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Veld fire management strategies in rural areas: The case of Ward 1 in Hwedza.

BY

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APPROVAL FORM

The undersigned people certify that, they read and recommend Midlands State University to accept a dissertation entitled, Veld fire management strategies in rural areas: The case of Ward 1 in Hwedza by Chihwai Jonathan (R104050Y) in partial fulfilment of Bachelor of Honours Degree in Geography and Environmental studies.

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Dedication

To my Father and my Mother, I love you very much and appreciate the sacrifices you made for me.

Acknowledgements

First of all, I wish to extend a word of gratitude and great appreciation to my family for the financial support that enabled me to do this research. Special thanks go to my father Jonathan senior and mother.

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Abstract

This study sought to assess veld fire management strategies in Hwedza Ward 1. Data was collected using questionnaires, field observation and key informant interviews. Major causes of fire in the area include hunting land clearance and smoking bees. Results show that people in Ward 1 have benefited from the introduction of a veld fire management plan that was introduced by EMA in 2010. Frequency of veld fires has declined from 31 between 2005 and 2009 to 11 between 2010 and 2014. As a result there are fewer cases of property loss and death due to veld fires. The veld fire management plan includes prevention, suppression and post suppression measures to veld fires although the plan's strength lies in veld fire prevention.

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Acronyms

EMA Environmental Management Authority

FAO Food Aid Organisation

FTLRP Fast Track Land Reform Programme

SADC Southern African Development Community

SAFNET Southern African Fire Network

WWF World Wide Fund

ZRP Zimbabwe Republic Police

CHAPTER 1: INTRODUCTION

1.1 Background of study

Fire has been used as a land use tool for controlling the environment since the evolution of humanity and has been used as such by people living in different ecosystems across sub-Sahara Africa (Goldammer and de Ronde 2004). Africa is the most fire-prone continent in the world leading some environmentalist to call Africa the "fire continent" (Nyamadzawo et al 2013). People in this continent have been using fire for hundreds of years to prepare the land for agriculture, hunting and other land management activities.

Veld fires are defined as fires that occur outside the built up area of an urban area posing the potential of running out of control (National Disaster Management Centre 2010). They are a persistent problem in many countries of the world because they frequently cause emergencies and often grow to disastrous proportions. Veld fires can be human promoted whilst at the same time they can be natural (Nkhensani 2011).

Sometimes the source of fire in rural areas is also due to plenty of fuel material left in the fields that facilitate burning (Svotwa et al 2007). The viciousness of the fire dependence on the availability of the dry fuel available, for example a wet year is often followed by increased fire incidents due to a higher availability of combustible materials that would have accumulated.

Many of the areas that are affected by veld fires are now becoming increasingly vulnerable due to a combination of inadequate land and fire management practices. Furthermore, increased human encroachment on formerly remote and unpopulated areas has also increased vulnerability (Southern African Development Community Fire Management Programme 2010). Alongside these stresses are weather conditions that have also amplified the number and intensity of veld fires in most areas of the world.

Societies have become vulnerable to direct damages caused by veld fires and the consequences of the secondary effects that prevail after destruction by fires. Veld fires negatively affect rural communities as compared to the urban community since many forests provide rural people with some of their basic needs like medicine. When fires are not properly managed they results in injury and even death to the people that cannot escape its smoke and heat (Nkhensani 2011).

Smoke that is produced during veld fires reduces the safety of air leading to associated respiratory diseases. Waugh (2002) pointed out that veld fires can cause destruction of irreplaceable reminders of human heritage. In extreme conditions, veld fires may burn having the ability of extending beyond property line. This results in them becoming problems that cannot be handled by individuals and require joint coordination of efforts (Nkhesani 2011). These fires if left unattended can cause political and social conflicts when they traverse across political and social boundaries. There is need for a proper and accurate fire assessment at all times. It is important therefore to manage veld fires properly so that even environmental value is protected. Environmental value is the worthiness that people place on the environmental goods (fruits) and services (carbon sequestration) (The Law dictionary).

Due to population growth, unsustainable land management and a breakdown in traditional management practices has also been on the increase causing negative impacts on the natural environment and human welfare. Veld fires can lead to vegetation degradation and related biodiversity loss resulting in immediate and long-term negative impacts on the livelihoods and economies at community and national level (Fanrd 2010).

The persistence of veld fires year after year also suggests that the reaction to fire to date needs to be reviewed. This calls for community based veld fire control strategies. Without preventive measures put in place to guard against veld fires, fire will continue to affect lives whenever the weather is favorable and when there is something to burn (Nkhesani 2011). The current environmental talk of climate change has the potential of exacerbating this situation of fires. It is difficult to exactly measure the environmental costs caused by fire (Nkhensani 2011). This is because much of the information is not documented and some fires are not recorded at all.

Fire management in Zimbabwe can be traced back to the arrival of white settlers in 1890 (Nyamadzawo et al 2013). The management practice included the Natural Resources Act (no 9 of 1941). The management practices were formulated to implement fire prevention policies in the commercial areas, communal areas, protected forests and nature reserves (Nyamadzawo et al 2013).

At farm level, farmers were responsible for establishing fire guards before the start of the dry season. Most of the commercial farms were fenced to restrict human movement there by

controlling veld fires associated with hunting and honey harvesting (Nyamadzawo 2013). Mudekwe (2007) pointed out that the fire protection was based on detection, quick reaction and suppression. Fire management practices were put in place after the realization that it was difficult to suppress veld fires. It was also realized that strategies that aim at mitigating the negative results of wild fires were more sustainable (Nyamadzawo et al 2013).

Masara (2013) cited that Environmental Management Authority (EMA) is the body in Zimbabwe tasked with the country's environmental protection. It has its hands full making efforts to curb the veld fire culture that has permeated in the country. The law in Zimbabwe is clear concerning lighting of fires outside residential and commercial area. Statutory instrument 7 of 2007 in the Environmental Management Act states that "no person is allowed to light a fire outside residential area and commercial area during the period July 31 to October 31 of each year". The regulation compels owners, occupiers and users of a given piece of land to have pre-suppression, suppression and post-suppression measures to be in place so as to curb veld fires. (Nkhesani 2011) noted that southern Africa is a non-exception in this regard and the responsibility for safety and management of this phenomena rest with every individual living or working in the traversing areas prone to veld fires

EMA upholds stake holder participation and this helps them to work with traditional leaders, churches, schools and the community (The herald 2012). It advocates that it is everyone's duty to manage the environment in a sustainable manner, "it is a duty of every Zimbabwean to protect the environment". EMA expect all the people to participate in protect the environment (Mushwe 2011). Traditional leaders play a pivotal role in fire management. They are empowered under the traditional leaders Act to apprehend and prosecute environmental law offenders including those that breach veld fire regulations (The herald 2012). They are mandated by law to preside over environmental offences in their area of jurisdiction. Some of the veld fire offences include failure to have a standard fire guard, failure to report a fire and leaving a fire unextinguished which one has started deliberately. Mushwe (2011) stated that the Traditional Leaders Act promotes the environment to be viewed as everyone business calling for us to work together in avoiding veld fires so as to maintain the integrity of the environment. Stakeholder participation is encouraged in order to create a healthy and clean environment.

Zimbabwe is also a member of the Southern African Development Community (SADC) Regional fire management which met in Luanda Angola in 2003. The organization recognizes the dependency of SADC communities on agriculture and natural resources for their livelihoods. (Nkhesani 2011) pointed out that the committee (SADC) Regional fire management advocates for utilization of natural resources and effective protection of the environment as some of its key objectives. It recognizes the fact that priority for any SADC programme must be truly regional in their scale and impact. This is the primary agreement that promotes the SADC regional fire management in sustaining its development processes.

The forest is viewed as a key natural resource and a major component of the environment which should be sustainably managed (SADC 2010). The environment is also viewed as a key component in the control of erosion as well as spiritual and cultural values to humans. Article 15 of SADC regional fire management require member states to develop early warning to protect forests from human induced fire. Subsection 2 (c) of the same clause calls for member states to prevent and suppress uncontrolled fires and facilitate trans-boundary assistance in emergency situations.

This management programme strengthens the existing plan that promotes exchange of information and knowledge within the region. Consequently, this will provide and make it possible to share readily available information and knowledge to address fire problems.

Veld fires know no boundaries to property, therefore a holistic fire management approach is an integral part of sustainable land and forest management to reduce veld fires. On average, it is estimated that fires burn millions of hectares of forest and grassland per year worldwide (Nkhensani 2011). In 2002, 350 million hectares of land was burnt worldwide. In Zimbabwe, an area of 1152413 hectares was burnt in the year 2010 alone (Environmental Management Agency2012).

1.2 Problem statement

Veld fires are a major problem in Zimbabwe causing annual death rates, health hazards and environmental destruction. Nkhesani (2011) pointed out that veld fires are very destructive occurring with significant frequency and intensity in many countries in southern Africa. As a result, the sustainability of the forest, grassland and farmlands are all at risk because of these

frequently devastating fires that are experienced. If left unchecked, they can cause widespread destruction and damage since they pose a risk to life, property and the environment.

In many rural areas because of poverty, environmental issues are given second priority after development issues that generate food in many communities. Many local communities find themselves unable to respond to veld fires. This is due to the fact that they have fewer resources to deal with this perennial problem. This limitation leads to poor planning that affects the management of veld fires and the subsequent response to this problem. The lack of the required resources and equipment contribute much in the extent of damage caused by veld fires in rural areas.

The above mentioned problems pose severe environmental consequences and straining of natural resources like grasslands and natural forests. Additionally, these fires cause huge negative impacts on the livelihoods of people. In 2010 EMA introduced fire management strategies in Duo farming area which saw the introduction of a fire fighting team. However, it is not clear how far the intervention strategies have been effective in the management of veld fires. The purpose of the research therefore is to investigate the effectiveness of these veld fire management strategies in Hwedza.

1.3 General objective

To investigate on veld fires and veld fire management in Hwedza.

1.4 Specific objectives

To identify the causes of veld fire

To examine the socio-economic impacts of veld fires

To assess the effectiveness existing fire management strategies

To recommend ways of improving veld fire management

1.5 Justification

Masara (2013) pointed out that the veld fire problem in Zimbabwe is approaching epidemic proportions. The period between August and October has become a “burning” period and is characterized by a forest burning somewhere each day. Nyamadzawo et al (2013) also

highlighted that veld fires destroy approximately a million hectares annually in Zimbabwe. Despite that veld fires are life threatening, the burning has continued and it is now worse than ever before Nyamadzawo et al (2013).

Numerous reports of veld fires ravaging farmlands, forests and grasslands in Hwedza district have been reported (Masara 2013). It is therefore important to evaluate the effectiveness of veld fire management practices and the likely impacts and outcomes in addressing environmental degradation in the area. This approach will help in formulating solutions and policy recommendations to improve fire management practices in the area.

Little attention has been given to occurrence and existence of veld fires in Zimbabwe. Information on veld fires is made available mainly at provincial levels, but information at ward level is scarce. The issue is even worse in rural areas where veld fires are more common. This study seeks to assess the effectiveness of veld fire management practices in addressing environmental degradation so that sustainable natural resource management at community level is ensured. This knowledge is vital and of paramount importance for community, regional and national planning a purposes and also for policy making in the conservation of natural forests and grasslands (natural resources).

The research will contribute information to all agencies involved in the management of veld fires within the district. The information will help the local landowners in making informed decisions about social and environmental consequences of fire. This will help in disaster risk reduction through a cooperative participation by the local people. Furthermore, an improved service delivery accompanied by increased capacity among local community members and agencies in understanding, preventing and responding to veld fire will be promoted (Nkhensani 2011).

The research also will help in identifying the strength of the current veld fire management plan and propose necessary adjustments if the current system is found wanting. (Nkhensa 2011) noted that this enhances the effectiveness of the management of veld fires providing a link in developing tools for predicting and mapping the degree of ecosystem change induced by the fire processes.

1.6 Description of study area

The study was conducted in Hwedza. Hwedza is a district in Mashonaland East province in Zimbabwe. Hwedza was established in 1910 by Colonial administration. It is believed that gold, beryl, nickel and tungsten were mined in the hills around the villages in Hwedza but the deposits were too small to make any mining viable (Zvinorova et al 2012). The word Hwedza when translated means “The lighting of the sun", and myth has it that the word is derived from the location of the ancient town which was found on the other side of a deep forest as pointed by (Svotwa et al).

Hwedza is located about 50 kilometers south of Marondera, and 127 kilometers south of Harare (Mtambanengwe et al 2012). The area is sparsely inhabited following a government policy to acquire land for resettlement to relive pressure in overpopulated areas. The area was once dominated by extensive large scale livestock rearing and tobacco farming during the white rule and was opened for resettlement in 2003 (Mtambanengwe and Mapfumo 2005) cited in Mtambanengwe et al 2012.

Hwedza mountain range is one of the most outstanding geographical features in Hwedza (McDonald 2003). The major vegetation types in the rural areas of Hwedza include bush savanna grassland with hyperhenia, hypothelia and digitaria as the major grass types, as well as deciduous trees such as musasa (brachystegia speciformis), mupfuti (brachystegia bohemia), mutondo (julbernadia globiflora) and mususu (terminalia) (McDonald 2003)

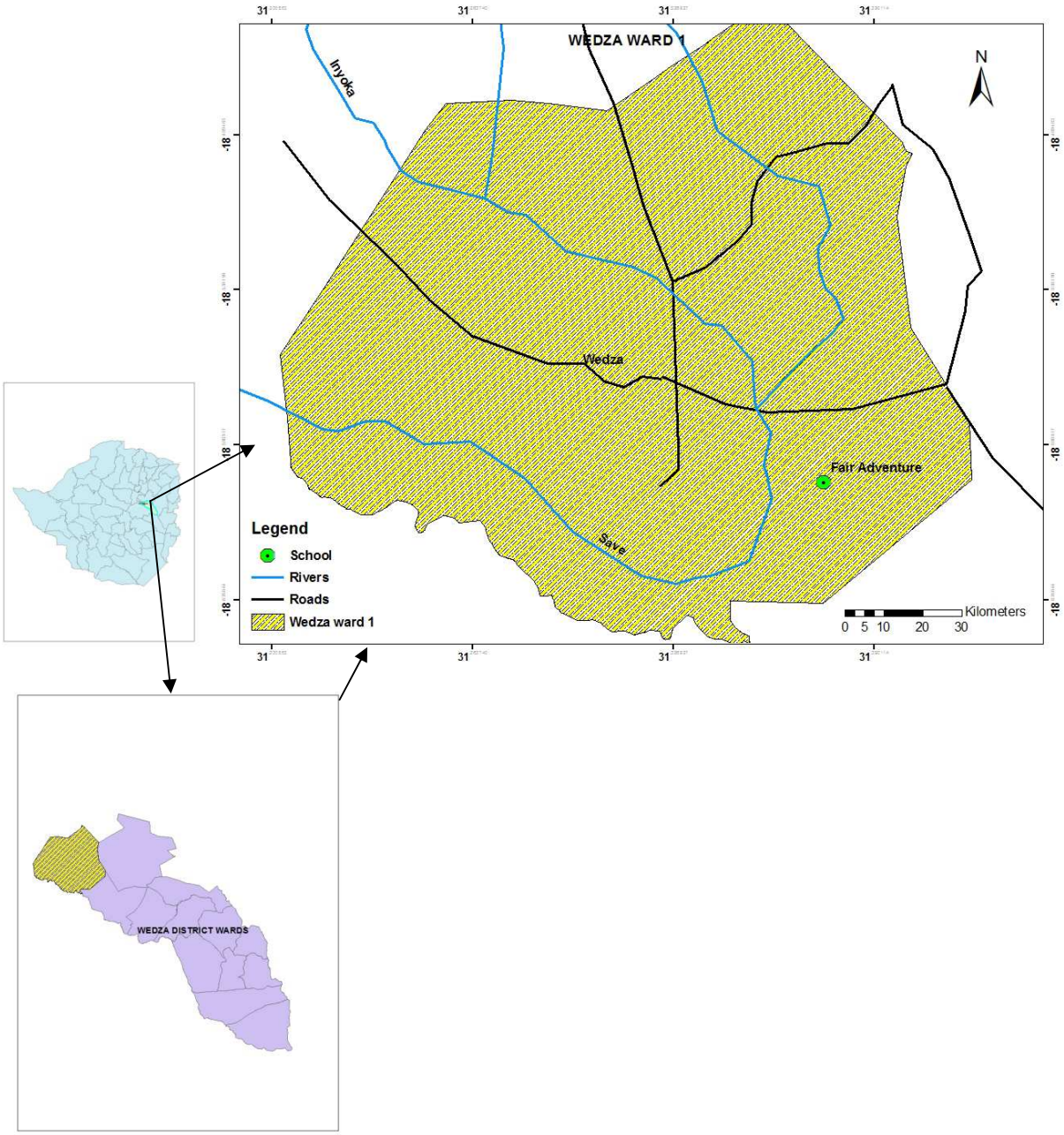
Hwedza is climatically divided into two halves, with upper Hwedza that stretches from St Barnabas Chisasike to Hwedza center onwards. This area is cooler and has average to high rainfall. On the other hand, lower Hwedza which is from Mukamba through Goneso and Zviyambe which is a small scale farming area (formerly known as purchase areas) which experiences warm to hot temperatures and lower rainfall amounts compared to the upper part of Hwedza (McDonald 2013). Even the crops grown in the two areas differ significantly. Cotton and sorghum or millet does better in lower Hwedza while in upper Hwedza the same crops would not produce much yield. Livestock rearing is also a dominant human activity in the rural area, thus, cattle and goats form a backbone of households’ wealth in the area.

Hwedza lies between Save River on the west and Ruzave River on the east. Other rivers include Nyamidzi, Mhare, Nyamhembe and Chineyi that drain within the district (McDonald 2003).

Granite is the dominant parent rock in the area. The soils are generally coarse sands derived from granite rocks. Average landholding is not less than 3 ha per family. Small fields are also a characteristic of the area near water sources for vegetable production. Maize and tobacco are the major cash crops grown through rain-fed agriculture, although a wide range of food crops are also grown for subsistence purposes (McDonald 2003). These include ground nuts round nuts and millet among others used as supplements.

The research is confined to Hwedza Ward 1. A ward is a local government administrative unit with between 1000 and 1500 households (Mtambanengwe et al 2012). Hwedza Ward 1 lies on (18°37′S: 31°34′E), and is in natural region 2(b), receiving between 650-750 mm year-1 between November and March. Figure 1.1 shows map of Wedza ward 1

Figure 1.1 Location of Hwedza Ward 1 in Zimbabwe



1.7 Livelihoods

Most of the people in this ward depend on agriculture for a living. The growing of crops known as mixed cropping and livestock production dominates in terms of household livelihoods (McDonald 2003). Staple crops are closely integrated with cattle or small ruminants. Small gardens are located near streams or in wetlands were tomatoes onions and sometimes sweet potatoes are grown for sell.

Economic hardships that were being experienced in the area led the people to engage themselves in small scale businesses. Some now operate flea markets which provide self-employment and this is usually passed within the family. Products are mainly collected from surrounding town like Marondera and Harare at a whole sale price.

Prior to the land reform of 2002 most of the area was under white ownership and were redistributed and allocated to the indigenous people (Nyamadzawo et al 2013). The area has undergone significant changes because of the difference in land uses between the whites and the indigenous people. Most of the area prior to the land reform programme was used for specialized diversified farming. The whites targeted the occurrence of the naturally occurring grass for livestock. Due to few concentration s of livestock in the area, abundant of biomass that can support fires has been made available.

1.8 organization of the study

The study is divided into chapters. Chapter 1 contains the background of the study, problem statement objectives, justification and description of the study area. It also provides the livelihoods of the people within the study area. In chapter 2, literature review is outlined and chapter 3 provides for data collection methods. Chapter 4 contains data presentation and analyses. Finally, conclusions and recommendations are in chapter 5.

CHAPTER 2: LITERATURE REVIEW

2.1 causes of veld fires

Causes of veld fires are divided into two. Veld fires can be viewed as natural, a result of the complexity of the natural system (if they are started by lightning) and anthropogenic caused veld fires. Natural fires have become almost rare. Many fires that occur have a human hand. Potgieter (2000) pointed that it is only in inhabitable areas of boreal forest that have tall trees such as birch and spruce growing in the extremely cold climates where fires can be attributed to lightning. Veld fires that are a result of lightning are viewed as important ecosystem drivers.

Impacts of fire were viewed only as negative to the environment and many authorities tried to stop them because of their destructive nature to human property. It was after 1950 in South Africa that fires were regarded as natural, beneficial even desirable to the environment (Potgieter 2000). The belief that fire is natural and desirable to the environment was so much that in Kruger national park the fire policy was " give lightning the best chance" to burn potions of the park. The burning helps to ensure that biomass build up does not get out of hand. Fires occur mainly in South America, Russia, the Mediterranean, sub Saharan Africa, Australia, South East Asia and are also destructive in southern Africa (Nkhensani 2011).

On the other hand it is argued that 95% of veld fires are not natural, but rather are started by human activities in savannah (Potgieter 2000). Anthropogenic causes of veld fire can be divided into deliberate and accidental fires. Deliberate comprise of veld fires that are intentionally lit. They can be used for early burning, improving pasture land, back burning, creation of firebreaks, land clearance for agriculture, hunting and smoking out bees during harvesting of honey (Nyamadzawo et al 2013).

Failure to control these fires can sometimes lead to veld fires, for example fireguards construction using fire may cause veld fires. This is true for many poor small holders in Zimbabwe who have limited resources for land preparation. The Fast Track Land Reform Programme (FTLRP) of 2000 resulted in an increased number of veld fire incidents (Phiri et al 2011). The (FTLRP) which was in 2000 encroached into areas that were not previously used for agriculture resulting in increased fire incidences. This was attributed to the poor land clearance practices that were being employed by the resettled farmers. In its report in 2011, EMA noted

that most of the veld fires reported occurred in A1and A2 model resettlement areas that were once large scale commercial farming area. This suggests that veld fires were associated with land clearance for agriculture.

Also, fire has been used in the past for hunting, a practice that is still practiced. In many cases, the hunting season coincides and is associated with the dry season after harvesting of crops in Zimbabwe. The presence of haystack and crop storage structures all add to veld fire risk (Southern African Development Community (SADC) Fire Management Programme 2010). During this season, workload is less and it is also during this season when the fuel load is high and ready for combustion. Intentionally lit fires to kill game or fires meant to direct game to traps might get out of hand during the dry season leading to veld fires.

Land use strategies that include cattle ranching also promote veld fires. Burning of pasture land is common in Zimbabwe. Fire is used to remove invasive species and moribund grasses that are unpalatable to livestock and game to give way to fresh growth (Nyamadzawo et al 2013). It is these kinds of fires that are started intentionally that often spread beyond the intended area that turn into veld fires. In Zimbabwe fires often occur between August and October with the official fire season starting on July 1 and ending on 31 October of every year (EMA 2011).

Additionally, arson is also a cause of veld fires that are experienced in Zimbabwe. The cause is seen where employees are disgruntled over low salaries or even nonpayment of salaries. The employees in many cases will deliberately set farms on fire contributing to veld fires (Nyamadzawo et al 2013).

Although veld fires can be described as deliberately human caused, accidents do happen. World wide fund (WWF 2001) articulated that indiscriminate throwing away of lit cigarette stubs and disposal of hot ash has also been identified as origins of veld fires. A report by EMA in 2011 showed that 60% of all fires occur within 500m from major roads. There is no doubt that among the causes of fire within 500m from major roads is the throwing away of lit cigarette stubs.

2.1.1 Weather related causes of fire

According to Waugh (2002) weather refers to the state of the atmosphere at a local level usually on a short time scale of minutes to month. Weather explains the aspects of the atmosphere that affects human activity like sunshine, cloud cover, wind, rainfall, temperature and humidity

among others. Wind, humidity and temperature are the main weather related causes of fire (Nkhensani 2011).

Goldammer and De Ronde (2004) pointed out that, wind speed and direction is the most dynamic variable influencing fire. This is because wind provides oxygen to the fire front affecting the rate at which fuels dry ahead of the fire front. Wind causes preheating of fuel load by means of radiation from the flames. The process prepares fuel ignition hence promoting spread of fire (Teie 2005).

Temperature is also another weather variable that affects veld fires. The main effect of temperature on veld fires is the ability to reduce fuel moisture. As temperature cools during the night, fuel moisture will be higher and there is a reduced case of experiencing an outbreak of a veld fire. Additionally, fires experienced under these conditions might be brought under control (Heikkila 1993). Goldammer and De Ronde (2004) noted that as the temperature rises reaching its peak between 12pm to 3 pm; fires will reach their highest intensity. Therefore, during the day it is difficult and uncomfortable to fight fires as fire fighters tire easily and dehydration becomes a problem.

Additionally, relative humidity is also another weather tool that causes veld fires. This is so since the amount of moisture in the air affects the amount of moisture in a fuel. According to Nkhensani (2011), 30% is the danger point of veld fires. When relative humidity is above 30%, occurrence of fire is lower and if they occur they are easy to control, but if relative humidity is below 30% occurrence of veld fires is very high (Nkhensani 2011)

2.1.2 Fuel load

Fuel load is the material that will ignite and support combustion under specific conditions. The extent to which a fuel will burn is controlled by the size of material and its moisture content (De Bane 1998). The drier the material the more it will be consumed and the larger the material is, the lesser time it will take for it to be consumed. Fuel load is a significance factor in the cause of veld fire. The total amount of heat energy that is available for release during a fire is directly related to quantity of fuel load.

The type of fuel load depends on the type of forest and time since the last fire occurred. A recent veld fire experienced would have consumed much fuel hence if the spacing of two veld fires is

characterized by less time, the last fire experienced will not be very violent and destructive since there will be few fuel loads. On the other hand, older mature forest would have larger amounts of fuel hence occurrence of veld fires outbreak is very high (Geldenhuys 1994).

Size and shape of fuel plays also a significant role in veld fires. The finer the fuel is the higher the reaction and the quicker it releases of moisture (Nkhensani 2011). This can be seen in the burning of grass. Additionally, the spacing between fuel particles is important in combustion. Combustion is favoured when fuel is loosely packed to allow oxygen to reach flame zones. In as much as fuel particles should be loosely packed, the fuel load itself should be dense enough to facilitate an efficient heat transfer (Luke and Mc Arthur 1998).

Also, fuel moisture helps inn causing veld fires. Fuel moisture is the amount of moisture in fuel (Nkhensani 2011). It controls what will burn and what will not with what intensity of burning. Fuel load with higher moisture content is likely not to burn. In the event of the fuel load burning, it is likely to burn with a lesser intensity. Thus when fuel is dry, they ignite easily and burn easily with a great heat intensity.

2.2 Classification 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 (Trollope et al 1990). The intensity of burning or temperature can also be used for further classification of fires as cool or hot fires. Nyamadzawo et al (2013) echoed that intensity of fire is determined by the release of heat energy per unit time and per unit length of fire front.

Cool fires, are usually fires that occur early in the dry season. This period of early dry season is from late April to late June when there is still moisture in leaves and grass. Heat energy of less than 2000k W-1, is released in the process. Whilst on the other hand hot fires are experienced during the late dry season of August to October (Williams et al 1998). Hot fires occur when grass and some trees have dried up because of the sunny conditions experienced in Zimbabwe during the period of August to October. Hot fires release heat energy of up to 8000k W-1 and are much more destructive than cool fires. This is also because of the windy conditions experienced in August (Williams et al 1998).

Hot 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 unburnt patches.

2.3 Characteristics of veld fires

Fire is characterized by its behaviour, ecology and chemical composition (Nkhensani 2011).

Fire ecology is the study of the ecology and the historical role of fire and the effect that fire has on the environment, ecosystem, animals and plants (Ecological society of America 2002). Fire ecology examines the role of fire in ecosystems. Its aim is to study the origins of fire, its influence on the spread, intensity and fire relationship within an ecosystem. Besides human activities related to urban living and agricultural production, fire is the most widespread ecological disturbance in the world (Komara 1971). Africa is considered to be the fire continent because of the widespread occurrence of biomass burning particularly in the savannah. Goldammer and De Ronde (2004) stated that in most areas of the summer rainfall in south of Sahara particularly in savannah biomes, fires are mainly caused by lightning and humans.

Fire behaviour is the manner in which fire reacts to variables of fuel, weather and topology (Goldammer and de Rond 2004). The behaviour of fire is also used to refer to the release of heat energy during combustion as described by the rate of spread of the fire front, fire intensity and flame characteristics. Fire behaviour gives the understanding of being able to predict what the fire is going to do under various conditions (Nkhensani 2011). This can further assist in applying the appropriate burning to achieve the desired effect ensuring fire suppression tactics are applied successfully. Knowing fire behaviour plays a pivotal role in all fire management control decisions and makes them more efficient in their role in veld fire management as a tool.

Fire is a chemical reaction called rapid oxidation (Teie 2005). When heat (just over 160 degrees Celsius) is applied to a fuel in the presence of oxygen, fire will be produced (Heikkila et al 1993). Oxygen, fuel and heat are necessary elements for a fire to start, removing one element make it possible to extinguish fire. The air constitutes of 21% of oxygen and this oxygen promotes burning, when oxygen is reduced to 15% a fire is extinguished. Veld fires are primarily controlled by focusing on the fuel. The drier the fuel the more ready it is for burning. In order to ignite a fire, fuel must be brought to its ignition temperature (Heikkila et al 1993). This means

that if heat falls below the ignition point, the fire goes out. Water is the most effective agent for this reduction of heat. Veld environment influences the behaviour off a fire. The three elements (oxygen, fuel and heat) interact with each other to set fire behaviour at a specific point and time. As these three elements change, the fire behaviour changes.

2.4 Measures to combat veld fires

2.4.1 Prevention

Prevention is defined as actions designed to impede the occurrence of a veld fire or it can be the prevention of occurrence of veld fires from having harmful effects on the community (Carter 1991). Prevention measures can be explained as those activities that are concerned with the minimization of the occurrence of veld fires. It is therefore action taken in anticipation of fire as highlighted by the Food and Agriculture Department of the United Nations (2002). Fire prevention measures are considered to be the most cost effective and mitigation programme an agency, organization and a community can implement (Nkhensani 2011). There are three elements to veld fire prevention. These include education, fuel breaks and law enforcement (Teie 2005).

For a proper fire prevention programme to be successful, fire causes must clearly be known since management actions have to address and reduce the cause in order to reduce the impact. Public awareness is one of the preventive methods that can be used. Prevention of fires requires an understanding of public knowledge on the damaging aspects of fire and the actions that lead to fire elimination and reduction. Nkhensani (2011) noted that many people are not aware of the impact of an uncontrolled fire has to the environment and that the primary problem in the prevention of veld fires lies in people. A well informed public is likely to use fire carefully. Therefore, educating the public is the primary step in veld fire prevention.

The process of public awareness can be done through books, radio messages, television programs and use of sign posters and handouts. Veld fire awareness involving communities can be very effective engaging the community as a responsible partner over resources. During awareness campaigns, visual aids can be important in delivering the message. Where literacy levels are low, visual elements can also be more helpful.

Fire breaks are also an important tool in preventing veld fires. According to Teie (2005), a fire break is an artificial barrier constructed before a fire occurs. It is a defensive mechanism against fires, where fires can be stopped, checked or attacked. A fire break has the ability of reducing the effects of veld fires since it is a cleared belt of inflammable material (Nkhensani 2011). These belts prevent fires from spreading from known areas or suspected areas of ignition. Fire breaks need to be maintained and regularly monitored for them to be effective. Their success depends upon where they are placed and how they are constructed.

Additionally, law enforcement is another preventive tool in veld fire suppression. Statutory instrument 7 of 2007 on environmental impact assessment and ecosystem protection governs veld fires in Zimbabwe (EMA 2007). The regulation compels users, owners and occupiers of a given piece of land to have pre-suppression and post suppression measures. Pre-suppression is a measure put in place before the start of a fire season, the reason being to avoid and curb for veld fires. The measure aims at eliminating and reducing risks. The tool compels any person or authority to put in place boundary standard fire guards that are at least 9m wide (external fire guards) and at least 4, 5 m wide (internal fireguards). These fire guards should be kept clear of any flammable material (Mushwe 2011).

In an effort to try and reduce the effects of fire and try to balance between the negative and positive effects of fire in southern Africa, a body was formed to deal with such issues. Most of the southern countries in Africa have come up with a body known as southern African fire network (SAFNET) to combat veld fires (Potgieter et al 2000). SAFNET is composed of managers of national parks, government forest fire sector, regional non-governmental organizations (NGO's), community based organizations, independent consultants and some universities.

2.4.2 Suppression

Suppression measures are those measures employed or which have to be undertaken when there is a fire outbreak. This is done in order to reduce environmental damage, property and human loss (Mushwe 2011). The law in Zimbabwe advocates that in case of a fire outbreak, any person within the vicinity of the fire other than the user or the owner of the land shall carefully put out the fire. Various techniques can be used that include direct attack and indirect attack (Mushwe 2011).

Direct attack consists of a series of action done in order to cool, beat out, starve or extinguish the flames of a burning fire. The method is mainly taken in lighter fuels on the flaming edge of the fire by creating fire lines that can halt the spread of a fire. A fire truck is considered to be the best and safest way of direct attack (Nkhensani 2011). Teie (2005) pointed out that an indirect attack can be employed after a direct attack is not possible. It is also practiced when there are extreme conditions of heat, slope and smoke. Hand tools such as spades, chain saws and rakes are primary tools used in suppressing fires.

2.4.3 Post suppression measures

Post suppression measures are measures that must be undertaken after a fire outbreak. An investigation and documentation of the causes and extent of fire damage to the environment, property or loss of life should be undertaken within 7 days from the day of occurrence (Mushwe 2011).

2.5 Fire management practices

Fire management practices are concerned with the protection of people, property, range and forest areas from unwanted veld fires. A holistic and integrated fire management is one that involves all the stakeholders to participate. It is governed by five principles that include

- Analyses of fire related data
- Prevention of fire
- Fire preparedness
- Actual fire suppression
- Restoration of affected areas

Fire management is a continuous cycle of efforts that initially require a comprehensive solution involving all stakeholders. A successful fire management is dependent on the cooperation and coordination among governments' agencies, local community and the private sector (FAO 2006)

2.6 Social impacts of fire

Veld fires have impacts on the livelihoods and social life of many people. They result in reduced agricultural produce in the event that fires occur just before harvesting of crops. This in turn

results in reduced food availability for both animals and humans, reduced growth rate of vegetation and loss of equipment. The overall impact of veld fires can be seen in increased food insecurity among households (Nyamadzawo et al 2013). Food security means to secure access at all times to sufficient food, but because of veld fires food security might be compromised. Availability in sufficient quantities of food on a consistent basses is sometimes hindered by veld fires.

In many cases farmers lose livestock and experience complete destruction of rangelands leaving livestock with no grazing. The effect turns to be low milk production, poor beef quality and lower selling prices of livestock as they are thin in many cases and unhealthy resulting in a generally low income for farmers (Nyamadzawo et al 2013).

Traumas are also common impacts among victims of veld fires. Shelter loss has often left families traumatized (Nyamadzawo et al 2013). Property loss that includes destruction of personal goods can be a source of grief. Having no shelter, sleeping in the open, no food supply, poor water quality and poor sanitation may lead to stress. Feelings of helplessness may arise among people whose lives and property are threatened by veld fires (Machilis 2002). Additionally, post-traumatic stress disorders (feeling jumpy), nightmares and disturbing dreams and bad memories might be experienced.

In many African cultures, the poor are segregated and discriminated (Nyamadzawo et al 2013). Due to loss of property incurred during veld fires, indirect effects may be experienced by the poor. Psychosocial well-being of families might be affected resulting in disintegration of families (Nyamadzawo et al 2013). Fowler (2003) observed that effects of fire range from temporary frustration, temporary or permanent reduction in health related quality of life.

2.7 Economic impacts of veld fires

The direct economic costs of veld fires include loss of tourism and the catchment integrity taking into consideration the rate of decreased water quality (Nyamadzawo et al 2013). Indirectly, veld fires affect the livelihoods and economic well-being of rural populations. This is because veld fires have an impact on recreation, spiritual value, biodiversity and ecological functions such as erosion control, water supply and regulation, waste treatment and storage of carbon (SADC 2010).

Veld fires often result in a wide spread destruction of the natural environment. The environment provides an important regulation mechanism that sustains life on earth. This can be seen in the production of oxygen. However, veld fires promote environmental degradation. Davis and Unum (1999) cited in Nyamadzawo et al (2013) articulated that smoke from fires reduces significantly photosynthetic activities in the environment. The process of environmental degradation is speeded up by veld fires.

One of the serious effects being faced in many countries as a result of fire is the disappearance of fertile soil due to erosion (Potgieter et al 2000). Trees and grass are being destroyed by veld fires, soils are becoming exposed to the biosphere where they are prone to the agents of erosion that include rain wind and temperature compromising their fertility. Much soil is lost through the conversion of virgin lands to crop lands many through the use of fire. Fire as a management and development tool is specially seen in poor communities where burning is in many cases the only option available as it is seen as cheap and simple to use. Although people are aware of the detrimental effects of veld fire people feel there is no other short term plan that can substitute the simplicity of land clearance using fire.

Environmental degradation is a process by which the environment i.e. air, water and land progressively become contaminated, exploited and destroyed (Etuonovbe 2009). Degradation can be mainly grouped into ecosystem imbalance, forest degradation, fresh water degradation, soil degradation, air pollution and global warming. In other words, when the environment becomes less valuable or damaged, environmental degradation is said to have occurred. There are many forms of environmental degradation that fires causes which include habitat destruction, biodiversity loss or depletion of natural resources. The largest areas of concern at present are the loss of rain forest, air pollution and ozone depletion caused by fires.

In the event of surface and canopy veld fires, leaf litter on the soil surface becomes limited and sometimes unavailable. Vegetation cover reduces hindering canopy interception hence promoting run off and erosion (Moody et al 2008). Shakesby and Doerr (2006) observed that after veld fires, runoff is increased and as a result, infiltration rates reduces. Soils will be left exposed and become compacted promoting less infiltration. Studies by Scott 1993 showed that post fire hydrological behavior is characterized by low infiltration and enhanced runoff. Loss of fertile soil is a big blow to the economy since it is one of the assets on which production is

centered upon (Nyamadzawo et al 2013). Zimbabwe relies on agriculture and this is done on land.

In addition, apparent diversity (observed directly) and hidden diversity is affected by fires. This causes impoverishment of biodiversity and the extinction of some species especially tree species (Nyamadzawo et al 2013). The result is the replacement of once forested areas by vast areas of grasslands. Nyamadzawo et al (2013) pointed in Zimbabwe, a single fire can reduce woody plant richness by a third to two thirds depending on the fire severity. Death of animals and plants will subsequently cause a reduction of revenue collected from game viewing and tourism. Therefore the country can suffer from lack of foreign currency since tourism is one of the industries that generate foreign currency.

Ecosystem services are also disrupted during events of fires. These services include waste assimilation that can be seen in carbon sequestration by vegetation (Costanza et al 1997). Services of goods provided by the ecosystem like fruits represent a benefit to human population (Nkomo and Sassi 2009). All these benefits can be lost in a single fire. Nyamadzawo et al (2013) pointed out that the cost of veld fires to the economy are difficult to quantifying monetary terms because they involve ecological processes and services that are not fully captured and which are not also traded on formal markets. Therefore, the destruction of the natural environment by veld fires has dire consequences on the economic status, but remains unknown in terms of actual figures (SADC Fire Management Programme 2013).

Forest and woodlands resources assume an economic role in the southern development community region since they supply many products and services that are essential for the well-being of rural communities (Nyamadzawo et al 2013). Moreover the products of forest and woodlands provide 20% of disposable income used by African families to meet basic needs and sustain informal economic activities (SADC Fire Management Programme 2010). Many rural populations rely heavily on the resources that are derived from the forest and woodlands like mazhanje (Uapaca kirkiana fruit).

These fruits are consumed by the local community and even sold to generate money to meet household demands. The commercialization of forest produce in local markets help local economies for rural household from income derived from the sale of fruits, firewood and even

timber (MacDonald 2003). The biggest economic loss is actually felt by the local people who depend on the forests for services and goods. Basing on the fact that the rural population relies on resources derived from the forest and wood lands, veld fires can be substantially destructive to local economies (SADC Fire Management Programme 2010)

Due to excessive smoke in areas affected by veld fire, respiratory diseases are experienced. Smoke from veld fires can interfere with road transportation, inhibit tourism and cause serious public health problems. Furthermore, wild fires contribute to significance amount of greenhouse gases and particulate to the atmosphere.

Pollution of air by veld fires causes a public health risk and psychological distress that alters natural concentration s of atmospheric gases. Katrowits (2000) pointed out that a component of pollution (ozone) is associated with negative effects and aggressive behavior. The poor economy being experienced in the country (unemployment over 90%) results in less funds towards the health system that might have been realized through taxes. The lack of a vibrant health system will lead to deaths. Respiratory diseases have been linked to veld fires. Diseases that also include asthma, skin and eye irritation diseases are experienced. In Brazil, a study showed that the number of patient suffering from the above mentioned diseases doubles during the peak of the burning season (Nepstad et al 1999). Therefore, air pollution is no doubt one of the reasons why the health systems of some countries are being stretched beyond their stretching limits.

Veld fire has also significantly caused or contributed to greenhouse gasses. The inter-governmental panel on climate change attributed 17. 3% of total human emissions to biomass burning of veld fires (Nyamadzawo et al 2013). This makes veld fire the second largest source of greenhouse gases by human activities after the burning of fossil fuels. Chenje et al (1998) pointed out that burning is the single largest contributor to atmospheric nitrous oxides and carbon dioxide during the dry season in Zimbabwe.

The effects of fire might even stretch to the destruction of the seed bank, seedlings and saplings. This has a negative impact on the recurrence of the original natural species since fire results in mortality of individual seeds, stems and plants (Shackleton 2007). Regeneration of plants is one of the biggest challenges communities face after occurrence of veld fires.

Death of wild animals is also experienced after veld fires. A vast number of animals might be destroyed for example fruit eating birds that help in seed dispersion. The animals that escape are exposed to long term indirect effects such as loss of habitat, shelter and food.

On the other hand, the effects of fire are not only negative as perceived by many. They improve the growth of green grass which provides grazing for animals (Hardy 1999). Veld fires remove old and normally less palatable dry plant material. Veld fires also limit animal parasites like ticks. Life cycles are broken of animal parasites resulting in reduced animal disease as

CHAPTER 3: RESEARCH MATERIALS AND METHODS

3:1Research design

Polit and Hungler (1999) cited in Nkhensani (2011) propounded that a research design is a blue print or an outline for conducting the study. A research design can therefore be viewed as a framework that guides and directs a research. Edmonds and Kennedy (2012) stated that a research design refers to the actual structure or framework that indicates the time frame in which data will be collected or how and when the data will be analyzed.

3:2 Target population

Population is the totality of all subjects that conform to a set of specifications comprising the entire group of persons that is of interest to the researcher (Polit and Hungler 1990). The targeted population can therefore be explained as a group of people that the researcher intends to carry out research on. Castillo (2009) referred to the targeted population as the entire set of units for which the investigation data are to be used to make inference. Therefore the population chosen is determined by the researcher.

The research collected data from ward 1 in Hwedza rural area. The targeted population is people aged 16 and above who were living in Hwedza ward 1 for at least 5 years before 2010. The reference period refers to when EMA had not yet introduced veld fire management practices. The researcher targeted mainly this population because they are the ones who received environmental education on veld fire management practices when such practices where introduced by EMA in 2010. The researcher collected data from Watershed ward 1 veld fire management area that consists of four villages. The villages have a total population of 196 people.

Targeted key informants included District administrator, one EMA official, ward councilor, Hwedza environmental committee director and one member of ministry of education. They were targeted because they work closely with Watershed ward 1 in the management of veld fires.

3:3 Sample size

Sampling refers to the process of selecting research participants (Dane 1990). A sample is only a portion of elements in a population. It is not practical to include all the members of the population in a research project, hence the need for sampling. Information is only obtained only

from a proportion of the target population (Nkhensani 2011). Therefore in simple terms, a sample is procedure that is undertaken to obtain information of an entire population by just examining only part of the entire population.

Non probability purposive sampling was used to select key informants. In this type of sampling, items for sampling are deliberately selected. These individuals are selected to provide specialist information (Mc Nealy 1999).

The researcher used probability sampling to select respondents. Probability sampling gives every item of the population an equal chance to be selected (equal chance of inclusion in the sample). The researcher divided the population into four, representing each village. This creation of these subgroups was done to ensure representation of all villages.

This method will give good results since we are dealing with participation of the community in veld fire management strategies, capacity building and care for the environment in order to benefit from it. The researcher calculated 20% of each village population in the research section area to represent the total number of people in that particular village. The 20% has been chosen in order to minimize errors and in order to get equal and fair representation of the whole community.

3:4 Data collection

Struwig and Stead (2010) articulated that data is information that includes pictures, words and numbers that are gathered according to certain scientifically accepted procedures. Data was obtained directly from individuals from watershed ward 1 using questionnaires, interviews and direct field observations. Data collected from the individuals was a source of primary data since primary data is data obtained directly from the information source which has not undergone analysis (ACAPS 2012). On the other hand, secondary data which is an analysis of data that has already been gathered for other purposes (ACAPS 2012) was also used in the research. This kind of data needs validation and alterations before utilization.

Sallant and Dillman (1994) referred to data collection as a systematic way of gathering information which is relevant to the research purpose or questions. Primary data collection was done through questionnaires, semi structured interviews and direct field observation.

3:5Primary data sources

3:5:1 Questionnaires

The main instrument used to gather information on veld fire management strategies in watershed Ward 1 was questionnaire with both closed ended questions and open ended questions. The questionnaire constituted of 58 questions with 45 closed ended questions and 13 open ended questions. Closed questions collected information on sex, history of veld fires, ways of mitigating veld fires and knowledge of the ward people on veld fires.

Open ended questions gave the respondents freedom to give answers in their own words and clarify issues. Open questions collected information on the effects of fire and the strength of veld fire management program that was initiated by EMA in 2010. For fair representation of males and females, 20 women and 20 man got questionnaire to ensure gender equality.

The researcher administered questionnaires a total of 40 questionnaires in ward 1. These were administered to the respondents on a face to face basis. The researcher collected the questionnaire after each respondent had finished answering the questions to ensure a high responds rate.

3:5:2 Key informant interviews

Interviews are commonly used methods for explorative research. Interviews seek to either discover respondent's own interpretation of the area under discussion or look for reasons when developing theories rather than proving or disapproving hypothesis (Elena 2011). In order to complement information obtained from questionnaires, interviews were used.

Key informant interviews provide individual perspectives and experiences through direct discussion (ACAPS 2012). It is a primary data source which collects information from people with prior knowledge of the affected community (ACAPS 2012).

The subject of interest in this case is veld fires, hence individuals who had knowledge on veld fire management were interviewed using structured interviews. The researcher conducted a preliminary survey on the 24th of March 2014 to organize and determine the day to conduct the interview in April and familiarize the key informants on issues to be discussed. An interview

guide which consisted of semi-structured questions was utilized to guide the discussion and was used on all key informants.

Interview with EMA office

A member from EMA (L. Dera) was interviewed who works in Hwedza district using a structured interview. A one on one type of interview was used in collecting information from the EMA officer with notes being written down during the interview. The interview provided the view of the agency's extent that has been achieved in addressing veld fires.

From EMA office information on background of veld fire practices and environmental education methods that are being used to educate people on veld fires was collected. Also the interview was conducted to get information on challenges that are being faced in implementing fire management practices and the state of the natural resources i.e. before and after the education centre was established. The interview lasted for 25 minutes.

Interview with the Headman

A one on one interview with the headmen within ward 1 was carried out by the researcher. The inclusion of the headmen (N. Muchichwa) was done in order to have a clear and true representation of the community head's view towards the role of veld fire management strategies that were introduced by EMA in preventing the devastating effects of fire.

Collection of information was done using structured interview to know how veld fire management practices were being initiated in the area of his influence by EMA. During the interview, notes were taken down in a diary with the interview lasting 22 minutes

Interview with a member of ministry of education

Using a structured interview, a member of ministry of education (L. Mugumbate) was interviewed for 16 minutes. The researcher used a one on one approach in interviewing the member of ministry of education. This was relevant so as to attain information on the methods used in educating people in ward 1 about veld fires and also knowledge of veld fire that could be passed by the ministry of education.

This was also important because schools were targeted as institutions that could help in the prevention of veld fire by disseminating information through environmental campaigns and seminars. During the interview, the researcher took down notes in a diary which were later compiled.

Interview with the District Administrator

Additionally, the district administrator (J. Mapungwana) was interviewed for 25 minutes. The researcher used a one on one type of interview in collecting information from the District Administrator's office. A structured interview was used to collect information on the effects and extent of damage that veld fires had caused and its relation to environmental degradation.

Notes were written down during the course of the interview in order also to know the changes that the Administrator had noticed in ward 1 concerning natural resources.

Interview with the ward Councilor

Additionally, the ward Councilor (E. Chagonera) was interviewed for 20 minutes. The researcher used a one on one type of interview in collecting information from the Councilor's. A structured interview was used to collect information on the extent of damage to property that veld fire had caused in the ward. During the course of the interview, the researcher wrote down notes in a diary.

Interview with Zimbabwe Republic Police

Furthermore a member of the Zimbabwe Republic Police (ZRP) was interviewed to gain knowledge on environmental crimes that were being recorded. A structured interview with the ZRP member (D. Chakacha) was aimed also at gathering information on whether there was any imprisonment to environmental perpetrators who had caused veld fires.

In interviewing the (ZRP) member, a one on one type of interview was employed with notes being taken down during the course of the interview. The interview lasted for about 16 minutes.

Interview with the Environmental Committee Director

To the Environmental Committee Director (L. Madzure), one on one type of interview was used. The interview's aim was to gather information on the current and burning environmental issues that were as a result of veld fires. Also the interview aim was to know whether there was any improvement that was experienced after the implementation of fire management practices in the area. In collecting this information, a structured interview was used. The interview took about 25 minutes to be completed.

Krathwohl (1998) stated that interviews require more time, more energy and more money as compared to the use of questionnaire. An interview guide that consisted of semi-structured questions was utilized to guide the discussion. Information that was received through the interviews was noted down in a diary. During the interview the researcher managed to chair the discussion and clarified questions presumed to be not clear or contentious so as to make sure that information obtained was valid.

3:5:3 Direct observation

Observations are ways of gathering data by watching behaviour, events or noting physical characteristics in their natural setting (Newton 2003). Observation is classified into two, direct observation and indirect observation. The researcher used direct observation. Direct observation is a process of collecting data on naturally occurring behaviour within their usual context (ACAPS 2012). Fire breaks and beaters were observed in ward 1

Direct observation aided by photographs was also part of the research. Observations were used to gather information on effects of veld fire on forest, grazing area and property. Photographs of fire prevention methods were also taken.

The researcher used simple random sampling to select an individual from each of the 4 villages. These individuals made observations and recordings on observation checklists. The names of all people from each village section were placed in a box and the first one picked automatically qualified to participate in the research.

The researcher selected the whole village area as a site for the observations within each village. The observers were informed of the importance of the activity. A general brief of the expectations was made by the researcher to the observers to ensure quality data. The observers

were trained on how to fill the observation checklist. Observations were to be done on daily basis and these observations were to be done in a week's time.

The observations covered issues on people seen clearing land using fire, constructing fire guards fire guards, collecting thatch grass and collection of traditional fruits among others. This was relevant so as to cover all areas and record the required data within the available timeframe. The data was summarized using notes and recordings attained during the observation period.

3:6 Secondary data sources

Secondary data is an analysis of data that have already been collected for other purpose. This data can be contemporary or historical and may be qualitative or quantitative and usually needs adjustments and validation before being put to use (ACAPS 2012).

The researcher used secondary data to get information on veld fires and fire management activities. EMA reports on population from 2008 to 20113 of ward 1 and fire management practices used were also used for the purpose of analyzing trends in veld fires and environmental degradation with respect to changes in time periods. The reference years refers to when data on veld fires was available.

Additional data was obtained from published books, natural resource management journals, agricultural production journals and forestry documents on the internet. The researcher used secondary data so as to complement primary data and also because secondary data is less expensive and also less time consuming.

3:7 Data analysis and presentation

Data analyses is the procedure for systematic application of statistical and logical techniques to describe, categorize, illustrate summarize and evaluate data (Shamoo and Rensik 2003).

The data obtained from questionnaires was subjected to statistical analysis. The researcher tabulated the data and grouped the number of respondents who were responding in the same manner in the same group. After grouping same responses in same group, data was presented using graphs and frequency tables in order to show the percentage change of frequency of veld fires.

Data that were obtained from interviews were analysed and presented in descriptive manner. The researcher had to read through all the data and organize comments into similar categories in order to analyze comments which showed data that was not numerical in nature. The researcher grouped the qualitative data through labelling. Patterns or associations were then analyzed and relationships noted.

Results obtained from direct field observation pertaining to fire management and prevention practices were also presented through the use of descriptions. Thus the data was also subjected to presentation in a descriptive manner. In addition, data that were attained from EMA records, Police records and village head among others were also presented in both descriptive and quantitative manner. The availability of this data gave the researcher adequate room to explore driving forces of veld fires and the role played by EMA in the prevention of fires.

CHAPTER 4 DATA PRESENTATION AND ANALYSES

4.1 Introduction

This chapter presents and analyses field work data.

4.2 Socio-demographic Information of Respondents

Table 4.1 shows socio-demographic characteristics of respondents.

Table 4.1: socio demographic characteristics of respondents (n=40)

Characteristic	Percentage of respondents
less than 20 years	25%
20-30 years	37.5%
31-40 years	10%
41-50 years	7.5%
50 years	20%
Employment Status%	
Formal employment	17,5%
unemployed	35%
self employed	47.5%
Years lived in the ward	
Before 2010	97,5%
After 2010	2.5%
Proportion of household income derived from	
Crop production	82.5%
Gardening	15%
Livestock production	2.5%

Table 4.1 shows that 25% of respondents are aged less than 20 years, 37.5% are in the age group 20-30 years. 31-40 years age group had 10 % representation while 7.5% and 20% were aged 41-

50 years and above 50 years respectively. Most respondents 37.5% were aged between 20 -30 years.

Formally employed people have the least proportion with only 17.5%. The unemployed are 35% and the self-employed constitute the greatest percentage 47.5%. Those who are self-employed derive income from selling garden produce at nearby Hwedza centre.

Table 4.1 also shows that (82.5%) of the respondents' source of household income is derived from crop production. House hold income from gardening constitutes 15% of the total and is usually derived from selling garden products at nearby shopping centre while only 2.5% of the total household income is obtained from livestock production. The majority of the people (82.5%) rely on crop production. There is continuous clearance of land for agricultural purposes which in some cases cause veld fires.

Most respondents (97.5%) were living in the ward before the year 2010. This group has information pertaining to changes that have occurred before and after the formulation and implementation of ward 1 veld fire management plan in 2010. Only 2.5% of the respondents came to live in the ward after EMA had established its veld fire management plan.

4.3 Causes of fire in ward 1

Figure 4.1 show causes of fire in the Hwedza ward 1 from 2000 to 2014.

Figure 4.1 causes of fire

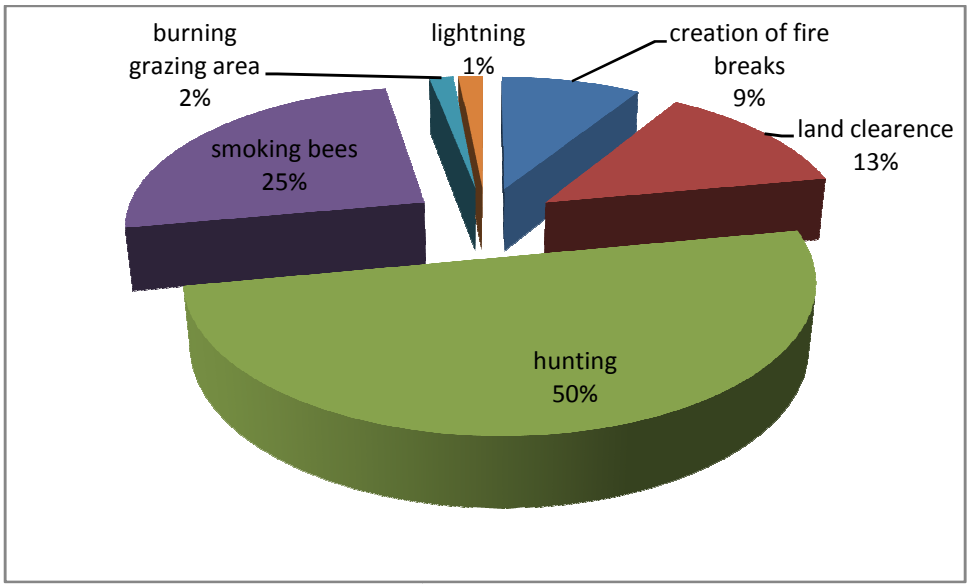


Figure 4.1 shows that 50% of veld fires are caused by hunting followed by smoking bees (25%). Land clearance constitutes 13% of the total causes of fire, creation of firebreaks contributes 9% and burning of grazing constitutes only 2 %. Lightning as a cause of fire contribute 1% to the total causes of veld fire in Hwedza ward 1. Thus, the majority of the veld fires in the area are started by hunters. Svotwa et al (2007) noted that illegal hunters also use fire to flush out wild animals and when extracting honey. When people were resettled in the area from communal areas, there were still pockets of forests home to impalas, kudus and warthogs. Due to reported past cases of drought and the prevailing high levels of unemployment, villagers engage in several surviving strategies including hunting. Fire is sometimes used to contain hunted animals in restricted area.

4.4 Occurrence of veld fires

Figure 4.2 shows the trend of occurrence of veld fires from 2000 to 2014

Figure 4.2 Number of occurrence of veld fires

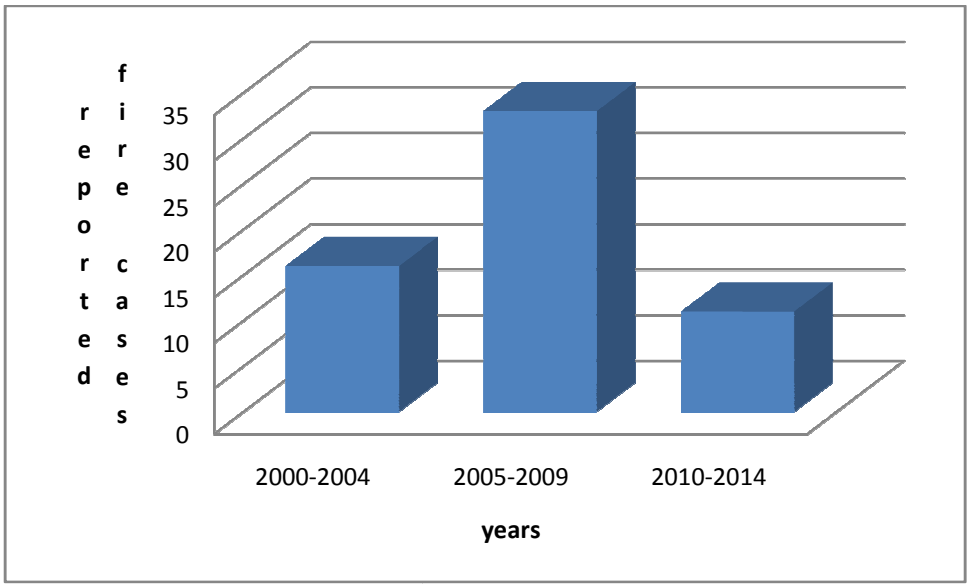


Figure 4.2 shows that between 2000 and 2004 ward 1 experienced 16 veld fires. This translates to an average of 3 reported fire outbreaks per yearly fire season. The number of fire out breaks went up by 15 cases to reach 31 reported fire incidences between 2005 and 2009. The reason why fire outbreaks doubled in between 20005 and 2009 was because of the hard economic conditions that prevailed from 2006 to 2009. Many people resorted hunting and selling of game meat for survival of which fire was used to trap wild animals. Between 2010 and 2014, only 11 cases of veld fires were reported. Mr. L Dera (EMA officer) highlighted that the decrease in cases of veld fires post 2010 is attributed to environmental education that the community was getting from veld fire management environmental committee. After the establishment of veld fire management plan by EMA in ward 1 in 2010, cases of veld fire decreased (from 31 between 2005 and 2009 to 11 between 2010 and 2014). Svotwa et al (2007) pointed that without coordination the risk of fire spread is high exposing property to veld fire risk and damage. Therefore, a carefully managed fire control strategy is needed to produce desired results.

4.5 Impacts of veld fire on grazing

Figure 4.3 shows the extent to which veld fires have destroyed grazing in ward 1

Figure 4.3 Impacts of veld fire on grazing

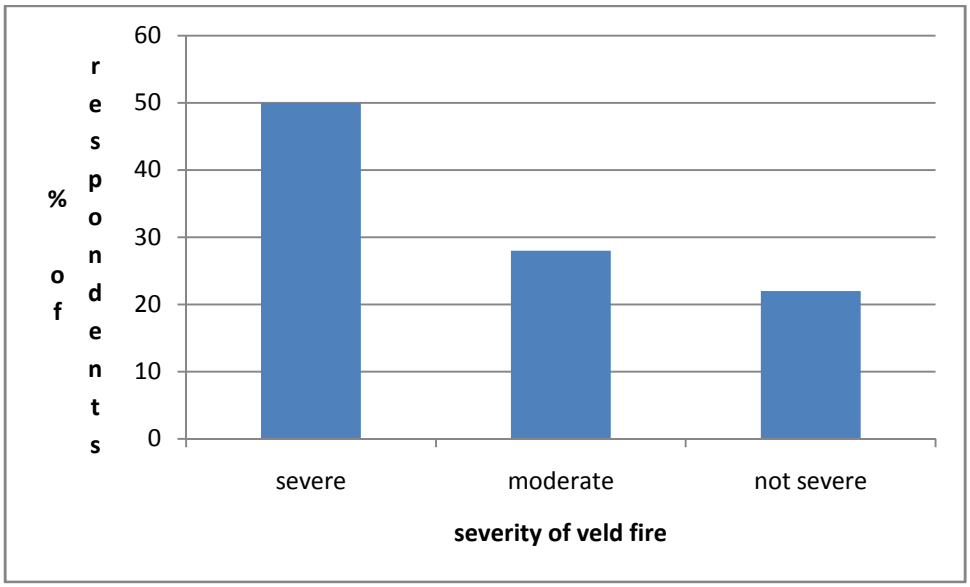


Figure 4.3 shows that 50% of respondents noted that the effect of veld fire on destroying grazing area is severe while 28% of respondents noted that the effect of veld fire on destroying grazing area is moderate. Twenty two percent of the respondents noted that the effect of veld fire on destroying grazing area is not severe. There is need to reduce veld fire destruction on grazing area through increasing knowledge of community members on its consequences. Community must participate actively in the protection of their own resources. Fire is known to destroy the woody component of the veld leaving behind the grass component dominating. The environmental committee Director noted that in the long run, there can be an overall change in the environment with more grass specie becoming available.

4.6 Impact of veld fires on property

Figure 4.4 shows the extent to which veld fires have destroyed property.

Figure 4.4 Impact of veld fire on property

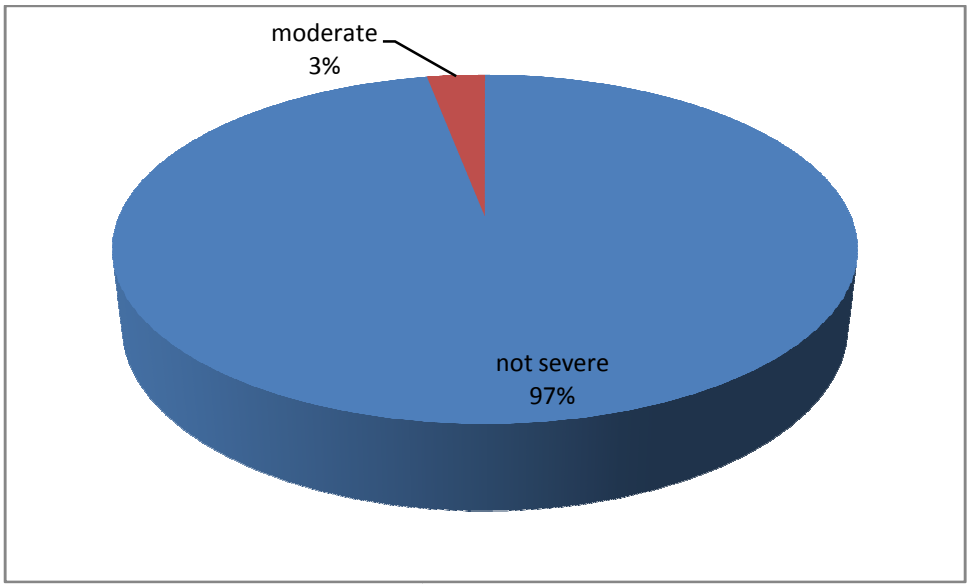
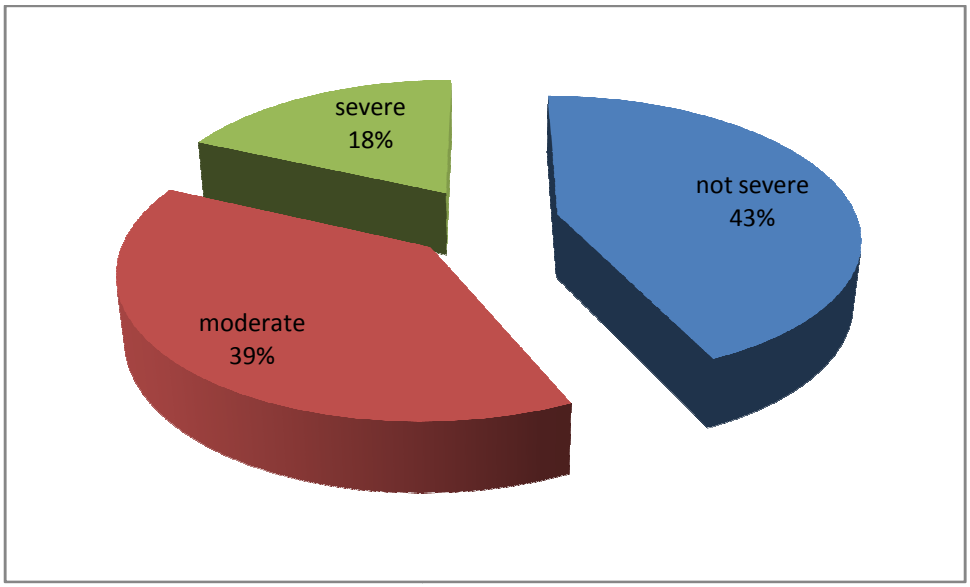


Figure 4.4 shows that 97% of respondents view veld fire's effects on property not severe and 3% view it as moderate. Reports on fire damage to property and even human life is quite a common feature in Zimbabwe (Herald reporter 9 September 2006). The active involvement of the local people and having fire information and disseminating early warning has created sense ownership of the resources in the ward increasing to the local responsibility and the efficiency of protecting property. This has led to fewer incidences of property loss in the ward.

4.7 Impacts of veld fire on wild animals

Figure 4.5 shows the extent of damage that veld fires have caused on wild animals

Figure 4.5 Impacts on veld fire on wild animals



It is shown in figure 4.5 that 43% of respondents view veld fire's effects on wild animals not severe and 18% view veld fires effects on wild animals as moderate. Thirty nine percent of the respondents view veld fire's effect as severe to wild animals. The case of veld fires affecting wild animals is a concern in Zimbabwe. In the year 2000 it was reported that fire engulfed three-quarters of the central part of the 43 000 hectare Hwange National Park forcing hundreds of wild animals to flee flames (BBC News, 2000). This tends to destroy both habitat and the food resource base for wild animals. Wildlife experiences a sense of terror and anxiety when confronted with forest wildfires, like humans, they flee to escape destruction. Most of the animal species that are forced out of their natural habitats will not be able to return to those same familiar habitats. This might lead to extinction of some animal in some areas.

4.8 Impacts of veld fires on domestic animals

Figure 4.6 The extent to which veld fires have negatively affected domestic animals

Figure 4.6 Impacts of fire on domestic animals

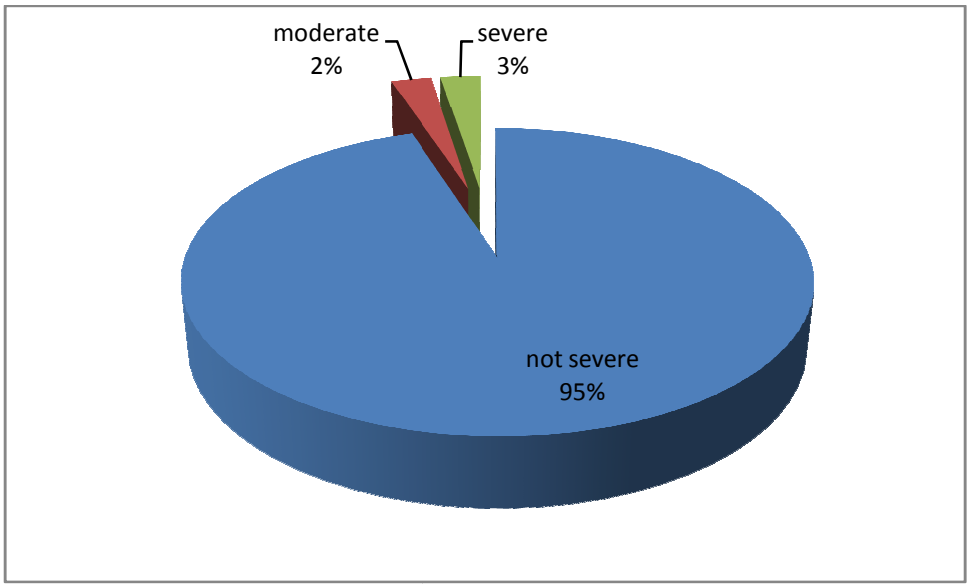
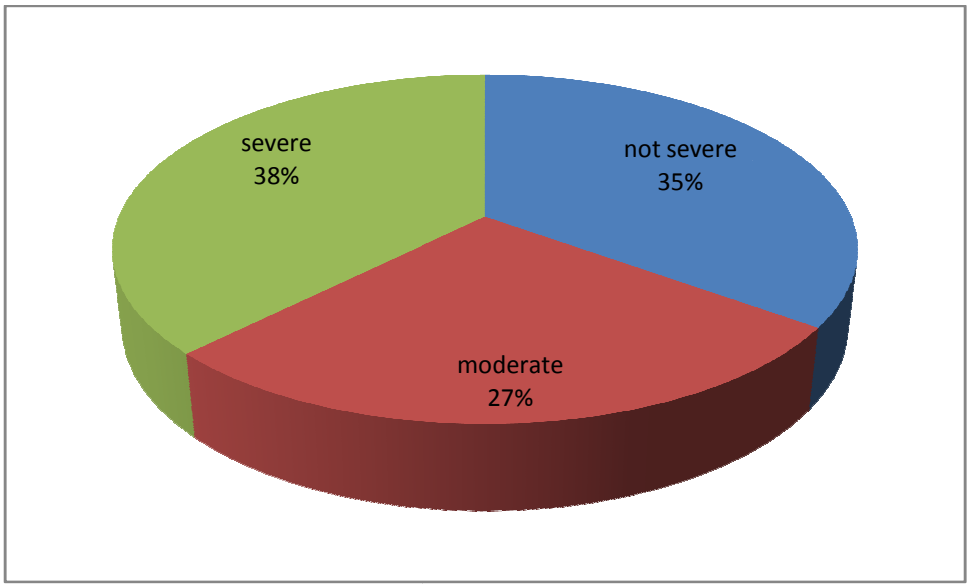


Figure 4.6 reflects that 95% of respondents view veld fire's effects on domestic animals not severe and 2% view it as moderate. Three percent of the respondents view veld fire's effect on domestic animals as severe. In cases where weather conditions are favorable, forest fires can be very wild and uncontrollable. This tends to destroy both habitat and the food resource base for domestic animals.

4.9 Impacts of veld fire on vegetation

Figure 4.7 shows the extent to which veld fires have destroyed vegetation in ward 1 leading to soil erosion.

Figure 4.7 Impacts of fire on vegetation

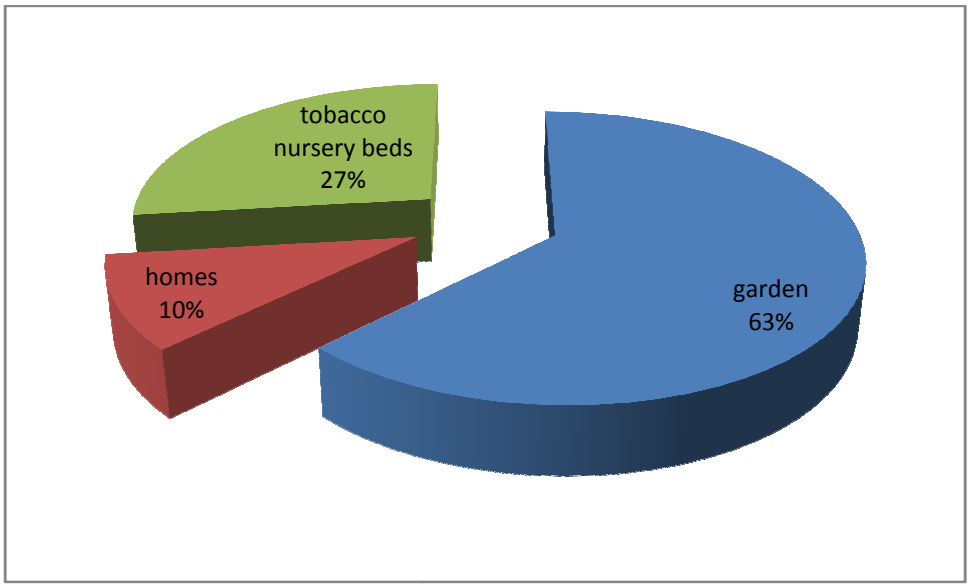


In figure 4.7, 35% of respondents view veld fire's effects on the environment as not severe and 27% view it as moderate. Thirty eight percent of the respondents view the effect of veld fire on vegetation as severe. The majority of the people (38%) worry that continued effect of fire on vegetation may cause soil erosion.

4.10 Impact of veld fire on homes, garden and nursery beds

Figure 4.8 shows the extent to which veld fires have destroyed gardens, homes and tobacco nursery beds.

Figure 4.8 Impacts of fire on homes garden and nursery beds



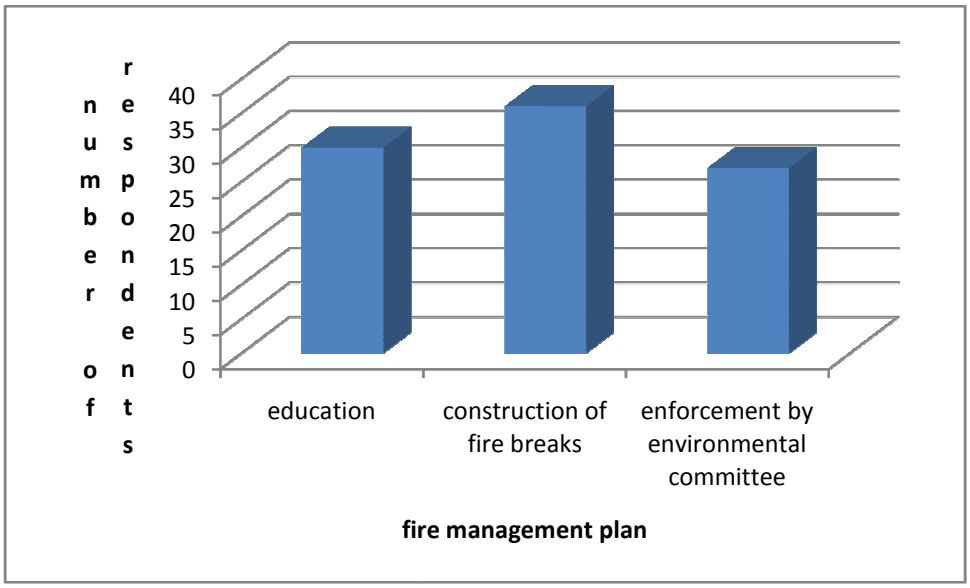
Ten percent of respondents had grass thatched huts destroyed by fire. Twenty seven percent of respondents had tobacco nursery beds burnt by veld fire while gardens are more prone to veld fire because they are the most affected having 63% of the total respondents. Since some of the income generated comes from selling of garden produce at nearby Hwedza centre, household income is being threatened. Gardens are mostly affected by veld fires because there is plenty of fuel material that is used in build gardens to prevent animals from entering the gardens. These fuel materials include dry grass and dead wood. In case of fire these materials easily catch fire resulting in many gardens being destroyed in an event of veld fire.

4.11 Components of the veld fire management plan that was implemented in Hwedza ward 1 by EMA.

Given the high annual frequency of fire out breaks in the area and many negative impacts to the society caused by fire in the ward as discussed above, EMA intervened. A veld fire management plan was launched in 2010. Components of this management plan are discussed below.

Figure 4.9 shows that the current veld fire management plan implemented by EMA which includes educating the community, construction of fire breaks and awareness campaigns.

Figure 4.9 fire management plan that includes education, construction of fire breaks and enforcement

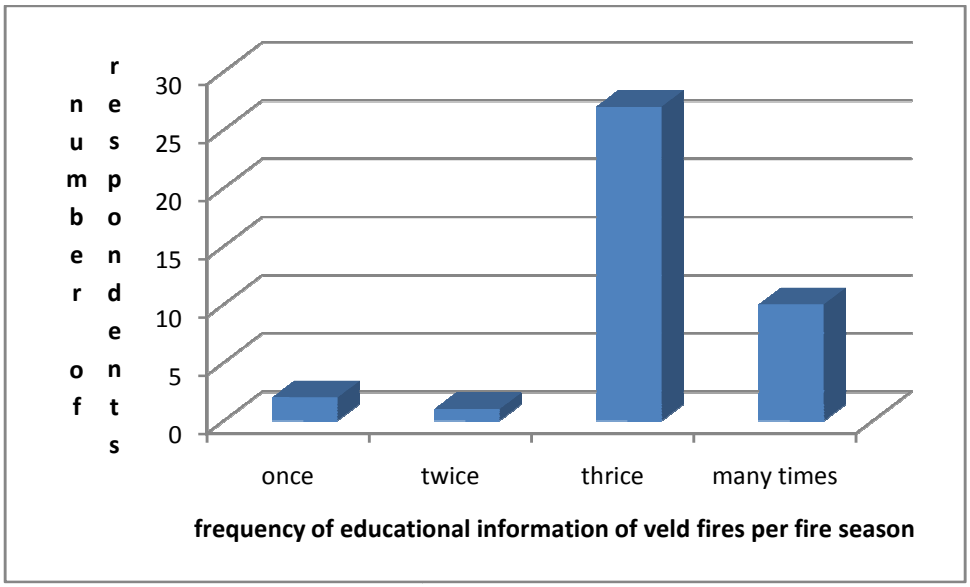


In figure 4.9 above, shows that many of the respondents (30) agreed that the veld fire management plan include educating the community on veld fire prevention and suppression measures. This therefore implies that, ward 1 is receiving information on veld fire hence it is evidenced by the reduction of fire out breaks experienced since 2010. Many of the respondents (36) agreed that the veld fire management plan in preventing veld fires also includes construction of fire breaks. Therefore it is evident that in as much as EMA is educating the villagers on veld fires, it is emphasizing more on prevention. The least number of respondents (27) think that there are enforcement measures implemented in the veld fire management plan.

4.12 Number of villagers who receive educational information

Figure 4.10 shows the frequency of educational information on veld fires reaching the villagers per each fire season.

Figure 4.10 Frequency of educational information on veld fires to villagers in ward 1

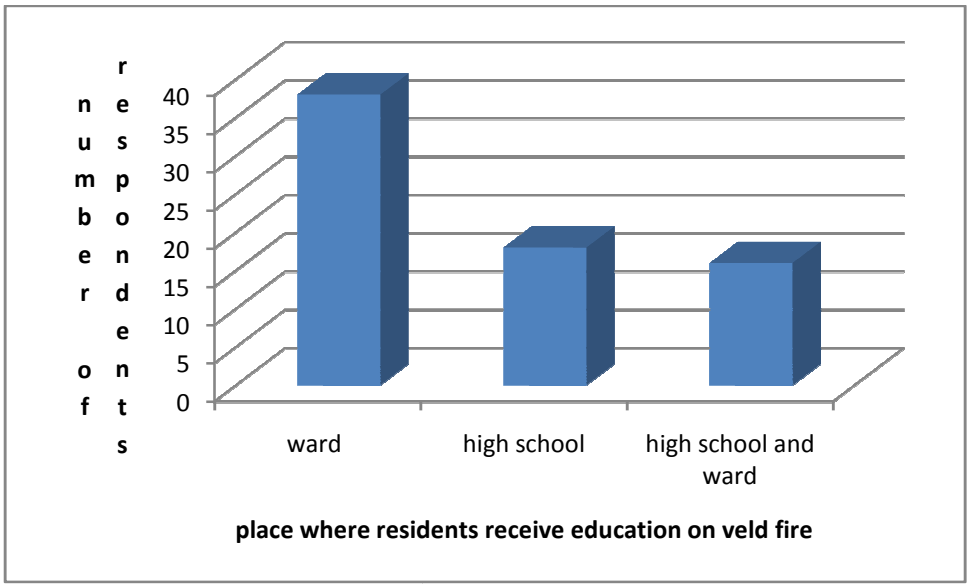


In figure 4.10, it is shown that the majority of respondents (27) were informed about veld fires thrice per fire season while 10 respondents were informed many times per fire season. Two respondents and one respondent were informed once and twice respectively informed about veld fires per each fire season. Overally, the majority of the villagers have received educational information on veld fires per fire season. EMA has managed to provide educational information which has resulted in the decline of fire out breaks in ward 1 as of 2010 when the veld fire management plan was implemented.

4.13 Place where residents receive educational information on veld fire management practices

Figure 4.11 shows where residents attain educational information on veld fire management practices

Figure 4.11 Places where residents receive educational information on veld fires

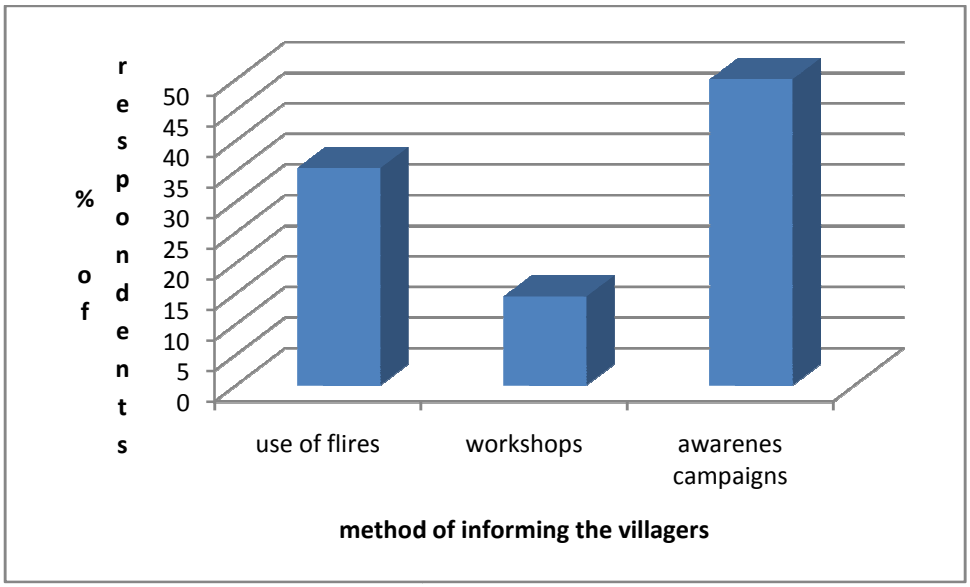


From figure 4.11 above, most of the respondents (38) receive information on veld fire management practices in the ward. Respondents who get information from high schools totaled to 18 while the respondents who receive information from both ward and high schools were 16. The veld fire management plan established by EMA is active in the ward and high schools. in the management of natural resources and property in ward 1, EMA has managed to reach out to the villagers. EMA has the responsibility of meeting with people. A well informed ward is more likely to use fire carefully and also adhere to the existing veld fire management plan. The majority of the respondents (38) were reached with educational information by EMA in their ward without incurring any costs to the villagers. High school students and villagers are also targeted by the management program introduced by EMA. As early as form 1, students are informed about veld fires and all age groups are informed on veld fires at ward level by EMA. This implementation strategy goes a long way in addressing veld fire management since information is passed from generation to generation. In future years, Hwedza ward 1 will see a few cases of fire out break since most of the community members will have information on veld fires.

4.14 Targeted population of the veld fire management plan introduced by EMA in 2010

Figure 4.12 shows the target population of the veld fire management plan established by EMA in 2010

Figure 4.12 target population of the veld fire management plan

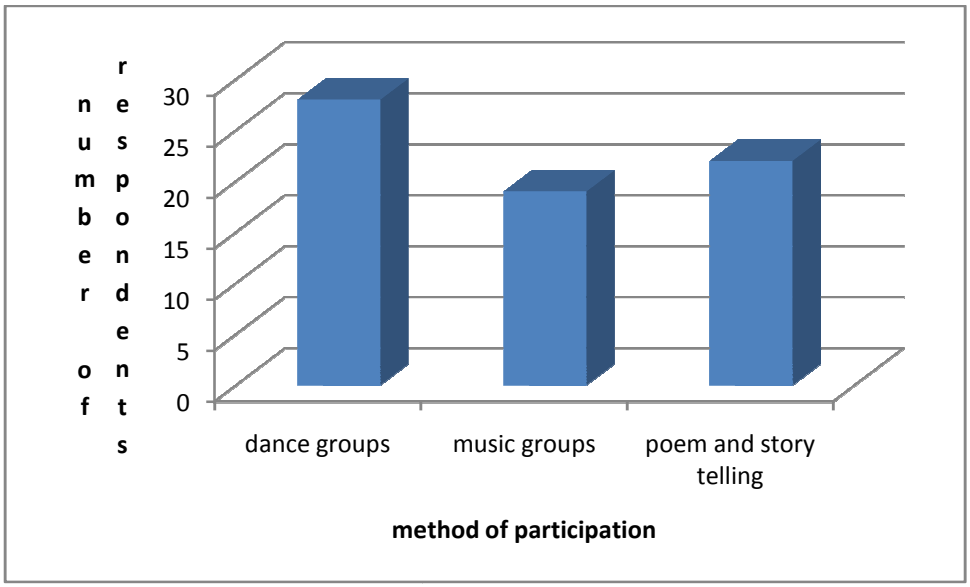


In figure 4.12 above, it is shown that 35.5% of the respondents received information on veld fires through fliers while 14.5% of respondents received information of veld fire through work-shops. The majority of the respondents (50%) received information of veld fires through awareness campaigns. EMA targeted both the literate and illiterate. Those who could read accessed information in written form. Awareness campaigns in the ward were responsible for information dissemination to both literate and illiterate.

4.15 Participation of the community in the veld fires management plan

Figure 4.13 shows how villagers in ward 1 are involved in participating in the veld fire management plan

Figure 4.13 Participation of the community in the management plan



Most of the respondents (28) are actively involved in dance groups established by EMA as shown in figure 4.13 above. Nineteen respondents are involved in music groups facilitated by EMA while 22 of the respondents are involved in storytelling and poem group initiated by EMA. Dance groups, music groups and poem and storytelling groups were established by EMA with an aim of educating the ward on prevention and suppression of veld fires. The music group managed to produce a song entitled "extinguish fire" that discourages people from starting fire while encouraging protection of the environment from veld fires. Therefore, the natural resource users are actively involved in conserving their own natural resources. This active involvement of the community helps in the reduction of fire outbreaks since a sense of ownership is implanted in the community and also builds trust in the ward making known to the villagers their responsibility in using fire wisely.

4.16 Facilitators of the veld fire management plan in Hwedza Ward 1

Figure 4.14 shows the responsible organization that has been facilitating the veld fire management plan in Hwedza ward 1

Figure 4.14 facilitators of veld fire management plan

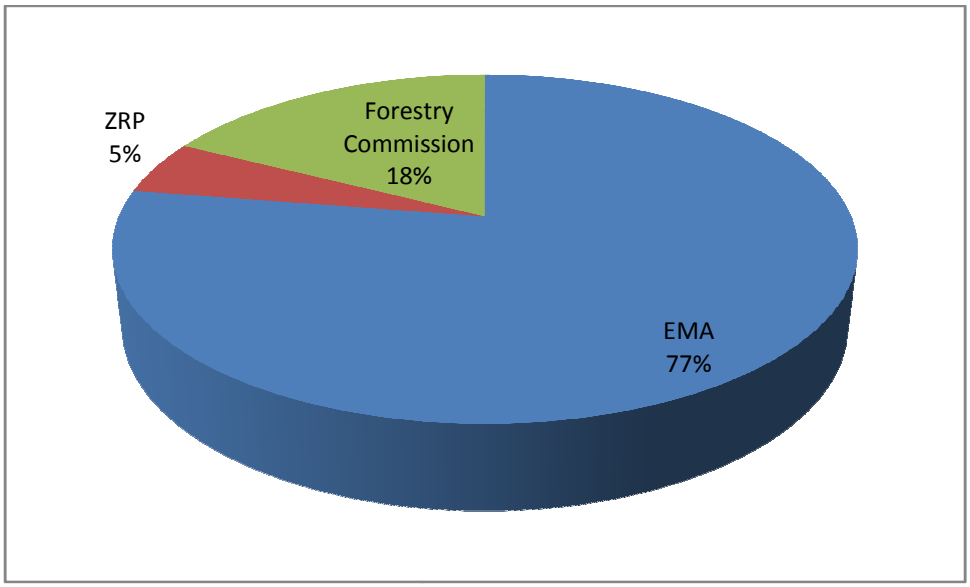


Figure 4.14 shows that most of the villagers (77%) acknowledge that EMA facilitated the veld fire management plan in their ward. Eighteen percent of the respondents think that it is forestry commission facilitated the program while 5% think that it is ZRP that facilitated veld fire management plan in their ward. EMA facilitated the program of veld fire management practices in Hwedza ward 1 and formed an environmental committee that includes representatives from ZRP and Forestry commission. The active participation from ZRP and Forestry commission has resulted in them being confused as implementers if the program.

4.17 Strength and weakness of the fire management plan

Figure 4.15 shows the area of strength and weakness of the implemented veld fire management plan

Figure 4.15 strength and weaknesses of the fire management plan

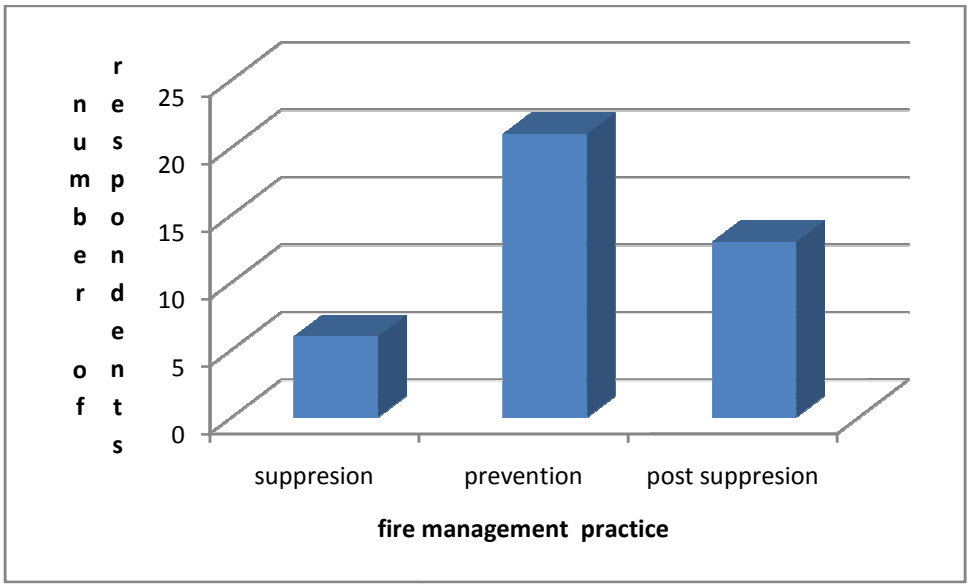


Figure 4.15 shows that the minimum number of respondents (6) is vexed with suppression measures of fire. The majority of the respondents (21) are well vexed with the fire prevention measures while 13 respondents clearly know post fire suppression measures. The villagers have acquired more information on prevention of fires resulting in a general decrease of veld fires. The low numbers of respondents representing suppression measures has resulted in the destruction effects of fire. In cases of fire out breaks, the village is not well informed resulting in many grazing area destroyed. The management plan on veld fires introduced by EMA lacks clarity on suppression measures.

4.18 Veld fire management plan enforcement policy

Figure 4.16 shows an existence of an enforcement policy as contained in the veld fire management plan

Figure 4.16 enforcement policies contained in the veld fire management plan

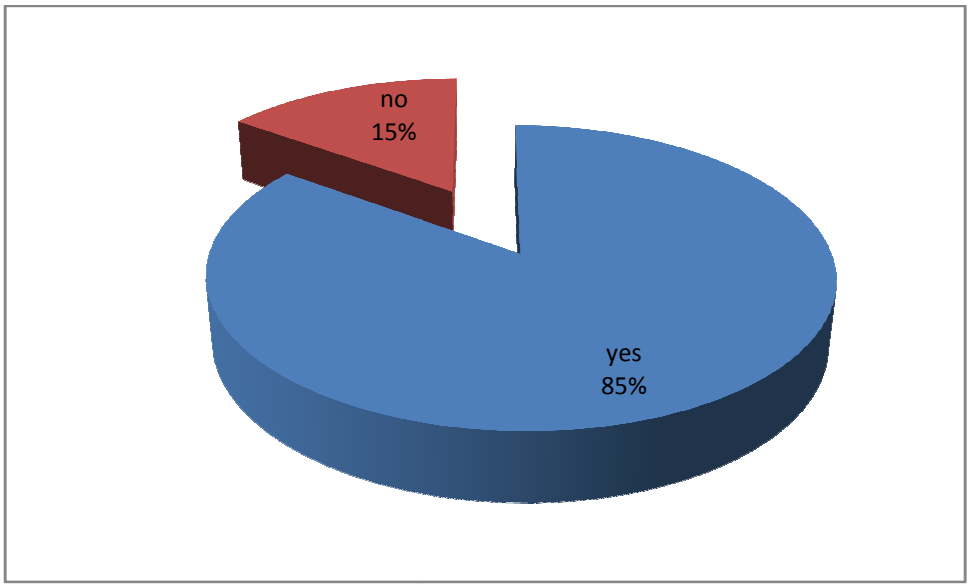
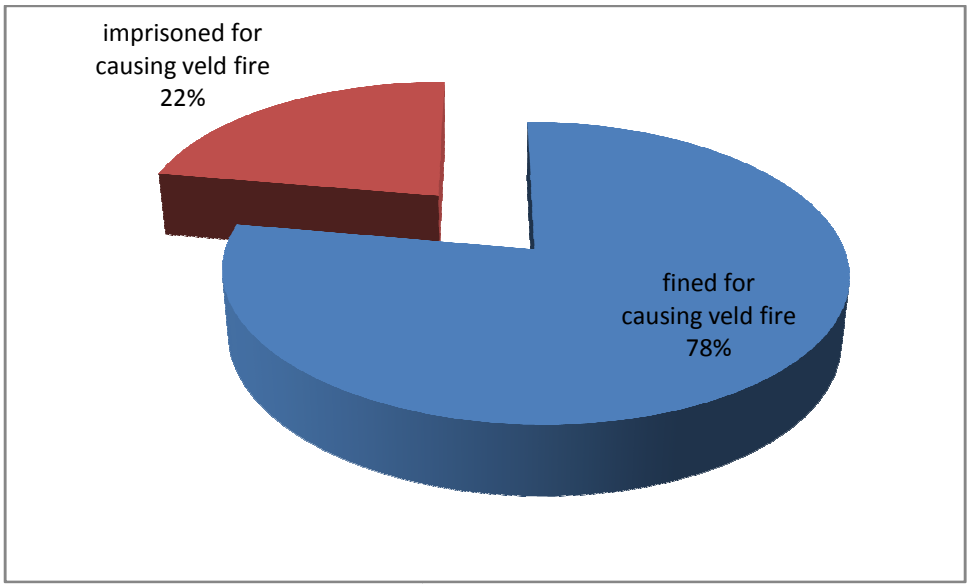


Figure 4.16 shows that 85% of respondents agree that there is an enforcement policy on veld fire management and 15% does not see enforcement policy on veld fire management plan. The enforcement helps in preventing unwanted fires. Traditional chiefs' ability to enforce traditional ways of fire prevention measures is key to prevention of fires in rural areas. It is considered that you attract a curse when you burn certain forests or pockets of forest. This therefore reduces the occurrence of veld fires within rural areas.

4.19 Punitive measures to deal with people who cause veld fire outbreaks

Figure 4.17 shows measures taken to deal with people who cause veld fires

Figure 4.17 percentages of villagers imprisoned and fined for causing veld fires



It is shown in figure 4.11 reflects that 78% of the respondents highlighted that villagers had been fined for causing veld fires whilst 22% highlighted that some villagers were imprisoned for starting a fire. The fines are good enough to deter them from causing veld fires hence there has been a decrease of fires from 2010 to date in ward 1. In its effort to enforce its veld fire management plan, 78% have been fined and 22% have been imprisoned. Depending on the magnitude of destruction, fines are as high as $500 according to representative from ZRP (Mrs. D Chakacha)

4.20 Visible signage for veld fire alert

Figure 4.18 shows information on visible signage for veld fire alert that have been put in place through the veld fire management plan introduced by EMA.

Figure 4.18 availability of visible signage for veld fire alert

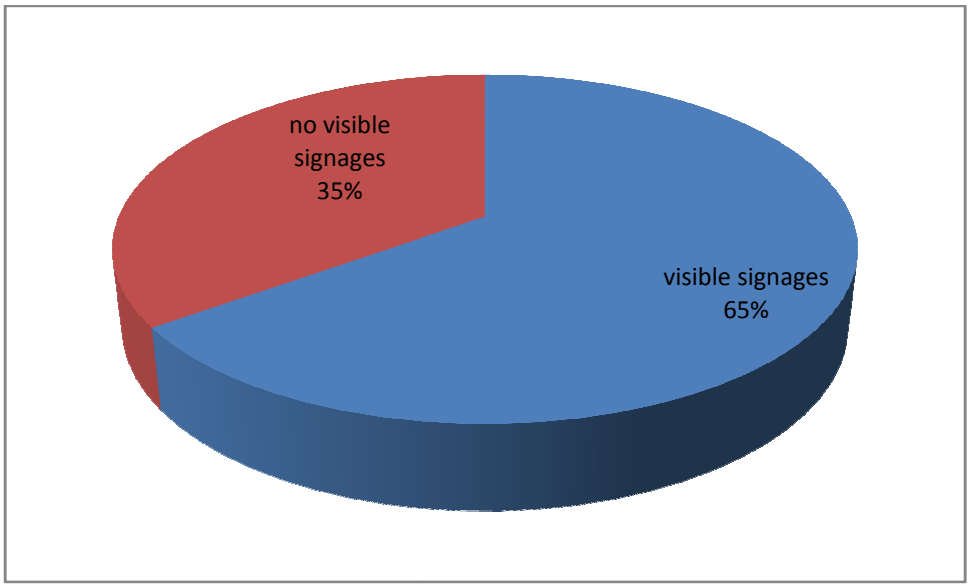
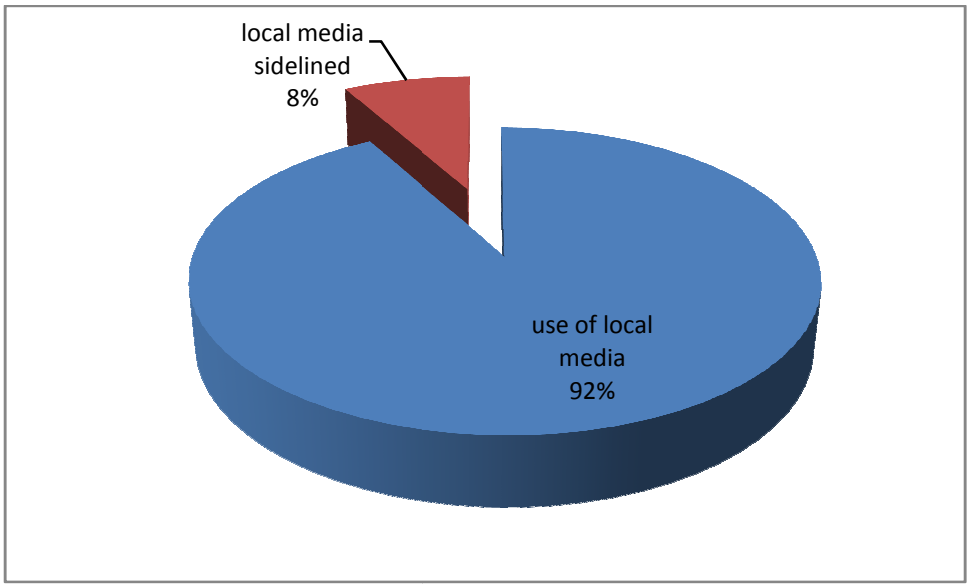


Figure 4.18 above shows that 65% of participants do agree that EMA has visible signage for veld fire alert while 35% of participants indicate that EMA does not have visible signage for veld fire alert. The research established that EMA has placed visible signage for veld fire alert with an inscription where fire can be reported. Svotwa et al (2007) pointed that without coordination the risk of fire spread is high exposing property to veld fire risk and damage. Therefore, a carefully managed fire control strategy is needed to produce desired results.

4.21 Local media use for dissemination of veld fire information

Figure 4.19 shows the use of local media for conducting awareness programs as part of the veld fire management plan implemented by EMA.

Figure 4.19 Use of local media in broadcasting information in ward 1

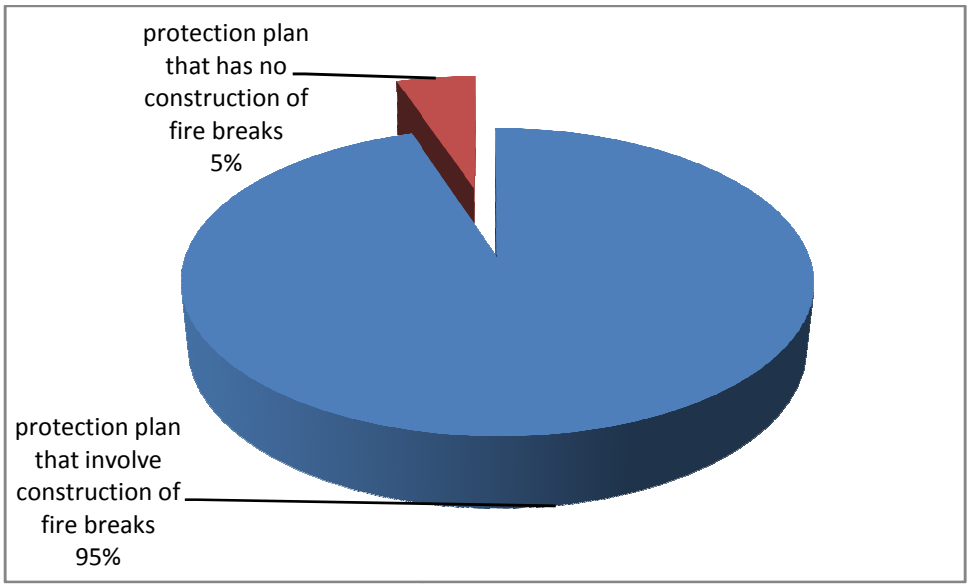


In figure 4.19 above, it is shown that reflects that 92% of respondents indicated that EMA uses local media for the promotion of veld fire awareness campaigns where as 8% indicates that EMA does not use local media to promote fire awareness campaigns. The research has established that many people (92%) have been informed through the use of local media. Properly informed and equipped villagers can decrease the incidents of veld fire.

4.22 Protection plan against veld fires

Figure 4.20 shows the existence of a protection plan from veld fires introduced as part of the management plan established by EMA.

Figure 4.20 protection plans against veld fires



In figure 4.20 it is shown that 95% of the participants agree that EMA has a veld fire protection plan that is being implemented through firebreak construction and 5% do not see protection plan being implemented in terms of fire break construction. An effective fire protection will be in a better position to reduce the impacts of unwanted veld fires. Inclusion of an integrated veld fire management is an approach which does not only focus on protection from fire but a system that takes into consideration of other aspects of veld fire management such as fire prevention, education and awareness (Daff 2003). Establishment of 95% respondents who agree that there is a protection plan explains why veld fires have been decreasing.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1: Conclusion

Veld fires cause serious social, economic and environmental damages. They 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 and the natural environment destroyed including its natural medicinal plants and other natural resources.

Veld fires in Hwedza Ward 1 have been mainly caused by human activities. Hunting, smoking bees, land clearance, creation of fire breaks and burning of grazing land has resulted in 99% of the total causes of fire. It is therefore possible to prevent veld fires since the occurrence of veld fire attributed to natural causes only account for 1%.

All villagers in Hwedza Ward 1 are affected by fire either directly or indirectly. Grazing areas, gardens, forests and wild animals are at risk of destruction by veld fires. Many fires are caused by hunters when trapping wild animals using fire.

After the establishment of community based fire control strategy by EMA in 2010, veld fire risk has fires notably decreased. With the involvement of other stakeholders such as ZRP, schools and an environmental committee veld fires marginally decreased from 31 between 2005 and 2009 to 11 between 2010 and 2014. Through the environmental committee people in the ward now have access to environmental educational materials. This has raised people's awareness about consequences of starting fires and the damage that was associated with uncontrolled fires.

The veld fire management strategy that was introduced by EMA involves education of the community on fire, construction of firebreaks and enforcement measures that are carried out by the environmental committee. Penalties or fines in the form of money, cattle or other types of livestock are paid to the chief or village head by the offenders. There is a strong enforcement policy as part of the veld fire management programme. This has provided a strong ward based fire control strategy.

EMA has the task of reaching out and providing information on prevention, suppression and post suppression measures of fire to ward 1. Information on veld fires is frequently disseminated to people in the ward and high schools each fire season. This therefore gives an opportunity to all

ward members of receiving information about the veld fire management practice that is being implemented in their ward. The strength of the management plan lies in the prevention of fires evidenced by the low frequency of veld fire out beaks. Suppression measures are not as effective as the prevention measures because in case of veld fires, severe destruction of gardens, grazing areas and nursery beds is experienced.

Active participation of villagers in ward 1 acts as a pivotal factor to the successful implementation of the veld fire management plan by EMA. The management plan depended also on the attitudes of the villagers tasked with the responsibility to spearhead firefighting and suppression strategies in the ward.

5.2: Recommendations

The veld fire management plan in Hwedza Ward 1 can be made more effective if villagers clean contour channels and ridges of grass and other fuel material. Since there is plenty of grass available in the ward, it can be used to feed livestock. This applies also to long grasses around cattle pens, crop fields, homestead and gardens that can be harvested to make hay and sold for income.

A bottom up approach can be adopted that can easily capture community dynamics and needs that can to be addressed to reduce impacts of fire. Since 50% of the respondents established that the issue of destruction of the environment by veld fires can be largely attributed to hunting. There is therefore need to involve hunters 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 emphasizes active involvement that strengthens capacity to cope with fires and improve on livelihood security. Additionally, an understanding of why fires are started can help EMA 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 abundance of fuel that can start veld fires. This helps in focusing on such areas so that any fire outbreak can be thwarted before considerable damage to the environment has been done. Villagers must be taught about fire suppression measures. It is also important for EMA to identify age groups in ward 1 that can take part in veld fire reduction activities

Time when fire out breaks is common and most destructive should also be understood. Such an understanding can help in the making of specific fire control measures during fire seasons. The age that normally causes fire must always be made targets for environmental education.

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.

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RESEARCH MATERIALS

Appendix 1

Questionnaire for residents in ward 1

My name is Jonathan Chihwai. I am an undergraduate student of Geography and Environmental Studies at Midlands State University. I am doing research on Veld fire management strategies in rural areas: The case of Watershed Ward 1 in Hwedza. Responses will be used for academic purposes and will be treated confidentially.

Section A: Background information

Village Name

……..

Tick were appropriate

1. Sex Male ☐ female ☐
2. When did you -start living in the area?

   2000-2004 ☐ 2005-2009 ☐ 2010-2014 ☐ other specify ☐

3. What is your age group?

   16-20 ☐ 21-30 ☐ 31-40 ☐ 41-50 ☐ 50+ ☐

4. What is the main source of household income?

   Crop production ☐ gardening ☐ selling forest produce ☐ livestock production ☐ other specify

5. What type of employment do you have?

   Formal employment ☐ self-employment ☐ unemployed ☐ other specify

Section B: History of veld fires

6. In which period of years have veld fires occurred in your ward?

   2000-2004 ☐ 2005-2009 ☐ 2010-2014 ☐

7. What has been the cause of veld fires?

   Creation of fire breaks ☐ land clearance ☐ hunting ☐

   smoking bees ☐ burning of grazing area ☐ lightning ☐

8. Who is he facilitator of the veld fire management practice in Ward 1?

   EMA ☐ ZRP ☐ Environmental Management Committee ☐

9. Does the ward have enough manpower to combat veld fires?

   Yes ☐ No ☐

Section C: Veld fire knowledge

10. Is there any enforcement of veld fire management strategies in your ward?

    Yes ☐ No ☐

11. Have you been taught about veld fires?

    Yes ☐ No ☐

12. How have you been taught?

    Use of fliers ☐ workshops ☐ awareness campaigns ☐ other specify

13. From whom do you get information about veld fires?

    EMA ☐ Environmental committee ☐ School ☐

    other specify

14. How often do you get information on fire management per year?

15. Does the current veld fire management practice include education, fire breaks and enforcement in its plan?

    Yes ☐ no ☐

16. Does the veld fire management strategy introduced by EMA have a fire prevention plan?

Yes ☐ no ☐

17. Where does EMA conduct its fire awareness campaigns?

Ward ☐ primary ☐ high schools ☐ other specify ☐

18. How do they involve you?

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……

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……

19. What have you learnt from them?

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Section D: Ways of mitigation

20. Does EMA have a visible signage related to fire awareness?

Yes ☐ no ☐

21. Does EMA use local media to conduct fire awareness programs like the use of radio, local television channel and local newspapers?

Yes ☐ no ☐

22. What is the strength of the veld fire management strategy?

Prevention of fire ☐ suppression of fire ☐ post suppression of fire ☐

23. Are fire breaks inspected by EMA prior to the start of the veld fire season?

Yes ☐ no ☐

24. Does the management plan include fire suppression measures?

Yes ☐ no ☐

25. Is there a call centre where a fire can be reported daily?

Yes ☐ no ☐

26. Is there a call centre were fire can be reported any time?

Yes ☐ no ☐

Section E: Enforcement measures

27. What are the effects of veld fire on the following, where 1 is not severe, 2 is moderate, 3 is severe

Grazing ☐ property loss ☐ death of animals ☐ death of domesticated animal ☐ destruction of the forest causing soil erosion ☐

28. Is there anyone in ward 1 who has been fined by EMA for starting a fire?

Yes ☐ no ☐

29. If your answer is yes to the above, how many people have been fined that you know?

0-4 ☐ 5-9 ☐ 10-14 ☐ 15-19 ☐ 20+ ☐

30. Is there anyone in ward 1 who has been imprisoned for starting a fire?

YES ☐ NO ☐

31. If your answer is yes to the above, how many people have been fined that you know?

0-4 ☐ 5-9 ☐ 10-14 ☐ 15-19 ☐ 20+ ☐

32. Is the fine on veld fires stiff?

YES ☐ NO ☐

33. If yes to the above, why do you say so?

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34. If no to the above, why do you say so?

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Section F: Effects of fire

35. Which natural resources are in your area?

    Thatch grass ☐ water ☐ trees ☐ grazing ☐ wild animals ☐ other specify

36. Do you benefit from natural resources in your area?

    YES ☐ NO ☐

37. Do you use traditional medicine?

    Yes ☐ No ☐

38. Do you collect traditional fruits for sale?

    Yes ☐ No ☐

39. Do you collect traditional fruits for home consumption?

    Yes ☐ No ☐

40. If your answer above is yes, how often do you use these resources?

    Frequently ☐ sometimes ☐

41. What are the benefits that you receive from natural resources in your area?

    ……

    ……

    ……

    ……

    ……

42. Which natural resources have been affected mostly by veld fires?

    Soil ☐ water ☐ trees ☐ grazing ☐ wild animals ☐ other specify

43. How have the natural resource /resources ben affected?

    ……

    ……

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44. Have you experienced any effect of fire?

YES ☐ NO

45. What were the effects of fire that you experienced if your answer above is yes?

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46. Who has been responsible for veld fires?

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47. Why are they responsible?

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48. Has the forest, grazing area and availability of wild animals changed after 2010?

YES ☐ NO ☐

49. If yes how have their changed?

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Section G: Participation of local people

50. Is there any community consultation by EMA on veld fire management practices?

    YES ☐ NO ☐

51. Do you take part in decision making concerning ways of improving management of veld fires?

    YES ☐ NO ☐

Strength of EMA management practices

52. Has the establishment of the management practice team of any benefit?

    YES ☐ NO ☐

53. If yes why?

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    ……

54. If your answer above is no why do you say so?

    ……

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    ……

55. Has the EMA addressed the fire problem in your area?

    YES ☐ NO ☐

56. How effective is the veld fire management plan in addressing issues of veld fire?

    Effective ☐ very effective ☐ not effective ☐

57. Any other comments

    ……

    ……

    ……

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THANK YOU FOR YOUR PARTICIPATION

Appendix 2

Observation checklist

Village……

…….

1.

Collected goods from the environment	Frequency of collection
Thatch grass	
Fuel wood	
Traditional medicine and fruits	
Traditional timber	
Other specify	

2.

Noticeable fire prevention measure	
Construction of fire guards	
Early burning	
Throwing away of unlit used cigarette stubs	

3. Any other observations

observation	comment
1.)	
2.)	

Appendix 3

Semi structured interview for the Environmental committee director

What is the current state of the resource base in ward 1?

What are the resources that are` in ward 1?

Which resources are being affected mainly by veld fires?

How have they been affected?

Has there been any change on the grazing land, forest and wild animals compared to five years ago?

What are the possible causes of change?

Who has been responsible for fires?

What types of fires are experienced?

Are the members of the community receiving education about fires?

When do you start educating the people about veld fire?

What experts are involved in enlightening the ward about veld fire?

What are the challenges in veld fire management?

Are the ward members involved in decision making?

How is the ward involved in management practices?

Are males and female equally represented and involved in the management strategies?

Besides veld fires, what are some of the issues that are addressed in the ward?

Appendix 4

Semi structured interview for Ministry of Education

When did you start working with EMA concerning veld fires in ward 1?

What is the status of the grazing area, forest and animals in ward 1?

Has there been any change in grazing area, forest and wild animals compared to the past 5 years?

Which are the most affected natural resources in the area?

Why are they mostly affected?

How effective is it in addressing veld fires?

Do local people know about veld fires?

What are the challenges being faced in the implementation of veld fire prevention?

What is being affected mainly by veld fires?

Appendix 5

Semi structured interview for District administrator

Do you get reports of veld fires destroying forests, grazing area and property?

During which period are mentioned problems of fire frequently experienced?

Were you experiencing veld fires before the establishment of veld fire management strategies by EMA?

Has the establishment of veld fire management practices by EMA in ward 1 brought any change in the effects of veld fires on grazing area, forest and on wild animals and property?

What do you consider to be the main cause of the above mentioned problems?

Have there been reports you know where people have been reported starting veld fires intentionally?

What are the reasons that these people give for starting these fires?

Have there been cases of property loos or death through veld fires?

Are there penalties imposed to these people who start veld fires?

How stiff are the penalties?

Has the initiation on veld fire management by EMA changed trends of property loss, grazing area loss and livestock loss due to veld fire?

Appendix 6

Semi structured interview for ZRP

When did you start working here?

Has there been any case of veld fire, death due to veld fires reported before 2010 in ward 1?

Are there any changes in number of reports of veld fires after 2010 in ward 1?

What do you suggest as the possible cause of change in the number of cases reported if there are any?

Does the establishment of watershed ward 1 by EMA have an impact on trends of veld fires?

Have there been reports of people causing fires?

What is the penalty or measure imposed on starting veld fires?

How have the penalties imposed helped in addressing the problem?

Appendix 7

Semi structured interview for the village head

How long have you been in the area?

After the establishments of watershed ward 1 by EMA have you recorded any changes?

What might be the possible causes of the change?

Have there been reports of veld fire destroying forest, animals and grazing land?

What is the penalty of veld fires?

Are the penalties effective in addressing veld fire problem?

Which natural resource is mainly affected and why?

Who has been responsible for starting veld fires?

How effective is the veld fire management practice introduced by EMA in ward 1 in addressing the issue of fires?

Does EMA consult you in veld fire management practice programs?

Are there any activities being run that help in veld fire management?

Are there any indigenous methods used to guard against veld fires?

What do you suggest needs to be done to improve veld fir e management?

Appendix 8

Semi structured interview for EMA personnel

How long have you worked with watershed ward 1?

What penalty is imposed on people who causes of uncontrolled fire?

Is the penalty deterrent?

Have people stopped starting veld fires because of the penalties?

Besides penalties what are other reasons that could have caused reduction of veld fires, if veld fire are decreasing?

If veld fires are increasing, what could have been the cause?

Which natural resource is mainly affected by veld fires?

How have the natural resources been affected?

Why have the natural resources been affected?

Who is responsible for starting veld fires?

Are there environmental monitors in ward 1?

Is there any change in trends of veld fires before and after veld fire management practices introduced by EMA in ward 1?