

The National Veld and Forest Fire Act (Act No.108 of 1998: 88) provide for a variety of institutions, methods and practices for achieving the purpose which includes, *inter alia,* regulating the formation, registration and operation of Fire Protection Associations (FPAs) in areas of South Africa that are prone to veld fires, development of a National Fire Danger Rating System, Veld fire prevention and combating through firebreaks, firefighting, enforcement, etc. The NVFFA places a óduty of careô responsibility upon all landowners both public and private on whose land a veld fire may start or spread. The NVFFA supports the implementation of Integrated Fire Management as the methodology to bring about a reduction of damaging veld fires and encourage improved land management techniques, including that of using fire as a beneficial land management tool.

Forsyth (2010: 147) stressed the need to invest efforts to identify the potential effects of climate change in South Africa, not only for improved and better informed veld fire management but for social, economic and environmental reasons too. South Africa, in particular, has a large rural population which faces a real threat from increased veld fires. It is advisable to invest substantially in precautionary and rational analysis to better understand the current risks and the potential effects of climate change on them (Forsyth *et al*. 2010:148). There appears to be an information gap between the science behind veld fire management (fire regimes and ecological function) and physical fire management on a ground level. The knowledge exists in South Africa but the execution appears to be a problem (Forsyth *et al*. 2010: 153).

6.3 Recommendations

A bottom up approach can be adopted that can easily capture community dynamics and needs that can be addressed to reduce the impacts of veld fires. Since 60% of the respondents established that the issue of destruction of the environment by veld fires can be largely attributed to human activities. There is therefore a need to involve community members in decision making. It is at this primary level that social and economic risks of veld fires can adequately be assessed and managed. At ward level, the approach must emphasize active involvement that strengthens capacity to cope with veld fires and improve on livelihood security. Additionally, an understanding of why fires are started can help in designing learning materials for environmental education that can be used to reduce veld fires.

It is also important to determine vulnerable areas where there is an abundance of fuel that can start veld fires. This helps in focusing on such areas so that any fire outbreak can be frustrated before considerable damage to the environment occur. The community must be taught about veld fire suppression measures. It is also important for the fire department to identify volunteers in both ward 4 and ward 7 that can take part in veld fire reduction activities. Fire prevention must be the central focus in fire strategy with firebreaks being inspected. Hot spots and infrastructure that are under threat from veld fire, including gardens, should be protected surrounded by fire guards.

6.4 Areas for future research

From this study certain areas of future research have been identified:

There is a need to identify other veld fire management systems throughout South Africa, their practice and adherence to veld fire regimes specific to their areas. Understanding an areaôs ecological function, social and economic vulnerabilities are important; an investigation into the órealô effectô that climate change might have on South Africa and implement new veld fire management adaption strategies if required; and investigation into the practical application of new technologies in veld fire management in South Africa will be beneficial.

APPENDIX A:

RESEARCH QUESTIONNAIRES

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I have designed this questionnaire in order to complete my research project which is part of the University requirement. The information collected will be used for academic purposes and no identification is requested from you

NB: your responses are confidential.

The questionnaire is aimed at determining the impact of exposure of livelihood assets to veld fire hazards in your community. You are therefore requested to answer all the questions truthfully. Indicate your choice with an ñXò and also put your answers in the boxes provided. You are also expected to add your comments in the spaces provided.

QUESTIONNAIRE FOR RESIDENTS

SECTION 1: BIOGRAPHICAL DATA

QUESTIONS

BIOGRAPHICAL INFORMATION				
1. Gender	1.	Male		
	2.	Female		
2. What is your main source of income?	1.	Crop production		
	2.	Gardening		
	3.	Livestock production		
	4.	Other specify	…… …… …… ……	
3. How long have you been staying in this ward?	1.	0 ï 5 Years		
	2.	6 ï 10 Years		
	3.	Above 10 Years		

SECTION 2: HISTORICAL IMPACT OF VELDFIRES TO LIVELIHOOD ASSETS

Damages caused by veld fires on livelihood assets of natural resources in your ward					
4. In which season does your ward mostly experience veld fires?	1.	Spring			
	2.	Summer			
	3.	Autumn			
	4.	Winter			
5. What do you do when veld fires occur? **Please explain**	…… …… ……				
6. Are there houses that were destroyed by veld fires in your ward?	1.	Yes			
	2.	No			
	3.	I donôt know			
7. Does human settlement assist by building houses of affected households?	1.	Yes			
	2.	No			
	3.	I donôt know			
8. Has there been a loss of human being in your ward due to veld fires?	1.	Yes			
	2.	No			
	3.	I donôt know			
	4.	Sometimes			
9. Has there been a loss of livestock in your ward due to veldfires?	1.	Yes			
	2.	No			
	3.	I donôt know			
	4.	Sometimes			
10. Are there any gardens or grazing-land that was destroyed by veldfires in your ward?	1.	Yes			
	2.	No			
	3.	I donôt know			
	4.	Sometimes			

11. Are there any firebreaks conducted prior to the start of the veldfires season?	1.	Yes		
	2.	No		
	3.	I donôt know		
	4.	Other (specify)	....	
The available human capital in your ward to combat veld fires				
12. Does your ward have fire volunteers to assist during veld fires?	1.	Yes		
	2.	No		
	3.	Donôt know		
13. Are the any firebreaks constructed around fire prone areas?	1.	Yes		
	2.	No		
	3.	I donôt know		
	4.	Sometimes		
14. Is there any community participation during firebreaks construction?	1.	Yes		
	2.	No		
	3.	Sometimes		
15. Does your ward have basic fire fighting equipment donated to combat fires?	1.	Yes		
	2.	No		
	3.	Donôt know		
16. Do you know where the Fire Services Department is located?	1.	Yes		
	2.	No		
	3.	I donôt know		
17. Does the fire department have a call centre where fire incidents can be	1.	Yes		
	2.	No		

reported on daily bases?				
18. Do you know the emergency number to use in a case of veld fire incidents?	1.	Yes		
	2.	No		
	3.	I donĉt know		
19. How would you rate the level of rapid response to fire incidents of the fire department in your ward?	1.	Low		
	2.	Medium		
	3.	High		
Veld fire ward base capacity building programs				
20. Are there any fire Volunteer training programs in your ward?	1.	Yes		
	2.	No		
21. Are there any community fire safety educational programs offered by the fire department?	1.	Yes		
	2.	No		
22. How do you communicate with the fire department as far as veld fire issues are concerned? **Explain**	…… …… ……			
23. Are there any messages or word of mouth you get as an early warning during high risk days?	1.	Yes		
	2.	No		
Mitigation strategies for livelihood assets of social capital on ward base level				
24. Are affected household members from fire prone areas relocated from high risk to low risk area of veld fires?	1.	Yes		
	2.	No		
If no, what is the alternative coping strategy of the affected households?	3.	…… ……		

		.....		
25. Is there any compensation from government institutions for households who loses their property through veld fires?	1.	Yes		
	2.	No		
	3.	I donôt know		
26. Do veld fires cause any damages to the network and power cables (i.e. Telkom or Eskom) that in return affect the functioning of the business and essential services operating?	1.	Yes		
	2.	No		
	3.	I donôt know		
Enforcement and compliance measures for reducing the impacts of veld fires on economic capital				
27. Does your ward have a committee responsible for veld fire issues?	1.	Yes		
	2.	No		
	3.	I donôt know		
28. Please identify commercial plantation that is usually destroyed by veld fires.	1.	Commercial timber plantations		
	2.	Sugarcane farms		
	3.	None		
If other please specify	4.	....		
Any other comments or recommendations:				

Thank you so much for your responses and time

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