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Effectiveness of Forest Fire management and monitoring strategies

stakeholder perspective in Mazowe rural district

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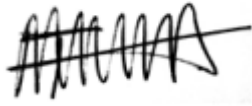
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APPROVAL FORM

The undersigned certify that they have read this project and have approved its submission for marking after confirmation to the faculty of sciences .Disaster Risk Reduction Department and HBSc DMS requirements.

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Dedication

I dedicate this work to my parents Mr. and Mrs. katungondo, brothers (Dion, Darrel and Dylan) for their prayers, endless effort, love, encouragement and motivation. Above all not forgetting almighty Lord.

Acknowledgement

First and foremost, I would like to thank the Lord almighty for the grace that He has granted me with, that made me to finish my studies well. I would like also to express my sincere gratitude and appreciation to a list of individuals with their valuable contributions and support throughout the completion of this project. To commence with, I would like to thank my supervisor, Doctor Manyangadze for his guidance, expertise, and unwavering support. His insightful feedback and direction were instrumental in shaping the project and ensuring its success. I would like to acknowledge my colleagues and friends who provided valuable inputs, advices, and encouragement throughout the project. Their support and discussions greatly enriched the research process. Lastly, I would like to express my heartfelt appreciation to my family for their unwavering support, understanding, and encouragement throughout this project. Their constant beliefs in my abilities and their love have been a source of inspiration.

Abstract

Forest fires pose a significant threat to the environment, economy and communities in many regions around the world. henceforth this study was conducted to assess the effectiveness of forest fire management and monitoring strategies in the Mazowe rural district of Zimbabwe from the perspective of key stakeholder. The study employed qualitative approach including interviews and questioners to assess the perceptions and experiences of local communities, government agencies, and no governmental organizations involved in fire management. It investigated the current policies, resources, and coordination mechanism in place for fire prevention, detection and suppression, as well as the challenges and barriers to their effective implementation. The data collected provides insight into the strengths and weaknesses of the existing fire management strategies, and identifies the opportunities for improving coordination, resource allocation and community participation. The research also explores the role of emerging technologies, such as early warning system in enhancing fire monitoring and response capabilities, under a sample size of 650. The research also have some recommendations which reads, development of a comprehensive forest fire management plan incorporating

stakeholder inputs, engage community engagement and education on Forest fire prevention an management and improve resource allocation and funding for forest fire management in Mazowe Rural area.

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Acronyms and abbreviations

CPU	Civil Protection Unit
DSP	Department of Social Protection
EMA	Environmental Management Agency
FFMU	Forest Fire Management Unity
NPAW	National parks and wildlife
PWMA	Parks Wildlife Management Authority
RDC	Rural District Council
WWF	World Wildlife Fund
ZRP	Zimbabwe Republic police
ZDF	Zimbabwe Defence Forces

Chapter 1

1.1 Introduction

This chapter provides a brief background of the study, statement of the problem, limitations of the research, the main research objectives and questions as well as its justification of the study

1.2 Background

Forest fires were once a natural phenomenon that played a very critical role in shaping species distribution and contributed to the persistence of fire depended species, and helped the natural evolution of species. These days' world fires are mainly caused by human pressure on the environment (San Miguel Ayanz et al, 2005). The spread and distribution of veld fires are a major concern to affected communities and policy-makers (Andersen et al., 2012) as they cause damage to the environment, property and affect livelihoods. The study of forest fire management and monitoring strategies, focuses on the use of remote sensing data to determine veld fire trends in a country, Zimbabwe, where the rise in veld fires is believed to have started in 2001 (Nyamadzawo et al., 2013; Chinamatira et al., 2016) yet official records of fire events started around 2009 (EMA 2011), but remained incomplete as some of the fire prone zones were inaccessible and management authorities lacked the resources to capture the events. It was noted that 5% of forest fires in Europe are of natural origin (San Miguel Ayanz et-al) .forest fires are a significant problem both in terms of the economy and environmental impacts they have, according to the United Nations Food and Agriculture organizations (FAO), an estimated 350 million hectares of land are burnt by fire each year and the total cost of fire estimated at 100 billion United States Dollars per year,

Globally the strategies have been quite effective in monitoring and managing forest fires. For example, the Copernicus EFFIS has been able to detect and monitor over 90% of all forest fires in Europe. The NIFC has helped reduce the number of large fires in the United States by over 30% since the 1970s. The INPE has helped to detect and monitor deforestation and forest fires in the Amazon, also it initiated Sentinel-3 satellite, which uses infrared sensors to detect and monitor fires. The data collected by the Sentinel-3 has been used to create a global forest fire monitoring system, which provides real-time information on active fires around the world. This strategy has

been used to support firefighting efforts and to better understand the causes and impacts of fires, (Miguel and Rodrigues, 2020).

Continently, the ARFO has provided valuable information on forest fires in Africa. In Africa, ARFO has been working to improve forest fire management and monitoring in a number of countries, including South Africa, Namibia, and Tanzania, (Justice, 2013). An estimated 2500 Mt of biomass are burned annually in Africa, which is around half of the world's total biomass burned annually. (Arino and Melinotte, 1998).

Nationally, EMA and the Forest Commission have also begun using new technologies and innovations. For example, they have started using remote sensing and satellite imagery to monitor fire risks and track the spread of fires. They have also deployed an early warning system, which uses a combination of ground-based sensors and satellite data to provide real-time information on fire risks and locations. By using these new technologies, the agencies hope to improve their ability to prevent and control forest fires. Additionally, EMA and the Forest Commission have implemented a number of training programs for firefighters, as well as educational campaigns for communities living near forests, the early warning system has been successful in lowering the quantity of fires in some areas, but there have been challenges in ensuring that the system is used and understood by all relevant stakeholders. Additionally, there have been challenges in ensuring the sustainability of these initiatives, as they often require ongoing funding and support (Dr. Michael Mahachi, 2019).

1.3 Problem statement

Despite the efforts made to manage and monitor forest fires in Zimbabwe done by different organization such as forest commission, rural district councils, national parks and wildlife, environmental management agency, Department of social protection, forest fire management unit (FFMU), Parks and wildlife management authority (PWMA), Zimbabwe national army, Zimbabwe republic police (ZRP), civil protection unit (CPU), World Wildlife Fund, among others. The country still experiences a significant number of forests fires each year, which have a significant impact on the environment, livelihoods, and people causing so many disasters. It is

important to note that these efforts are still in the early stages and have not yet been fully implemented across the country. So far, the impact of these new technologies and policies has been mixed, with some successes and some challenges. For example, the early warning system has been successful in lowering the frequency of fires in some areas, but there have been challenges in ensuring that the system is used and understood by all relevant stakeholders, for instance last year in Manicaland a certain group of people were killed by forest fires in trying to get rid of it and died leaving their families vulnerable to poverty. Another thing to consider is yes of course all the systems and have been implemented by different stakeholders are trying to reduce, but day by day. year by year we continue to hear, see and testify a large number of people and livelihoods being destroyed veld fires for example in 2016, a large wildfire in Hwange national park, destroyed more than 20,000 hectares of wildlife habitat and displaced more than 1000 families, this had a devastating impact on people who live in around the park, as they lost their homes and livelihoods, also in 2019 a wildfire in Chimanimani national park destroyed more than 4000 hectares of forest and killed 500 cattle's belonging to local farmers, in 2020 in NYANGA national parks, in 2018, in Chihota district destroyed 2000 hectares of farmland and displaced more than 500 families, families lost their homes and livelihoods, in Rushinga it destroyed livelihoods that same year, in 2019 in Binga, wildfire destroyed cattle's, goats and other livestock, causing a devastating impact on livelihoods of local people since they rely on livestock for their income and daily needs. In Gokwe, 2017 people lost their crops and source of income, in Mwenezi district, 2021 wildfire destroyed hectares of land, cattle's, homes crops, leaving many families without food and shelter, in the same year in Chiredzi district livelihoods were destroyed, in 2022, wildfire in the Zambezi valley in Matabeleland North it destroyed property and livelihoods of people, in that same year in Chimanimani, hectares of land, cattle's were destroyed due to prolonged drought in the area, in 2023 Gokwe and Kariba fires were exacerbated by temperature and strong wind, all these cases have proved that forest fires are still a major threat to people and livelihoods due to human activities, prolonged drought conditions climate change lack of resources for firefighting (Twine, 2020), (Marufu and Nyahuma, 2019). Additionally, there have been challenges in ensuring the sustainability of these initiatives, as they often require ongoing funding and support.

1.4 Aim

1. assess the effectiveness of forest fire management and monitoring strategies in Mazowe district.

1.5 Specific objectives

- I. To identify forest fire management and monitoring strategies that are in place in Mazowe
- II. To assess factors related to the effectiveness of forest fire management and monitoring system in Mazowe.
- III. To suggest strategies to improve forest fire management and monitoring strategies in Mazowe.

1.6 Main research Questions

- I. How effective is the forest fire management strategy?

1.7 Specific research Questions

1. To what extent is the current strategy of managing and monitoring effective in controlling forest fires?
2. What are the factors related to the effectiveness of forest fire management and monitoring strategies in Mazowe?
3. What strategies can improve the management and monitoring strategies in Mazowe.

1.8 Justification of the study

The effectiveness of forest fires management and monitoring strategies in Zimbabwe is important, this is because it is crucial to evaluate the effectiveness of these strategies in order to ensure that

the right resources are being allocated to them and that they are making a meaningful impact, this study can help to identify gaps and challenges in the current strategy , which can be addressed to improve future fire management strategies and monitoring efforts , also this study can contribute to a deeper comprehension of the impacts of fires on local communities , the environment and the economy , adding on, it can contribute to the development of more resilient communities in the face of climate change since fires are often made worse by climate related factors such as drought and extreme weather events. The forest commission is going to benefit by having a more accurate and up to date understanding of the severity and consequences of forest fires in Zimbabwe , this information can be used to raise the efficacy and efficiency of fire management efforts (kamoto and chimonyo, 2016).local communities would benefit from an improved ability to detect and respond to forest fires , such as property damage and loss of livelihoods (Sibanda and chimonyo ,2017) ,also the department of national parks and wildlife management it will benefit from an improved ability to detect and respond to forest fires which can have a devastating impact on wildlife (Gore and Ndlovu , 2017), another stakeholder to benefit is the Zimbabwe national meteorological department which would benefit from an improved ability to forecast and monitor weather conditions that can lead to increased risk of forest fire (Chidavaenzi and Rusero , 2019) the government will benefit since it is the one that develops policies that protects the environment and the tourism industry .I would like to help stakeholders like EMA, ,ZRP<Forest Commission , to be able to improve forest fire, detection and monitoring strategies in order to reduce the loss of lives, property and livelihoods which so many people in Zimbabwe depend on for a living .

Conclusion

This chapter has provided an overview of the importance of forest fire management and monitoring, highlighting the devastating impacts of forest fires on ecosystems, biodiversity, and human livelihoods. The chapter has also reviewed existing literature on forest fire management and monitoring strategies, identifying gaps in current knowledge and practices. The need for effective forest fire management and monitoring strategies has been established, particularly in the context of climate change and increasing fire risks.

The chapter has set the stage for the research study, which aims to evaluate the effectiveness of forest fire management and monitoring strategies in Mazowe. The following chapters will

present the research methodology, results, and discussion, providing insights into the strengths and weaknesses of current strategies and recommendations for improvement.

Some possible research questions or objectives that could be explored in subsequent chapters include, what are the most effective forest fire management and monitoring strategies in Mazowe?, how do current strategies address the impacts of climate change on forest fires? and what are the key challenges and limitations of implementing effective forest fire management and monitoring strategies?

Chapter 2

Literature review

2.1 Chapter Introduction

On this section the researcher gives an appraisal of literature surrounding in the concept on the effectiveness of forest fire management and monitoring strategies and revealing the gaps in it. The literature review covers the scope of forest fires management and monitoring strategies on a national, regional and global perspective. The chapter also explains the research questions and objectives clearly exposing whether forest fires are effectively managed in face of the monitoring strategies the literature will be focusing on the effectiveness of forest fire management and monitoring strategies in Bindura, Mazowe district. It brings out interventions undertaken

2.2 Forest fires management globally

There are a variety of studies that have evaluated different management strategies for forest fires According to, Stephens et al. (2016). In the study, the researchers analyzed the usefulness of prescribed burns in plummeting the threat of severe wildfires. The researchers found that prescribed burns are generally effective in reducing the severity of wildfires, although the effectiveness can vary depending on the location and the specific conditions. They also found that the timing of prescribed burns is important, and that they are most effective when conducted during the early spring or late fall, when vegetation is still green and less flammable. (A.L. Westerling, 2016 et al). According to M.P. McHugh, 2009 et al. Within the European Union, a lot of research has been done on the efficacy of forest fire supervision strategies in Mediterranean countries, due to the high frequency of fires in this region, according to Pausas et al. (2008). Researchers analyzed the effectiveness of prescribed burning in reducing fire hazard and promoting forest regeneration in Mediterranean forests. They found that prescribed burning can be an effective tool for reducing fire hazard, but that it must be carefully planned and implemented in order to be successful. They also found that prescribed burning can have a positive impact on forest regeneration, by stimulating seed germination and reducing competition from shrubs. (Miller et al. 2009). However, the study found that the effectiveness of prescribed burning in Australia is challenging to assess since of a deficiency of monitoring statistics. In particular, there

is little data on the long-term effects of prescribed burning on vegetation and wildlife. The study also found that there is a lack of systematic, long-term data on fire behavior and fire impacts. This makes it difficult to assess the effectiveness of prescribed burning in reducing the impacts of fires

Forest fires are dangerous threats to forest ecosystems, fires naturally occur and are also often triggered by human misbehavior. Anthropogenic factors increase the risk of forest fires, these include land use changes and land abandonment, urban settlements near forests (WUI), recreational use of forested area, and lack of public awareness. In addition, and most influentially the lack of application of forest management practices and absence of appropriate policy render forest areas neglected (fuel accumulation) or abused (arson). The management of forest fires includes assessment of fires (risk), prevention of fire occurrence and intervention to suppress and fight the fire, FAO (2005) Global Forest Resources Assessment, Forest fire risk identification and evaluation Forest fire risk assessment feeds into monitoring and early warning signaling. Forest fire risk assessment allows the evaluation of the fire occurrence probability using the interaction between ‘hazard’ and ‘vulnerability’ (Mitri, 2018).

Direct causes of fire in WUI (Mitri & Ph, 2018) Human induced forest fires in wild-urban interface areas can be triggered by farmers burning of pruning residues which uncontrollably expand, irresponsible celebration behavior when using fireworks near forested lands by residents and restaurants or resorts, individual misconduct by dumping burning cigarette buds, visitors and campers not putting out cooking fire in the woods, and lastly the open burning of garbage.

Fire management includes monitoring of land, setting up early warning signs, putting ground for preparedness and prevention, act for fire suppression and forest restoration. Fire-shed fuel treatment limits burning extent and reduces environmental and social harm (Bahro, Barber, Sherlock, & Yasuda, 2007). When forest fire management is done at the landscape level, wildfire behavior is modified over time to become less damaging and less costly, herein considering long-term benefits for easier suppression and management (Finney, 2001). Forest fires can result in social, environmental and economic impacts that can be either short term and acute to the circumstance of the event or can be long term. Fire combustion causes short term consequences

that threaten human animal and plant life, and causes environmental pollution (Martin, Tomida, & Meacham, 2016).

However, they are Challenges faced by the Civil Defense (Personal communication with the civil defense Kesrwan unit). Civil defense stations have considerably low number of registered employees, and technologically unevolved equipment. The low number of employees affects workforce deployment during an emergency as the number of respondents in an ambulance depends on the number of volunteers available during the occurrence. A civil defense volunteer stated: “Every civil defense office has around 10 people, but not all people are available in the case when an emergency happens. Most of the civil defense staff are volunteers and few of them are employed, employees are usually around 60 years old”. Having civil defense employees would have ensured daily teams ready to be set out when an emergency happens. As the national directorate does not provide evolved technological equipment, local offices depend on self-funding and personal initiatives when kitting their stations with internet access and a computer for example. This is directly linked to the training and application of information keeping, reporting and data sharing which is still not computerized in stations all over Lebanon. Another issue related to equipment purchase as some material might get damages during a fire and due to the long time needed from government bureaucracy the volunteers end up buying a new hose for example. The government’s civil defense directorate needs a policy reform that feed into enhancing its finances to develop its de-centralized firefighting and emergency response stations. Other external challenges faced by the civil defense are local to fire locations and they include: - Distance of fire from water sources. Nonexistence of roads to facilitate reaching fires inside the forest. It is also hard to cut roads in Lebanon during the fire as the hilly Topography does not allow it.

2.3 Forest fire management regionally

Africa is the continent most prone to fires worldwide, according to the results of the first Global Burned Area (GBA) survey conducted by the Joint Research Centre of the European Commission in 2000. The survey was based on the SPOT-VEGETATION sensor's ability to identify fire scars. In 2000, an estimated 230 million hectares (Mha) or 7.7% of the continent burnt, accounting for 64% of the slightly over 350 Mha global total (JRC-EU, 2005). East Africa (87.4 Mha, or 15.0 percent of the region), Central Africa (53.9 Mha, or 13.5 percent), and southern Africa (67.7 Mha, or 11.5 percent) saw the most extensive burning, also In Africa, fire is a common seasonal

occurrence. Roughly 168 million hectares burn each year south of the equator, which is almost 17% of the 1014-million-hectare total land base and 37% of the dry matter burned worldwide. Fifty percent of this comes from burning savanna; the remaining portion comes from burning fuel wood, agricultural waste, and land cut. Both humans and lightning can start a fire, but the proportion of human-caused fires is rising quickly. Pastoralists use fire to encourage the growth of grass for their livestock, while subsistence farmers use fire to clear unwanted biomass from their lands and remove any leftover agricultural residue after harvest. Household energy for cooking and heating is primarily obtained from fires fueled by wood, charcoal, or agricultural residues.

Many of these are sizable nations with abundant rainfall, abundant plant life, comparatively low rural population densities, and terrain that is either mountainous or not broken up by roads, farms, or settlements, making it simple for fires to spread uncontrolled across wide areas. Africa also leads the world with 54 percent of all fires, as measured by the number of fire scars. In 2004, 2.3 million 1 km² pixels, or 7.8% of Africa's surface area, were found to have active fires according to data collected by NASA's MODIS sensors on board its Terra and Aqua satellites. These figures indicate that the level of burning in 2004–2005 was comparable to that in 2000.

Two areas stand out for having particularly high fire frequency: northern Angola and the southern Democratic Republic of the Congo; and southern Sudan and the Central African Republic. The extent of burning across Africa in 2004–2005 is expressed as the number of active fire detections per 100 km² (data derived from MODIS at 1 km² resolution and provided by NASA and University of Maryland). Although the majority of the vegetation in these places was once tropical forest, it is now a patchwork of tall secondary grasslands and sections of remaining tropical forest, scattered with farms and the villages of both sedentary and shifting cultivators. The majority of this zone's deforestation occurred decades ago, and although fire is clearly impeding forest restoration, its frequency is a sign of the forest's previous conversion to grassland. Satellite imagery currently cannot distinguish between prescribed burning and wildfires, nor can it easily distinguish between fires associated with deforestation and land conversion. These data are based on only a few years of observation, but they are broadly consistent with previous studies conducted at a coarser scale over several years or covering only a portion of the continent (Barbosa et al., 1999; Silva et al., 2003). Where comparable figures from national statistics are available, the remotely-

sensed data generally show much more extensive burning (FAO, 2005). Every year, there is a significant variation in the quantity of flames and the burned area, frequently coinciding with El Niño/Southern Oscillation (ENSO) and related extreme weather occurrences. In southern Africa, there is a particularly significant correlation between rainfall, plant productivity, and ENSO. When the region went through a severe drought in 1992, there was less widespread burning than there was in 2000, which came after a season of above rainfall.

Africa's forest fire monitoring and management According to Justice et al. (2018), the study looked at patterns in wildfires across Africa from 2001 to 2015 and discovered that there were more wildfires during that time. The study also discovered that the main causes of this growth are changes in land use and climate. The primary cause of the rise in wildfires in West and East Africa, according to the authors, is changes in land use, such as the conversion of grasslands and woodlands to cultivation. The primary cause of the rise in wildfires in southern Africa is climate change, which has also revealed some information gaps about wildfires in Africa. There are several information gaps about wildfires in Africa, and the primary cause of the rise in flames in southern Africa is climate change. For instance, information on the precise causes of wildfires, their socioeconomic effects, and the efficacy of fire management techniques is lacking (A.N. Skidmore et al. 2018). The study came to the conclusion that more investigation is required to comprehend and control wildfires in Africa. Asner et al.'s study on monitoring systems in Africa illustrates the prospects and challenges in this regard (2012).

The study discovered that tracking the loss and deterioration of African forests is fraught with difficulties. These difficulties include the absence of national forest inventories, the difficulty of keeping an eye on forests in isolated locations, and the shortage of technology and skilled labor. The study also found that there were some chances to enhance forest monitoring in Africa, such as the creation of national monitoring programs and the application of remote sensing technology.

One can argue about fire prevention in sub-Saharan Africa. A national fire prevention program has been formed in the majority of African nations. On the other hand, the actual execution of a fire prevention program presents a distinct challenge. Annual preparations for fire breaks result in a rather wide network in places like Namibia, South Africa, and Botswana. These fire breaks primarily occur along property lines, protecting a particular location or region. An investigation carried out in South Africa demonstrated the benefits of creating so-called "Regional Buffer

Zones," or places where natural fire breaks occur, such as rivers, etc. are integrated into the fire brake system in order to safeguard an entire area rather than just isolated areas. This strategy is very tough to implement and would require the willing participation of all role actors and stakeholders within an area. The first areas in South Africa where zoning has proven beneficial are those where "Fire Protection Associations" (FPAs) have been established and where fire safety and prevention encompass the entire area, involving all landowners, government officials, traditional leaders, and their communities, (Wang et al, 2024).

Every year, 12 000 km of fire breaks are prepared in Botswana, mainly through mechanical methods with minimal community engagement. The annual cost of maintaining firebreaks is \$5 million USD.

Prescribed burning is still the main method used today to reduce fuel as a preventive precaution in and around commercial forestry plantations and nature conservation areas. The extent of fuel reduction initiatives in sub-Saharan Africa makes it evident that prescribed burning activities need to be greatly expanded, particularly in the wildland-urban interface where values and assets are at risk. However, this is true of controlled burning in general in ecologies that have adapted to fire. In the first instance from Botswana that follows. Although prescribed burning is not practiced in Botswana, the Herbage Preservation Act of 1977 allows for it.

However, because individuals were unsure of the necessity of obtaining a permit in order to burn their own land, it remained unutilized. People who obtained burning permits were afraid they would be watched, jailed if the fire got out of control, or fined merely for burning. People would rather burn their fields illegally and take a chance because they are still unsure if they would go to jail for doing so. As of right now, the Botswana government is not receiving any assistance from other nations with firefighting-related matters (Mafoko, 2004). The same is true for Namibia, a neighbor, which gets its fair share of border crossing fires from Botswana because the country is lower on the map than Namibia and burns more readily.

Tens of millions of hectares are burned annually by land use fires in Angola, Botswana, Namibia, Zambia, and Zimbabwe; border crossing fires have scorched 900,000 ha in a single day (NFFP, 1997). These land use fires are one of the greatest burned regions in the world. The absence of

even the most basic burning apparatus, a basic understanding of fire behavior, and the ability to use fire as a tool safely are major issues in the majority of sub-Saharan African nations.

Understanding the causes of fires is the first step in preventing them; otherwise, the wrong community group may be the target of preventative efforts. Aside from a few targeted community-based fire management programs (CBFiM) in Tanzania, Mozambique, Namibia, and South Africa, prevention programs typically target the community in a general way, failing to take into account the fact that men, women, and children may experience fire in quite different ways on a daily basis due to differences in how they perceive and use it. For example, if the primary cause of the fire in an

If children in the area leave abandoned "warming fires" on their way to school (as in the higher elevations of South Africa, for example), it may be ineffective to try to teach the local males how to properly smoke out beehives. Although it won't lessen the number of unintentional fires in that specific location, it is still a good idea. An effective preventive approach depends in large part on an understanding of the function of fire in a given community. Apart from disputes, uncontrolled fires will be less common the more local farmers are taught and trained. Although the quantity of fires may essentially stay the same, as seen in Burkina Faso and Namibia, there is a significant decrease in the demand for local firefighting and detection. The majority of sub-Saharan African nations, with the exception of South Africa, lack the necessary capabilities, resources, and expertise to detect and put out wildfires.

In most fire management budgets, 80–90% of funds are allocated to suppression and only 10–20% to prevention. Fortunately, this is not the case in many foreign-assisted fire management programs in Africa, where preparedness and prevention are given significant attention. However, many of these programs are funded for a short period of time and are not adequately integrated into a national fire strategy, necessitating a permanent annual budget. However, during the nine years of Finland's engagement (from 1996), the fire component of the Namibia-Finland Forestry Program (NFFP) was managed extremely well. According to a recent evaluation of this program conducted in December 2005, the Directorate of Forestry (DoF) staff is effectively managing the aforementioned program, even though many community members and 10 out of 13 fire-trained employees of the DoF have either moved or died from HIV/AIDS.

Working on Fire (WoF), a community-based fire management initiative in South Africa, is another extremely promising strategy. To put it briefly, WoF is a program that fights poverty by hiring

1,200 formerly jobless individuals to work as wildland firefighters. The initiative was decided to expand to 5,000 fire fighters because it shown such efficacy in mitigating the effects of uncontrolled fire. WoF can serve as an example for other African nations and is the primary partner of the ISDR Region Sub-Sahara Wildland Fire Network (AfriFireNet).² The SADC area is promoting WoF with the help of AfriFireNet. Annex provides a detailed description of the WoF program. Very limited capabilities in the private sector is available for fighting fires in the SSA Region, with the exception of South Africa and a few other nations south of the Sahara.

The majority of wildfire suppression resources are located in capital cities or larger cities and are not specifically designed to tackle wildfires that occur in rural regions. In many cases, they are even not mandated to deal with wildland fires. It follows that several initiatives to improve urban and local fire control and suppression capabilities have been carried out throughout Africa. Nevertheless, following project conclusion, the majority of these initiatives had minimal long-term effects. While government priorities shift over time, issues related to food security and rural livelihood—including the responsible use of fire—generally remain at the top of the list. But still , if a fire management budget is available then in most cases 95% of these funds are invested in enhancing the ability for monitoring and fire suppression rather than funding capacity building and prevention. An approach to integrated fire management activities is made through the projected expansion of the Working on Fire Program into additional SADC countries; suppression, of course, plays a role, but it shouldn't be the program's primary goal. Not much more can be stated about fighting fires in sub-Saharan Africa.

Historically, the ministries of Environment/Agriculture and Rural Development have been in charge of handling wildland fires in the SADC region and the surrounding sub-Saharan nations. Nonetheless, a growing number of nations are imitating South Africa and granting the National Disaster Management Centers a portion of this responsibility; in Tanzania, this involves proposing a combined engagement of personnel from the Forestry Department and the Fire and Rescue Service Force. It is imperative that traditionally, in the SADC region and neighboring sub-Saharan countries, the responsibility for wildland fires is with the ministries of Environment/Agriculture and Rural Development. However, an increasing number of countries are following the South African example and are giving the National Disaster Management Centers a share in this mandate; in Tanzania this includes a suggested joint involvement of Forestry staff and staff of the Fire and

Rescue Service Force. Stakeholders outside forestry need to be thoroughly trained in issues regarding wildland fire, especially regarding fire behavior and techniques in use of fire to stop approaching fire. Traditionally, in the SADC region and neighboring sub-Saharan countries, the responsibility for wildland fires is with the ministries of Environment/Agriculture and Rural Development. Non-forestry stakeholders receive extensive training on wildland fire issues, particularly with regard to fire behavior and approaches to putting out fires.

Historically, the ministries of Environment/Agriculture and Rural Development have been in charge of handling wildland fires in the SADC region and the surrounding sub-Saharan nations. Nonetheless, a growing number of nations are imitating South Africa and granting the National Disaster Management Centers a portion of this responsibility; in Tanzania, this involves proposing a combined engagement of personnel from the Forestry Department and the Fire and Rescue Service Force. It is imperative that non-forestry stakeholders receive extensive training on wildland fire issues, particularly with regard to flame behavior and approaches to putting out fires. One may use South Africa as an example of a cooperative fire management strategy: The National Veld and Forest Fire Act of 1998 facilitates the establishment of Fire Protection Associations (FPAs). All land users and owners, as well as traditional and local authorities, are being informed of their obligations.

Nonetheless, a significant problem still needs to be resolved, and that is the authority and leadership of the individual in charge of the fire suppression operations (the fire chief). The question of which Act the Fire Chief will operate under and who will have the power (political-administrative) and/or technical competence emerges when various layer stakeholders work together to suppress flames. As a result, nations must draft a fire chief's job description or terms of reference. Copying this job description from the Fire and Rescue ordinance or related document would be preferable (Jurvélius, 2001). Particularly in places where farming is a business, the function and jurisdiction of the fire chief with respect to local authorities, such as governors, must be clearly established. Is it legal for a fire chief to smash through fences keeping cattle inside buildings, remove shatter pens for cattle, clear out blockages in water pipelines, fill fire engines from nearby wells, block off roads, evacuate schools, etc.? Will he be in charge of the military and police? In order to plan for increased stakeholder participation, a formed "National Fire Council" will need to define these questions.

2.4 Forest fire management nationally

The study discovered that the Tsholotsho Communal Area in Zimbabwe lacks efficient fire management, according to Gumbo et al. (2010). This is caused by several things, such as inadequate fire management resources and capability, a lack of a fire management plan, and poor coordination and communication amongst various stakeholders. According to Moyo et al., the study suggested several measures to enhance fire management in the region, such as creating a fire management committee, educating fire management staff, and creating a plan for fire management. (2013). The study discovered a discrepancy between local populations' perceptions and the government's fire management tactics. executed by Zimbabwe's government. According to the study, whereas the government views fire as a threat to the environment, local populations view it as a helpful tool for controlling the environment. Conflict between the two groups has arisen from this, and inadequate fire management has been the outcome. This study also revealed some recommendations for enhancing fire management in Zimbabwe. These include the creation of a more coordinated and cooperative approach to fire control, the acknowledgment of the importance of traditional knowledge in fire management, and the involvement of local communities in decision-making processes. Furthermore, a different study discovered that the government and local communities in the Bikita area of Zimbabwe are not always in communication, which results in conflict as the communities understand fire management differently than the government. The study recomm government should work to improve communication with local communities, and should consider their perspectives when developing fire management policies (Manzungu et al. 2015). Nevertheless, the Environmental Management Agency has lately begun deploying the Advanced Fire intelligence System (AFIS), a satellite-based fire intelligence tool that gives users access to fire information almost instantly. At the recently concluded Zimbabwe International Trade Fair in Bulawayo, EMA displayed the AFIS system. According to EMA principal research officer Mr. Ntandokamlimu Dondo, the technology has prompted quick action in extinguishing veld fires. We are pleased to report that, despite a high number of occurrences, the amount of land that has burned to date is rather little thanks to the application of AFIS. A total of 2 459 fire events have occurred since the beginning of the fire season, burning 538 656 hectares of land. In comparison to the same period last year,

when 326 206 hectares were burned from the 605 veld fire occurrences that were reported, the cumulative scorched area represents a 79 percent increase, according to Mr. Dondo.

This literature study was relevant. From the standpoint of stakeholders, this aids in determining the efficacy of forest fire management and monitoring techniques in the Mazowe rural district and adds to existing knowledge. More details regarding management and monitoring practices in Zimbabwe, Africa, and the rest of the world were disclosed in this chapter. The chapter also outlined the objectives of the study and included samples of writing from other authors who have researched monitoring and management techniques for forest fires

Chapter 3

Methodology

3.1 Chapter introduction

This chapter gives a clear picture of the methods and procedures that were employed when data was collected on the effectiveness of forest fire management and monitoring system in Zimbabwe. The research is explorative in nature, employing the qualitative research approach. It was conducted in various settings and it included focus group discussions, questionnaires and key informant interviews, and document analysis. Ethical considerations, feasibility and reliability was carefully considered to ensure the study's value and accuracy. The chapter outlines the research design, the sampling method, data collection methods and analysis used while comprehensively and coherently explaining the rationale behind each selected technique

3.2 Descriptive of Study

In Zimbabwe's Mashonaland Central province, the Mazowe district is situated in the southwest between latitudes 16°47'2"–17°44'28"S and longitudes 30°36'18"–31°17'32"E. The highest point above sea level is 1747 meters, while the lowest is 879 meters. With 233,450 people living in the district, its size is 4354.16 km², and its population density is 53.6/km² (Zimstats 2012). The average monthly precipitation is 1 mm, the average maximum is 220 mm, and the average monthly precipitation is 901 mm. The monthly minimum temperature varies from 5.4° to 15.9°C, and the monthly maximum temperature spans from 20.2 to 31.4°C on average. Typically, May to September is when the dry season occurs (Manatsa & Mukwada 2012; Mushore 2013). However, the fire season lasts until the end of October and occasionally into the first week of November. The Mazowe region experiences semi-arid weather and is vulnerable to droughts, which can negatively affect water supplies and agriculture. According to the most recent census data from 2012, the Mazowe district has a population of approximately 100,000 people. The bulk of people live in rural areas, and the region is home to many small-scale farmers.

According to Momberume et al. (2010, Mazowe area is located in the Highveld region of Zimbabwe, which is characterized by a variety of vegetation types. The most common vegetation type is Miombo woodlands, which are characterized by deciduous trees such as *Brachystegia* and

Julbernardia. There are also areas of grassland, which are dominated by species such as *Aristida* and *Digitaria*. In addition, there are areas of savanna, with scattered trees and shrubs

3.3 Target Population

The research aims to explore effectiveness of forest fire management and monitoring system in Zimbabwe from different stakeholders in Mazowe rural areas, as well as the key informants from ministries that are involved in Organizations that deals and controls with forest fire management and monitoring systems It encompasses both men and women with the age range of 20 to 50 years old. A population is a group of individuals who share some common characteristics that are relevant to the research question (Muisa, 2020). The target population is the specific group that the research wants to generalize the findings to (Herman, 2015). Therefore, the target population for this research includes people from forest fire, environmental management agency and fire brigade.

3.4 Study design

Van Wyk and Toale (2015) define research design as the overall plan for connecting the conceptual research problems to the pertinent (and achievable) empirical research. The research design articulates what data is required, what methods are going to be used to collect and analyze this data and how all of this is going to answer the research question. Research design also reflects the purpose of the inquiry which can be characterized as one of the following, exploratory, descriptive, and prescriptive explanation, evaluation and history (Rukani. 2019)

The study adopted qualitative method during the study of the effectiveness of forest fire management and monitoring system in Mazowe rural area, this is so because qualitative approach allows for a detailed exploration of individuals thoughts, beliefs, and experience .it focuses on capturing rich and nuanced data that provides a deep understanding of the research topic. Also, this approach allows participants perspective, qualitative research values the voices and perspective of participants, it allows participants to express their experience, opinions and emotions in their own words, providing a more authentic and in depth understanding of their lived experience. this approach can reveal insights that might be missed by quantitative research.

The study used one method. And qualitative data was collected through semi-structured interviews with key stakeholders,

3.5 Sampling methods

The study used purposive sampling and stratified random sampling. The target population were stakeholders like the forest commissions, environmental management agency, fire brigade among others since they are considered to be able to give full information on who do people report to in case of a fire disaster has been identified, the process it takes prior to the disaster until it reaches to those authorities who give a final say, on how best they react and response to fire disaster. Purposive sampling would involve identifying and selecting a sample of respondents based on their relevance to the study, while stratified random sampling would involve dividing the population into subgroups and randomly selecting respondents from each subgroup study on Mazowe rural district, purposive sampling helps in identify key stakeholders who are involved in forest fire management and monitoring, such as forest managers, stakeholders perspectives official which will then help to select a sample of these stakeholders for the study, based on their relevance and expertise. Purposive sampling is a good choice for the study because it allows to select a sample that is highly relevant to the research questions. This helps to get detailed and specific information on the effectiveness of forest fire management and monitoring systems in the Mazowe district. In addition, this method can save time and resources, since there was no need to select a large sample from the population. The research used a non-probability sampling, which is a stratified sampling method in which the study selected participants based on their subjective assessment rather than random selection (QuestionPro, 2022). The researcher used homogeneous sampling to select participants according to those that have sufficient knowledge about the aspect under study, according to Nicolas (2021). Homogeneous sampling is a sampling strategy in which individuals are chosen because they have common features (Patton, 2015). This technique was suitable for qualitative research, as the study aimed to gain a deep understanding of the effectiveness of forest fire management and monitoring system in Mazowe rural area.

3.6 Sample Size

Sampling is the process of selecting a subset of individuals or elements from a larger population to represent and provide insights into that population (Trochim, 2006). As noted by Fox (2012), sample design encompasses both the selection and estimation methods used. The sampling method

should be planned to ensure that data can be collected from each respondent that is relatable to our study. In this research, the sample is 165 people with the knowledge of forest fire management that are 150 people without the knowledge, 15 people with the knowledge of forest fire management and monitoring strategies.

3.7 Data Collection methods and Procedure

During the course of the study qualitative methods is the one I used. The study made use of focus group discussion assessing the effectiveness of forest fire management and monitoring system in Zimbabwe, stakeholder perspective. Stakeholder perspective in the community helped in providing how forest fires are managed and monitored effectively. This is because qualitative exploratory research designs can produce descriptive data that is suitable for analyzing stakeholder's perceptions, they are considered essential. Unlike the positivist school of thought, a qualitative approach of inquiry is based on the exploratory paradigm (Corbelitative researcher's objective is to gather as much information as possible on human behavior and the causes of that behavior. To put it another way, the qualitative research approach looks at and provides answers to the issues of how, where, what, when, and why someone might act a certain manner in relation to a particular issue. The materials will also be utilized in the study.

3.7.1 Questionnaires

A questionnaire is a study or survey tool that consists of a series of questions created so that the responder can provide precise information about a given defined topic. This study employed questionnaires to gather information about the efficiency of the monitoring and management system for forest fires. Questionnaires created for the study were sent to the several cohorts who are either directly or completely participating in

teams for managing and monitoring forest fires. It was designed to gather information that was both qualitative and quantitative. Sections A, B, C, and D of the questionnaire were therefore created; part A asked for the respondent's personal information, while section B sought to gather information on the intensity of forest fires. The purpose of Section C was to gather information on the efficiency of the governmental and non-governmental management and monitoring systems.

The questions were designed to be specifically organized to enable the research to gather data that will allow the study's objectives to be completely addressed. Part A whereas Section C used open-ended questions, and B used closed-ended questions. According to Penwarden (2013), respondents are prevented from delivering original, unclear, or unexpected answers to closed-ended questions because the amount or range of viable replies is known, which saves time and yields easily quantifiable data. Conversely, open-ended inquiries allow for a free response from the respondent and extract their thoughts, opinions, and suggestions. Penwarden (2013) also emphasizes the exploratory character of open-ended inquiries and their capacity to yield rich qualitative data on subjects that are unfamiliar with

3.7.2 In-depth Interviews

This qualitative research approach entails interviewing respondents who may offer in-depth information about the aspects related to the research issue using a semi-structured interview. This approach was chosen because, according to Jerry and Marcin (2007), it enables the researcher to probe and elicit things that are difficult to observe, like beliefs, values, biases, opinions, sentiments, and perceptions. Using this technique, the interviewer can change the questions based on the interviewee's responses. This is a crucial step in the ethical process for conducting research on human subjects. Interview those that oversee or manage forest fires in-depth, such as government representatives, firemen, and forest fire teams.

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3.7.3 Focus groups

Focus groups, this is way to organize a focus group with community members who have been affected by forest fires in Zimbabwe. Asking them about their experiences, their concerns, and their suggestions for improvement for example the 2017 Chimanimani fire, this occurred in the Chimanimani District of Zimbabwe. For this case study, one would examine how the fire was managed and monitored, how effective the response was, and what the impacts of the fire were on the community. Also looking at whether there were any lessons learned from this fire that could be applied to future forest fires in Zimbabwe. By also conducting focus groups with people who

live in community affected by forest fires, or with people who have lost property or livestock to forest fire

3.7.4 Field data collection

The researcher used data obtained by visiting ministries with information on the management of forest fires and monitoring strategy, Records of fire reports through the agency responsible for environmental management. The Meteorological (Met) Office provided meteorological data, the Forestry Commission provided land cover maps for 2008, and the Mazowe Rural District Council (MRDC) provided some skeletal records on reported fire outbreaks in several of the wards. Records of fires from the

3.8.1 Qualitative Data analysis

To transform the qualitative data into information, the researcher used a thematic analysis approach. This involved transcribing the data from the informants and categorizing them into broad and specific themes. Thematic analysis is a way of classifying and organizing data to make it more readable and interpretable (Kabir, 2016).

3.8.2 Quantitative Data presentation and analysis

To evaluate quantitative or numerical data, the Statistical Package for Social Sciences (SPSS) was utilized. data that will be extracted from questionnaires, focus group discussions, and interview replies. A variety of tables, charts, graphs, and figures will be used to illustrate the data.

3.9 Ethical considerations

The researcher will follow ethical principles and behave appropriately towards the subjects involved in the research. Ethics are a part of philosophy that examines how to make right and wrong decisions, Gilbert (2005). Research ethics protect the integrity and dignity of the research and the participants (Mardani et al, 2019). They also ensure that the research serves the interests of the respondents (Beebe & Smith, 2008). The researcher considered research ethics such as informed consent and confidentiality in this research.

3.10 Limitation of the study

While conducting the study, the researcher encountered several challenges that had the potential to hinder data collection and compromise the validity or completeness of the findings. However, various mitigation strategies were employed to ensure the continuity and integrity of the research process.

Chapter 4: results and discussion

4.1 Chapter introduction

This chapter delves into the conclusions and discussions of fire management and monitoring systems in Mazowe Rural, Zimbabwe. The analysis, which is based on data from questionnaires and key informant interviews, reveals the complex challenges to effective fire prevention and control. The data identify resource constraints, limited community engagement, communication gaps, and uncontrolled burning practices as significant weaknesses in the current strategies. This chapter will delve into these issues in depth and discuss opportunities for improvement, ultimately aiming to inform the development of a more robust and coordinated fire management strategy for the region.

4.2 Questionnaire and interview response rate

The results from the table below show the number of questionnaires distributed, responses received, and response rates for both questionnaires and Key Informant Interviews. The study utilized a mixed-methods approach to better understand fire management and monitoring strategies in Mazowe Rural, Zimbabwe, with an emphasis on stakeholder perspectives. The questionnaires, which were issued to 150 stakeholders, had a strong response rate of 82% (123 responses), providing a wide range of information on current fire management practices, perceived challenges, and opportunities for improvement. The key informant interviews (KIIs) with 15 stakeholders (80% response rate) provided in-depth insights and specific experiences from government officials, community leaders, and other key individuals. This combination of quantitative data (questionnaires) and qualitative data (KIIs) enables an in-depth understanding of fire management in the region. The high response rates across both instruments indicate a high level of stakeholder engagement, which strengthens the validity of the study's findings.

Table 4.1: Response rate from the research instruments

Method	Distributed	Responses	Response rate
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Questionnaires	150	123	82%
Key informant interviews (KIIs)	15	12	80%

4.3 Participants' demographic characteristics

This section examines the demographic characteristics of the study's participants, as described in Section 1 of both the KII and the questionnaire. The main demographic factors evaluated were age, gender, primary occupation and length of residence/work in Mazowe Rural as detailed in the subsections below.

Table 4.2: The Participants' Demographic Details

Category		Number	Percentage
Age			
18-35		67	54.3%
36-49		37	29.6%
50+		20	16.1%
Gender	Male	70	57%
	Female	53	43%
Occupation	Farmer	56	45.5%
	Community leader/health worker	28	22.7%
	Business owners	15	12.2%

	Civil servants	15	12.2%
	Others	9	7.3%
Length of Residence			
0–5 years.		19	15.5%
5–10 years.		31	25.2%
10+ years		73	59.4%

Length of Residence		
0–5 years.	19	15.5%
5–10 years.	31	25.2%
10+ years	73	59.4%

4.4 Existing Forest fire management and monitoring strategies in Mazowe Rural

The data from questionnaires, as shown in the Figure 5 below, show that the majority of respondents, 89.43%, are aware of efforts to manage and monitor forest fires in Mazowe Rural. This high level of stakeholder awareness highlights the importance and visibility of the region's existing forest fire management and monitoring strategies. This suggests that fire management is a relevant issue within the community. Ultimately, the significant percentage of respondents who are aware of these efforts suggests that there are established mechanisms and initiatives in place to manage and monitor forest fires in Mazowe Rural.

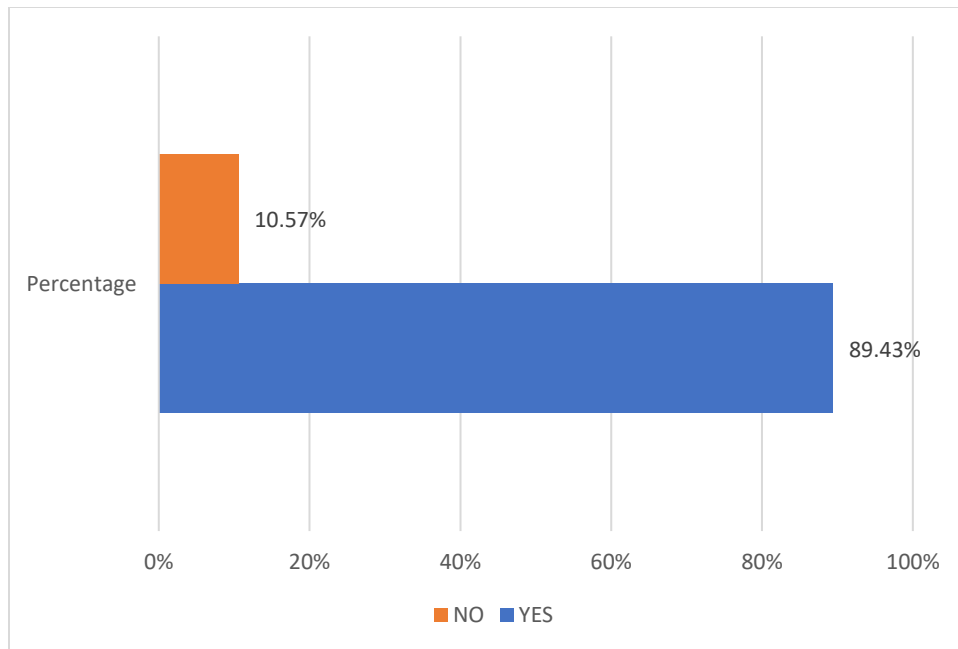


Figure 4.1 Level of awareness of the existing forest fire management and monitoring strategies in Mazowe Rural

After establishing the general level of awareness of fire management efforts, the study proceeded on to identify the existing forest fire management and monitoring strategies in Mazowe Rural. This is demonstrated in the subsequent section.

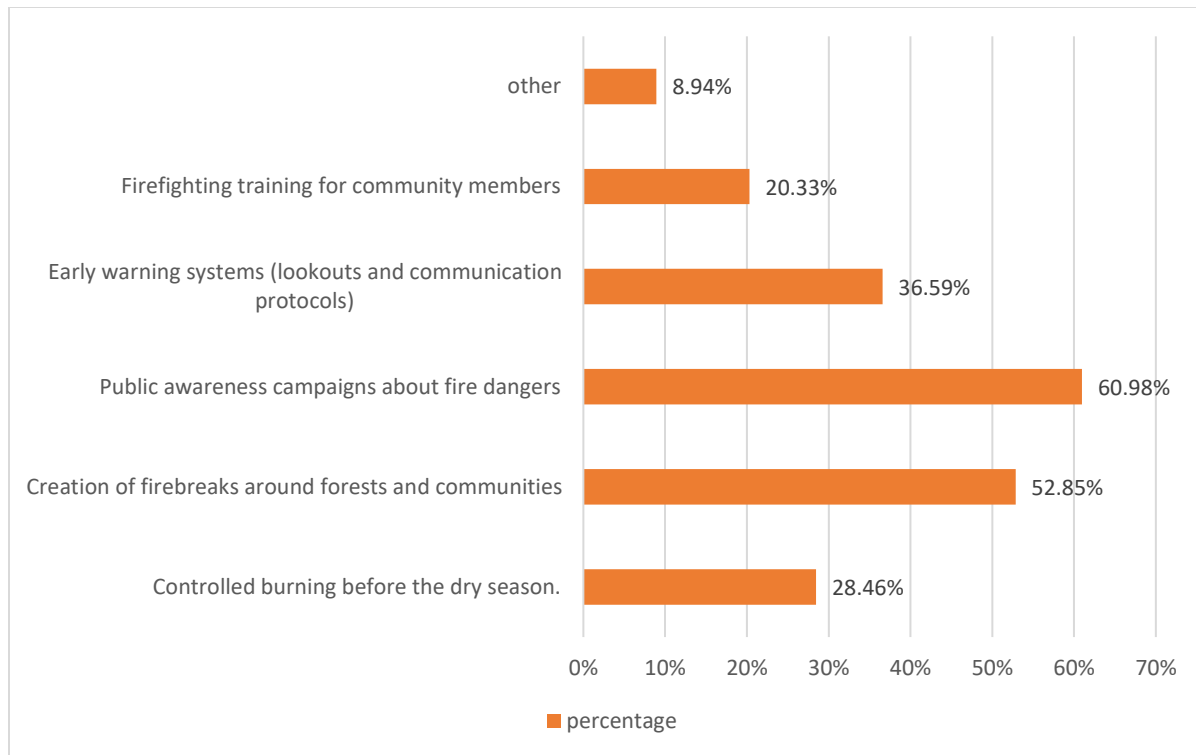


Fig 4.2 showing most common fire management activities in Mazowe.

According to the data from the questionnaires, as depicted by the figure above, the most common fire management activity in Mazowe Rural is public awareness campaigns about fire dangers, with respondents being aware of this initiative. This high percentage indicates that raising awareness about the risks and consequences of forest fires is a common and effective strategy in the region. The establishment of firebreaks around forests and communities was also identified as a significant fire management activity, with respondents reporting its observation.

Additionally, the responses to the questionnaire show that respondents identified the use of early warning systems, such as lookouts and communication protocols, as a fire management activity in Mazowe Rural. The recognition of early warning systems as a significant fire management activity emphasizes the importance of proactive measures for enhancing Mazowe Rural overall preparedness and resilience to forest fire risks. The questionnaire's results further indicate that a sizable proportion of respondents, 28.46%, observed controlled burning before the dry season as a fire management activity in Mazowe Rural. This data suggests that controlled burning is recognized and used in the region as a strategy for managing and mitigating forest fire risks.

On the other hand, the survey results show that the least observed fire management activity was firefighting training for community members, with only respondents mentioning its implementation. This data indicates a potential area for improvement in the local capacity for fire suppression and response. Furthermore, the presence of “other” responses at 8.94% suggests that Mazowe Rural may have unique and diverse approaches to fire management that should be examined and evaluated further. Overall, the data provides valuable insights into the region’s existing fire management and monitoring strategy, emphasizing the importance of public awareness campaigns and firebreak creation as key strategies to mitigate forest fire risks.

In-depth interviews with key informants revealed a number of themes about Mazowe Rural’s current fire management practices. Controlled burning was mentioned by the majority of the key informants (9 out of 12, 75%) as a strategy used to reduce flammable materials prior to the dry season. However, there were concerns that these fires could spread uncontrollably. Firebreak development received overwhelming support as a crucial fire mitigation activity (10 out of 12; 83.33%). Interestingly, all interviewees (12 out of 12) discussed public awareness campaigns conducted by the government and non-governmental organizations (NGOs) and other stakeholders to educate communities about fire dangers and prevention methods. This finding suggests that, in addition to on-the-ground practices, a strong emphasis should be placed on public education. On the other hand, the survey results show that the least observed fire management activity was firefighting training for community members, with only respondents mentioning its implementation. This data indicates a potential area for improvement in the local capacity for fire suppression and response. Furthermore, the presence of other responses suggests that Mazowe Rural may have unique and diverse approaches to fire management that should be examined and evaluated further. Overall, the data provides valuable insights into the region’s existing fire management and monitoring strategy, emphasizing the importance of public awareness campaigns and firebreak creation as key strategies to mitigate forest fire risks.

Furthermore, the second objective managed to identify factors related to effectiveness management and monitoring strategies

While not as widely mentioned as other practices, a sizable proportion of KIIs (7 out of 12, 58.33%) mentioned the presence of early warning systems based on lookouts and communication protocols. This suggests some level of infrastructure for fire detection and community alert.

Firefighting training appeared to be the least popular activity reported by participants (5 out of 12; 41.67%). This finding identifies a potential gap in preparedness, as having a trained local response could be critical during fire events.

There is room for improvement, as the data also shows. The focus on controlled burning in questionnaires and KIIs, with concerns about control) suggests a possible over-reliance on this technique, even though a significant portion of respondents acknowledged early warning systems. Additionally, a critical gap in preparedness is highlighted by the least prevalent activity in the questionnaires (20.33%) and interviews (only 41.67% of KIIs mentioned firefighting training). The “other” answers on the questionnaires point to unexplored fire management strategies that need more research.

4.5 Factors related to the effectiveness of the forest fire management and monitoring strategy in Mazowe Rural.

The data from the quantitative survey, as shown in the table below, show that stakeholders in Mazowe Rural perceive a significant risk of forest fires in the area. With a nearly-unanimous mean score of 4.72 (ranging from 3, neutral to 5, strongly agree), there is widespread agreement on this critical issue. The majority of stakeholders agree, on a moderate to strong agreement, that there is a risk of forest fires in the area, according to the standard deviation of 0.498. Furthermore, stakeholders are acutely aware of the dangers that forest fires pose to people and property, with an average score of 4.23 (ranging from 4 - agree to 5 - strongly agree). The majority of stakeholders agree that forest fires pose a serious risk to people and property, as indicated by the mean score of 4.23 and standard deviation of 0.381.

However, participants do not perceive the current fire management and monitoring strategies are effective at preventing forest fires. Participants gave the current fire management and monitoring strategies a minimum of 1 (strongly disagree) and a maximum of 5 (strongly agree) indications that they have no confidence that they are effective in preventing forest fires. There is disagreement regarding the effectiveness of these strategies, as evidenced by the mean score of 3.25 and standard deviation of 1.146.

Perhaps the most concerning finding is that stakeholders have low confidence in the current strategies' ability to prevent and control forest fires. The average score (ranging from minimum of 1 for strong disagreement to maximum of 5 for strongly agree) indicates a widespread lack of confidence in the effectiveness of these strategies. Additionally, the high standard deviation (1.146) emphasizes the disparity in opinions among stakeholders.

Table 4.3: factors related to the effectiveness of the forest fire management and monitoring strategies

	N	Minimum	Maximum	Mean	Std. Deviation
There is a clear risk of forest fires in Mazowe Rural.	123	3	5	4.72	.498
Aware of the dangers forest fires pose to people and property	123	4	5	4.23	.381
The current fire management and monitoring strategies are effective in preventing forest fires.	123	1	5	3.25	1.146
There is sufficient communication about fire risks amongst stakeholders (government, community).	123	1	5	3.18	1.202
Are you confident that Mazowe Rural current fire management and monitoring strategies can prevent and control forest fires?	123	1	5	3.09	1.273
Valid N (listwise)	123				

In-depth interviews with 12 key informants (KIIs) representing various stakeholders in Mazowe Rural yielded qualitative insights into the perceived effectiveness of fire management and monitoring strategies. Thematic analysis revealed recurring themes concerning system strengths and weaknesses as well as recent experiences.

Examining the strategy effectiveness through key informant interviews revealed a critical perspective. The majority of KIIs expressed concern about Mazowe Rural current fire management and monitoring strategies. These limitations were attributed to several factors that were discussed earlier in the study. Resource constraints. The most frequently mentioned weakness was a lack of resources for equipment, personnel training, and fire monitoring infrastructure. According to information provided, this hindered proactive prevention, rapid detection, and effective suppression efforts.

Additionally, Stakeholders who took part in the Key Informant Interviews (KIIs) expressed significant concerns about the lack of community engagement in fire management and monitoring efforts in Mazowe Rural. The majority of informants expressed concern about the lack of fire safety education and awareness among community members. This knowledge gap was identified as a critical factor that could contribute to accidental fires and limit residents' participation in fire management initiatives. The community's lack of understanding of fire risks and preventive measures was identified as a major challenge that must be addressed in order to improve overall fire management effectiveness in Mazowe Rural.

Communication challenges were a common theme identified. The interviews revealed significant communication gaps between government agencies, non-governmental organizations (NGOs), traditional leadership, and local communities in Mazowe Rural. These challenges were viewed as a barrier that could result in disjointed responses and delayed information sharing during critical fire events.

Furthermore, a significant theme that emerged in the interviews was the issue of uncontrolled burning. While some informants recognized the cultural significance of controlled burning for land clearing, there were concerns about the possibility of these fires spreading out of control and contributing to accidental forest fires. This demonstrates the delicate balance between traditional burning practices and the risk of unintended consequences, such as forest fires.

In addition, all participants reported witnessing recent fire incidents in Mazowe Rural, emphasizing the ongoing threat. Out of the mentioned success stories that described instances in which prompt community response or the installation of firebreaks resulted in the successful containment of fires. These successes highlight the community's potential for employing effective fire management strategies. Nonetheless, failure cases were described by the vast majority of KIIs.. These incidents characterized uncontrolled forest fires that caused significant damage and were ascribed to insufficient resources and delayed response times. The frequency of failure cases highlights the difficulties in controlling forest fires in Mazowe Rural and highlights the pressing need for better fire management and monitoring strategies in order to avert such catastrophic outcomes.

4.6 Discussion of the results

This section discusses the study's key findings in order to determine the degree to which the results of the questionnaire's quantitative and qualitative sections fulfilled the objectives of the study and were consistent with the body of research on fire management and monitoring strategies in rural areas. This study implemented a triangulated approach of questionnaires and key informant interviews (KIIs) to examine, from a stakeholder perspective, the effectiveness of forest fire management and monitoring strategies in Mazowe Rural, Zimbabwe. The combined data demonstrate significant weaknesses in the current strategy while also unveiling promising opportunities for improvement.

A majority of the participants reported having observed recent fire incidents, and the data consistently showed that stakeholders were well-aware of the risks posed by forest fires. The high level of awareness among respondents regarding forest fire management efforts in the area highlights the visibility and importance of fire management in Mazowe Rural, which aligns with the literature that emphasizes the significance of community awareness in effective fire management. This is in accordance with the theory of planned behavior, in which knowledge of negative consequences can influence motivation to engage in preventative actions (Verweij, 2024). Similarly, the prevalence of activities such as public awareness campaigns and firebreak creation reflects the community's proactive approach to mitigating forest fire risks, which is consistent with best practices recommended in forest fire management research (Nikolakis & Roberts, 2020).

However, stakeholder confidence in the current strategies ability to prevent and control forest fires was low. This echoes the argument that ineffective fire management strategies render communities more vulnerable to forest fires (Dhall et al., 2020).

Despite overall awareness and participation in fire management activities, the study noticed gaps in areas such as firefighting training and communication strategies, which have been highlighted in previous literature on fire management challenges (Wang et al., 2022). A lack of resources, community engagement, and effective communication were identified as key weaknesses in the current strategies, echoing previous research on the barriers to successful fire management in resource-constrained environments (Tsalera et al., 2023). This is also consistent with the concept of social-ecological resilience, in which a lack of resources reduces a community's resilience to fire disturbances (Villaverde et al., 2024). Also, the emphasis on controlled burning and early warning systems, combined with concerns about effectiveness and control, highlights the importance of a balanced and coordinated approach to fire management strategies, as recommended in the fire ecology literature (Attri et al., 2020).

Furthermore, the discussion of factors related to the effectiveness of forest fire managing and monitoring forest fires in Zimbabwe raised critical issues such as resource constraints, limited community engagement, and communication gaps that impede effective fire management efforts. These factors support existing literature on the complexities of forest fires management, which emphasizes the importance of community engagement, capacity building, and stakeholder collaboration in enhancing fire resilience (Partidário et al., 2022). The opportunities identified, such as community participation, capacity-building initiatives, and technology integration, are consistent with global best practices in fire management, which emphasize the importance of comprehensive and inclusive approaches to reducing fire risks and strengthening response capabilities (Essen et al., 2023).

In assessing the effectiveness of forest fire management and monitoring strategies in Mazowe Rural, the study revealed stakeholders' concerns about the current strategies' ability to prevent and control wildfires. Data collected is consistent with previous research on the negative factors related to fire management effectiveness, emphasizing the importance of improved communication, resource allocation, and community engagement in improving overall fire resilience (Ansari et al., 2024). Concerns raised about the lack of confidence in the effectiveness of existing strategies,

especially in preventing forest fires and communicating fire risks, highlight the critical need for improving preparedness and response mechanisms to effectively address forest fire threats (Bacciu et al, 2022).

Ultimately, this study identified significant challenges with Mazowe Rural fire management and monitoring strategies. Resource constraints, limited community engagement, communication gaps, and uncontrolled burning practices all impede effective fire prevention and control. The study did, however, identify areas for improvement such as increased community participation, the integration of traditional knowledge, and the use of technology. By addressing these challenges and capitalizing on identified opportunities, stakeholders can work toward a more effective and coordinated approach to fire management in Mazowe Rural, ultimately contributing to the region's fire resilience.

4.7 Strategies to improve forest fire management and monitoring strategies

The data from the questionnaire about strategies to improve the effectiveness in managing and monitoring forest fires in Zimbabwe indicate significant number of obstacles that have an impact on the country's attempts to control and manage forest fires. As shown in Table 2, resource constraints emerged as the most pressing issue, as evidenced by the high mean score (4.58) and low standard deviation, indicating strong agreement among participants. This is likely to result in limitations in acquiring the essential equipment, training personnel, and establishing adequate fire monitoring strategies. Beyond resource constraints, stakeholders recognized the inherent difficulty of managing forest fires (mean score: 4.32). This complexity could be due to factors such as large areas to cover, unpredictable fire behavior, or a lack of readily available control measures.

The data also indicates a potential gap in community engagement. Stakeholders perceive a lack of community awareness and participation in fire prevention and response strategies. This highlights the need for improved outreach and education initiatives to empower communities to take a more active role in fire management. Furthermore, inadequate communication among stakeholders poses a challenge. Disjointed communication may impede the coordination of fire management activities, potentially resulting in slower response times or inefficient resource allocation.

Lastly, policy and regulations received the lowest mean score, but with a relatively high standard deviation. The higher standard deviation indicates that respondents have differing opinions about the impact of policy and regulatory barriers on forest fire management. While some may see specific policies as impediments, others may not be as concerned.

Table 4.4 Key challenges for stakeholders in managing and monitoring forest fires in Zimbabwe (n=123)

	Minimum	Maximum	Mean	Std. Deviation
Forest fire management presents a significant challenge in Zimbabwe.	1	5	4.32	.788
Resource constraints impact our ability to effectively manage and monitor forest fires.	2	5	4.58	.959
Policy or regulatory barriers impede the efforts to manage forest fires.	1	5	3.87	1.040
Lack of community awareness or involvement affects forest fire management efforts.	2	5	4.21	.852
Communication challenges prevent stakeholders in coordinating forest fire management activities.	1	5	4.09	.923

N=123

Table 4.5 Opportunities for stakeholders in managing and monitoring forest fires in Zimbabwe (n = 123)

	Minimum	Maximum	Mean	Std. Deviation
Improving collaboration among stakeholders could enhance forest fire management.	1	5	4.48	.678
Technology can be leveraged enhance forest fire management and monitoring efforts.	1	5	4.23	.821
Community participation is essential to improving Zimbabwe's forest fire management.	3	5	4.62	.592
Capacity-building and training initiatives can help stakeholders better manage forest fires.	2	5	4.51	.632
Integrating traditional fire management practices and innovative approaches or best practices from other parts of the world could help Zimbabwe manage forest fires more effectively.	2	5	4.37	.753

Building on the analysis of challenges, this part explores opportunities to improve Zimbabwe's Forest fire management strategies, as collected through the questionnaires of the 123 participants,

reveal several promising avenues for improvement. The analysis uses mean scores and standard deviations to determine the level of agreement.

Community participation was identified as the most critical strategy. This strong agreement emphasizes the importance of empowering communities to be more involved in fire prevention and response strategies. Stakeholders also showed strong support for capacity building and training initiatives. This demonstrates a common understanding of the need to improve stakeholder knowledge and skills for more effective fire management.

Additionally, improved stakeholder collaboration also received a high rating indicating broad agreement on the potential benefits of coordinated efforts. This indicates widespread agreement on technology's potential, but also suggests some variation in perceptions. Stakeholders may have different perspectives on the most appropriate technologies or face implementation challenges.

Lastly, stakeholders expressed moderate agreement on the importance of integrating traditional fire management practices with innovative approaches or best practices from other areas. Utilizing a combination of traditional and innovative approaches is seen as a way to improve forest fire management in Zimbabwe. The mean and standard deviation indicate that respondents agree on the potential benefits of implementing a balanced approach to fire management techniques.

Data collected from in-depth interviews with twelve key informants (KIIs) representing various stakeholders in Mazowe Rural, Zimbabwe, yielded valuable information about the effectiveness of forest fire management and monitoring strategies. Using thematic analysis, recurring themes regarding challenges, their consequences, opportunities, and potential actions emerged.

The most pressing issue was identified as resource constraints, with stakeholders citing limitations in equipment, personnel training, and fire monitoring infrastructure. This lack of resources was said to have a direct impact on efforts to prevent, detect, and suppress fires. Limited community awareness also presents a significant challenge. A significant number of interviewees expressed concern about the lack of fire safety education and awareness among community members. According to the KIIs, this knowledge gap can lead to accidental fires and hinder potential participation in fire management initiatives.

Additionally, communication gaps emerged as a hurdle Stakeholders identified communication challenges between various groups involved in fire management, including government agencies, Non-Governmental Organizations (NGOs), traditional leadership, and local communities. They insisted that this has resulted in disjointed responses, delayed information sharing, and hampered coordination during critical fire incidents.

Lastly, a little over half of the interviewees cited uncontrolled burning practices for land clearing as a major concern. While it may be a traditional practice, these fires can quickly spread out of control, contributing to accidental forest fires. They argued that these challenges have a ripple effect, undermining the effectiveness of fire management in Mazowe Rural.

Furthermore, both the questionnaire responses and the key informant interviews emphasized a lack of community engagement and awareness as a critical challenge. Stakeholders expressed concern about the community's low participation in fire prevention and response strategies, highlighting the need for improved outreach and education initiatives to empower communities to take an active role in forest fire management. In line with this, communication gaps were identified as a common barrier in both sources of data, with stakeholders emphasizing the need for improved coordination and information sharing among all parties involved.

Consequently, the triangulation of questionnaire and key informant interview findings provides a comprehensive understanding of Zimbabwe's key forest fire management challenges, consequences, opportunities, and potential actions. By addressing the identified challenges and capitalizing on opportunities for improvement, stakeholders can work toward more effective and coordinated efforts in forest fire management and monitoring, ultimately contributing to Zimbabwe's Forest conservation and sustainability.

conclusion

Examining the data collected and discussions surrounding fire management and monitoring strategies in Mazowe Rural, Zimbabwe. Utilizing a comprehensive mixed-method approach, this study explored into the complexities of these strategies and their impact on the local community. Key insights into the region's forest fire management factors both negative and positive that were related to the effectiveness were gathered through questionnaires and interviews. The data collected highlighted the importance of stakeholder engagement, community involvement, and

continuous monitoring in effectively mitigating forest fire risks. The forthcoming chapter will elucidate the conclusions and offer recommendations to enhance forest fire management practices

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 Introduction

The chapter gives a summary of research study presented and analyzed from chapter one to four. This chapter is going to provide a conclusion and recommendations on data presented and analyzed on the effectiveness of forest fire management and monitoring systems in Mazowe rural district.

5.2 Summary

This research being guided by the research questions and objectives focused on the contribution of key stakeholder perspective on the effectiveness of forest fire management and monitoring strategies in Mazowe rural district. On the methodology, the three research tools that are questionnaire, interview guide and focused group discussion were effectively used to obtain results from the research. Purposive and stratified were conducted to obtain the study participants. These research instruments were effectively used as primary data sources in the study to obtain information from the stakeholders including the key informant, members, farmers, business owners and residents. The study revealed that awareness campaigns were found to be the most well-known activity and controlled burning although they sometimes turned out to disasters in Mazowe Rural district. The study also shows that, fire breaks, awareness campaigns, in Mazowe rural district plays a crucial role in mitigating the impacts and severity of forest fires on livelihoods and property. The research reveals that there were some draw backs faced by the management team and monitoring strategies in Mazowe rural district. These challenges resource constraints, lack of community engagement, policy and regulatory barriers Forest fires pose a significant threat to the environment, economy and communities in many regions around the world. henceforth this study was conducted to assess the effectiveness of forest fire management and monitoring strategies in the Mazowe rural district of Zimbabwe from the perspective of key stakeholder. The study employed qualitative approach including interviews, questioners to assess the perceptions and experiences of local communities, government agencies, and no governmental organizations involved in fire management. It investigates the current policies, resources, and coordination mechanism in place for fire prevention, detection and suppression, as well as the challenges and barriers to their effective implementation. The data collected provides insight into the strengths

and weaknesses of the existing fire management strategies, and identifies the opportunities for improving coordination, resource allocation and community participation. The research also explores the role of emerging technologies, such as early warning system in enhancing fire monitoring and response capabilities.

5.3 Conclusion

The study unearthed the contribution of stakeholder perspective in the management of forest fire and monitoring strategies in Mazowe rural district towards the impacts of forest fires, management and monitoring issues. Through the use of objectives, the data collected shows that the majority of respondents are aware of efforts to manage and monitor forest fires in Mazowe Rural. This high level of stakeholder awareness highlights the importance and visibility of the region's existing forest fire management and monitoring strategies. This suggests that fire management is a relevant issue within the community. Ultimately, the significant percentage of respondents who are aware of these efforts suggests that there are established mechanisms and initiatives in place to manage and monitor forest fires in Mazowe Rural. The research study indicated that the key informants and general public were well aware of awareness campaigns by the government and other stakeholders and firebreaks activities although they would sometimes result in uncontrollable outbreaks causing devastating impacts on the social, economic and environmental factors, leading to loss of lives and livelihoods. The responses to the questionnaire show that respondents identified the use of early warning systems, such as lookouts and communication protocols, as a fire management activity in Mazowe Rural. The recognition of early warning systems as a significant fire management activity emphasizes the importance of proactive measures for enhancing Mazowe Rural overall preparedness and resilience to forest fire risks. The data from the quantitative data as illustrated by the table below show that stakeholders in Mazowe Rural perceive a clear risk of forest fires in the area indicating general agreement on this issue. Additionally, stakeholders are acutely aware of the risks that forest fires pose to people and property. However, participants do not perceive the current fire management and monitoring strategies are effective at preventing forest fires. This indicates a wide range of opinions about the effectiveness of the existing strategies. Similarly, participants believe that there is insufficient communication about fire risks among stakeholders.

Perhaps the most concerning finding is that stakeholders have low confidence in the current strategies' ability to prevent and control forest fires. The average score, which ranges between "Neutral" and "Disagree," indicates a general lack of confidence in the strategies effectiveness.

A majority of the participants reported having observed recent fire incidents, and the data consistently showed that stakeholders were well-aware of the risks posed by forest fires. The high level of awareness among respondents regarding forest fire management efforts in the area highlights the visibility and importance of fire management in Mazowe Rural, which aligns with the literature that emphasizes the significance of community awareness in effective fire management. This is in accordance with the theory of planned behavior, in which knowledge of negative consequences can influence motivation to engage in preventative actions (Verweij, 2024). Similarly, the prevalence of activities such as public awareness campaigns and firebreak creation reflects the community's proactive approach to mitigating forest fire risks, which is consistent with best practices recommended in forest fire management research (Nikolakis & Roberts, 2020). However, stakeholder confidence in the current strategies ability to prevent and control forest fires was low. This echoes the argument that ineffective fire management strategies render communities more vulnerable to forest fires (Dhall et al., 2020).

Despite overall awareness and participation in fire management activities, the study noticed gaps in areas such as firefighting training and communication strategies, which have been highlighted in previous literature on fire management challenges (Wang et al., 2022). A lack of resources, community engagement, and effective communication were identified as key weaknesses in the current strategies, echoing previous research on the barriers to successful fire management in resource-constrained environments (Tsalera et al., 2023). This is also consistent with the concept of social-ecological resilience, in which a lack of resources reduces a community's resilience to fire disturbances (Villaverde et al., 2024). Also, the emphasis on controlled burning and early warning systems, combined with concerns about effectiveness and control, highlights the importance of a balanced and coordinated approach to fire management strategies, as recommended in the fire ecology literature (Attri et al., 2020).

Furthermore, the discussion of factors related to the effectiveness of forest fire managing and monitoring forest fires in Zimbabwe raised critical issues such as resource constraints, limited community engagement, and communication gaps that impede effective fire management efforts.

These factors support existing literature on the complexities of forest fires management, which emphasizes the importance of community engagement, capacity building, and stakeholder collaboration in enhancing fire resilience (Partidário et al., 2022). The opportunities identified, such as community participation, capacity-building initiatives, and technology integration, are consistent with global best practices in fire management, which emphasize the importance of comprehensive and inclusive approaches to reducing fire risks and strengthening response capabilities (Essen et al., 2023).

Despite the negative factors identified, the prevalence of activities such as public awareness campaigns and firebreak creation reflects the community's proactive approach to mitigating forest fire risks, which is consistent with best practices recommended in forest fire management research (Nikolakis & Roberts, 2020).

Also, On the strategies to improve strategically the strategies being used, Data collected from - depth interviews with twelve key informants (KIIs) representing various stakeholders in Mazowe Rural, Zimbabwe, yielded valuable information about the effectiveness of forest fire management and monitoring strategies. Using thematic analysis, recurring themes regarding challenges, their consequences, opportunities, and potential actions emerged. The most pressing issue was identified as resource constraints, with stakeholders citing limitations in equipment, personnel training, and fire monitoring infrastructure. This lack of resources was said to have a direct impact on efforts to prevent, detect, and suppress fires. Limited community awareness also presents a significant challenge. A significant number of interviewees expressed concern about the lack of fire safety education and awareness among community members. According to the KIIs, this knowledge gap can lead to accidental fires and hinder potential participation in fire management initiatives. Additionally, communication gaps emerged as a hurdle Stakeholders identified communication challenges between various groups involved in fire management, including government agencies, Non-Governmental Organizations (NGOs), traditional leadership, and local communities. They insisted that this has resulted in disjointed responses, delayed information sharing, and hampered coordination during critical fire incidents. Lastly, a little over half of the interviewees cited uncontrolled burning practices for land clearing as a major concern. While it may be a traditional practice, these fires can quickly spread out of control, contributing to

accidental forest fires. They argued that these challenges have a ripple effect, undermining the effectiveness of fire management in Mazowe Rural.

5.4 Recommendations

1. Develop a comprehensive forest fire management plan incorporating stakeholder inputs.
2. Engage community engagement and education on Forest fire prevention and management.
3. Improve resource allocation and funding for forest fire management in Mazowe Rural area.

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APPENDIX

Bindura University
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BINDURA UNIVERSITY OF SCIENCE EDUCATION

27 February 2024

To Whom It May Concern:

ASSISTANCE TO THE STUDENT WHO IS SEEKING INFORMATION FOR HIS RESEARCH PROJECT

This is to confirm that **Dereck Katungondo**, Registration Number **B200648B** is a student doing a Bachelor of Science Degree in Disaster Management Sciences in the Disaster Risk Reduction Department at Bindura University of Science Education and is required to do a Research Project as part of his degree programme. The student is expected to gather data for his project from various sources including your institution.

This letter therefore serves to kindly ask you to assist the above-mentioned student with information relating to his project entitled:

EFFECTIVENESS OF FOREST FIRE MANAGEMENT AND MONITORING SYSTEM IN ZIMBABWE

Thank you.

CHAIRMAN
GEOGRAPHY DEPARTMENT
FACULTY OF SCIENCE

EMMANUEL MAVHURA (PhD)
CHAIRMAN

A: QUESTIONNAIRES

Introduction

Thank you for your participation in this study of forest fire management and monitoring systems in Mazowe Rural, Zimbabwe. Your perspective is valuable in understanding how these systems work and how they can be improved. Your honest response will be crucial in helping us achieve this goal. All information provided will be kept confidential and used strictly for research purposes.

Please note: There are no correct or wrong answers. Please kindly respond honestly and to the best of your ability.

Section 1: Demographics

1. What is your age range?

18-35		36-49		50 and above	
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2. What is your gender?

Male		Female	
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3. What is your primary occupation?

Farmer		Business owner/entrepreneur		Community leader/health worker		Civil servant		Other	
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4. How long have you lived/worked in Mazowe Rural?

0-5 years		5-10 years		Over 10 years	
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SECTION 2: Existing Fire Management Systems

5. Are you aware of any efforts to manage and monitor forest fires in Mazowe Rural?

Yes		No	
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6. If you responded “Yes” to question 5, please specify which of the following fire management activities you have observed in Mazowe Rural (select all that apply):

Controlled burning before the dry season.	
Creation of firebreaks around forests and communities	
Public awareness campaigns about fire dangers	
Early warning systems (lookouts and communication protocols)	
Firefighting training for community members	
Other (specify)_____	

Section 3: Stakeholder Challenges and Opportunities.

Instructions: Please rate your level of agreement with the following statements on a scale

(Key: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

No.	STATEMENTS	1	2	3	4	5
CHALLENGES						

7.	Forest fire management presents a significant challenge in Zimbabwe.					
8.	Resource constraints impact our ability to effectively manage and monitor forest fires.					
9.	Policy or regulatory barriers impede the efforts to manage forest fires.					
10.	Lack of community awareness or involvement affects forest fire management efforts.					
11.	Communication challenges prevent stakeholders in coordinating forest fire management activities.					
OPPORTUNITIES						
12.	Improving collaboration among stakeholders could enhance forest fire management.					
13.	Technology can be leveraged enhance forest fire management and monitoring efforts.					
14.	Community participation is essential to improving Zimbabwe's forest fire management.					
15.	Capacity-building and training initiatives can help stakeholders better manage forest fires.					
16.	Integrating traditional fire management practices and innovative approaches or best practices from other parts of the world could help Zimbabwe manage forest fires more effectively.					

SECTION 4 - Perceived Effectiveness

Instructions: Please rate your level of agreement with the following statements on a scale

(Key: 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

No.	STATEMENTS	1	2	3	4	5
17.	There is a clear risk of forest fires in Mazowe Rural.					
18.	I am aware of the dangers forest fires pose to people and property					
19.	The current fire management and monitoring systems are effective in preventing forest fires.					
20.	There is sufficient communication about fire risks amongst stakeholders (government, community).					
21.	Are you confident that Mazowe Rural's current fire management and monitoring systems can prevent and control forest fires?					

Thank you again for taking the time to fill out this form. Your honest and valuable responses will make a big contribution to this study effort.

