Enhancing Early Warning Systems for Fire: The Role of Local Actors in Disaster Preparedness in the Eastern Cape, South Africa

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Abstract
This report explores the role of local actors in enhancing early warning systems (EWS) for fires in the Eastern Cape province of South Africa. Veld and urban fires present significant risks to communities and infrastructure, especially in rural and informal urban areas. The study focuses on (1) understanding how local actors such as fire services and Fire Protection Associations contribute to the design and enhancement of early warning systems for fires and (2) what preparedness measures are needed for the actors to be able to act efficiently to warnings. By examining their needs for timely and accurate information, the research highlights the importance of effective communication and collaboration among involved actors.

Key findings highlight the importance of clearer role definitions, better communication and more inclusive collaboration. There is a need for more accurate and region-specific fire warnings, improved resources and ongoing training for actors at all levels. The study also emphasises that while significant strides have been made toward proactive disaster management, funding and structural barriers continue to hinder the full effectiveness of these efforts. The results suggest that strengthening local response capabilities, involving more stakeholders in the design of EWS, and addressing resource gaps are crucial steps in enhancing disaster management in the region.

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Summary

The report explores the development, implementation and improvements of early warning systems (EWS) for veld fires in the Eastern Cape province of South Africa, with a specific focus on how local actors – such as fire services, NGOs, weather services and disaster management centre – are involved and integrated into such systems. As the poorest province in South Africa, the Eastern Cape consists of extensive rural areas that are highly prone to veld fires (National Government of SA, 2024). Local responders in the area suffer from limited resources, which hampers effective preparedness and response (Department of Cooperative Governance and Traditional Affairs, 2020).

Using a theoretical lens grounded in risk and resilience thinking, the report emphasises that EWS should not merely function as a technical tool for issuing alerts but must also be socially embedded, adaptive, and understandable for all stakeholders involved in the process. The report argues for a four pillar EWS approach: (1) risk knowledge, (2) forecasting and monitoring, (3) dissemination and communication, and (4) response capabilities (UNDRR, 2023). While the first two pillars are only briefly addressed, the report focuses on the last two pillars, highlighting trust, transparency and sustained conversation between relevant actors and communities. These factors are important for ensuring both the understanding and accessibility of the warnings, as well as the capacity of local actors to respond efficiently.

Methodologically, the study is based on qualitative fieldwork conducted in Eastern Cape, specifically in the Sara Baartman District Municipality and Nelson Mandela Bay Metropolitan Municipality. The research involves semi-structured interviews with representatives from disaster management centres, a volunteering fire association, the South African Weather Services, and local fire chiefs. The interviews were thematically analysed, with key themes drawn from the findings revealed from the interviews.

Findings showed that although South Africa has national legislation frameworks for disaster risk management, there is a gap in the implementation of these frameworks at the local level. Interviewees consistently highlighted limited resources - such as funding, personnel and equipment - as the main issue for an adequate implementation. Funding was in general seen as the root issue as both manpower and equipment are dependent on it but are limited from weak institutional structures. Moreover, there is limited access and understanding of official early warning systems, and the trust in government are sometimes strained. Instead, communities rely on strong internal networks and local knowledge, such as WhatsApp groups, word of mouth and volunteer fire associations.

Further, trust and ongoing conservation emerge as critical to ensure effective collaboration and coordination, which are central to a successful EWS. Findings from the interviews indicated unclear roles and responsibilities, inaccurate and overly broad warnings, lack of understanding, and insufficient resources as factors that undermine trust and communication. This in turn, limits the ability of relevant actors to engage in the development and design of EWS.

To improve the effectiveness of EWS, the report recommends a shift toward a more proactive and inclusive approach, including:

- Clarification of roles and responsibilities in both policy and practice.
- Educational initiatives and a unified definition EWS.
- To improve the effectiveness of EWS, the report recommends a shift toward a more proactive and inclusive approach, including:
- More inclusive collaboration and coordination, supported by better establishment of structured communication and feedback mechanisms.

Ultimately, the report argues that early warning systems must be socially grounded and adapted to local realities in order to be truly effective, especially in regions like the Eastern Cape where vulnerabilities are high and formal state capacity is limited.

Abbreviations

DFFE – Department of Forestry, Fishery and Environment

DMA – Disaster Management Act

DMC – Disaster Management Centre

DOC – Disaster Operations Centre

DRR – Disaster Risk Reduction

DRR-M – Disaster Risk Reduction and Management

ECUFPA – Eastern Cape Umbrella Fire Protection Association

EWS – Early Warning Systems

FDI – Fire Danger Index

FDRI – Fire Danger Rating index

FPA – Fire Protection Association

FPO – Fire Protection Officer

MHEWS – Multi Hazard Early Warning System

NDMC – National Disaster Management Centre

NMBMM – Nelson Mandela Bay Metropolitan Municipality

NVFFA – National Veld and Forest Fire Act

SAWS – South African Weather Services

SBDM – Sarah Baartman District Municipality

SBW FPA – Sarah Baartman West Fire Protection Association

WMO – World Meteorological Organization

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1 Introduction

In the introduction a background and motivation to the study, the purpose and research questions and limitations are presented.

1.1 Background and motivation

The Eastern Cape Province of South Africa has a diverse geography and is vulnerable to several natural hazards including droughts, floods, and severe storms (IMERS, 2024). Furthermore, Eastern Cape is also one of South Africa's poorest provinces (National Government of SA, 2024).

South Africa faces a significant risk of both urban fires and veld fires, reaching above the international norms (Republic of South Africa, 2013; ECUFPA, 2017; Forsyth et al., 2010). According to Global Forest Watch (2025), the frequency of veld fires in South Africa has remained constant since 2012, with about 13 500 fire alerts reported in total between February 2024 to February 2025. In January 2025, approximately 450 high confidence fire alerts were reported (ibid) and the Eastern Cape province has the second highest rate of tree cover loss in South Africa (ibid). Forsyth et al. (2010) reported that 48% of the Eastern Cape province falls within the extreme veld fire risk category. More recent data from 2017 indicates that provinces with sour grassland are particularly susceptible to veld fires, the Eastern Cape largely consists of sour grasslands making the province naturally prone to fire outbreaks (ECUFPA, 2017).

Even though the frequency of fires has been approximately the same the last decades, the Department of Environmental Affairs (2016) in South Africa mention that climate change is predicted to increase the frequency of disasters in the near future. This includes severe veld fires, drought, and storms. Climate change may also be the reason why weather forecasting and predicting fires is believed to decrease in accuracy (Guido, 2021).

According to the Republic of South Africa (2013), frequency of urban fires has increased within the last decades. The increase is largely driven by the rapid ongoing urbanisation in South Africa (CSIR, 2019). This has led to expansion of informal settlements, which are usually densely built with highly combustible materials (Republic of South Africa, 2013; CSIR, 2019; Walls et al., 2020). These areas typically lack access to electricity, relying instead on open fires for cooking and lightning. In addition, fire brigade services are highly absent in these settlements (ibid).

In addition to the expansion of informal settlements, the Republic of South Africa (2013) also highlights a growing rural-urban interface, contributing to unequal access to fire response services depending on geographic location. Fire services in South Africa are generally understaffed, ill-equipped, and inadequately prepared (Department of Cooperative Governance and Traditional Affairs, 2020).

Early Warning Systems (EWS) are crucial for mitigating the impact of natural disasters, including veld and urban fires, on communities, infrastructure, and local economy (Maripe et

al., 2022; IMERS, 2024). The purpose of EWS is to deliver timely and accurate information about incoming hazards, enabling proactive measures and reactive responses by individuals, communities, and authorities (IMERS, 2024). The early warning system chain encompasses critical actions such as evacuation planning, securing property, and mobilising emergency services (Maripe et al., 2022; IMERS, 2024).

This thesis focused on the role local actors, that are involved in the response to fires, play in the development, implementation, and improvement of EWS. This includes enhancing response capabilities by strengthening the ability of communities and actors to respond effectively to fire hazards through regular training, emergency drills, and ensuring clearly defined protocols and responsibilities (ibid). We were actively involved in a larger project called Investing Multi-Hazard Early warning and ReSilience (IMERS) which focused on enhancing resilience though early warning systems and addressing the gap in understanding how such messages are conveyed and received within the complex African context.

1.2 Purpose and research questions

Maripe et al. (2022) highlight that response capabilities in many parts of southern Africa are inadequate, often due to outdated response plans or their failure to reach the intended audience. The fact that conditions also vary greatly between municipalities in terms of access to rescue and fire services, combined with the lack of national standards, can create significant challenges (Department of Cooperative Governance and Traditional Affairs, 2020). However, by addressing these challenges, it is possible to significantly enhance community resilience and improve the protection of lives and livelihoods from the potentially catastrophic effects of fire related disasters (ibid; IMERS, 2024).

This thesis sought to understand the role local authorities, such as fire services and other actors involved in preparedness and response to fires, play in improving EWS and to identify the specific needs of these actors, enabling them to effectively respond to fire warnings issued by early warning systems. It explored whether local actors have a say in the design and development of the early warning system they use.

Additionally, it studied what information the actors need from the EWS to ensure timely and effective action by these services. The Sendai Framework for Disaster Risk Reduction (2015) emphasises the importance of investing in, developing, strengthening and maintaining early warning systems, with preparedness and response planning as one of the key components of an effective system.

Therefore, this thesis aimed to address the following research questions:

- What role do local actors play in the development, implementation and improvement of early warning systems for fires in the Eastern Cape province, South Africa, and how can their efforts be improved to enhance community disaster preparedness?
- What early warning information do local actors need and what preparation measures are needed to enable them to respond to the warnings effectively?

1.3 Limitations

This study primarily focused on fire service's response capabilities to both veld fires and urban fires, which is a part of the fourth and final component of the EWS elements, after disaster and risk knowledge, forecasting and monitoring and risk communication (Haque et al., 2023; Maripe et al., 2022; WMO, 2024). Specifically, it examined how local actors integrate with EWS within the context of fire response capabilities and preparedness. Response capabilities are highly dependent on the previous elements. However, forecasting and monitoring were only presented, whereas disaster risk knowledge as well as risk communication were addressed and discussed in the study.

One of the major limitations of this research was the time constraint. The fieldwork was conducted over a limited period of eight weeks and at a significant distance from Lund, making it difficult to return if additional data was needed. This restriction may have limited both the depth and scope of our data collection, including the number of interviews we could conduct.

Another limitation was that the researchers are not natives to the country being studied. They were unfamiliar with the local cultures and do not share the same first language as most of the participants. This culture and language gap may have influenced both the data collection process and the interpretation of responses. To mitigate this impact a local researcher was present, who knows the language, if needed. Additionally, the researchers had a limited network of contacts in the area, which posed challenges in accessing certain key stakeholders. However, this was greatly mitigated with the help of Prof. Van Niekerk, who, with his extensive network and previous experience in disaster management in the Eastern Cape, facilitated valuable connections for the study.

Accessing specific data and detailed information on the subject proved challenging. Fortunately, the researchers had support from their local contact who had conducted similar projects and could assist in navigating these difficulties.

2 Theoretical and conceptual framework

This chapter presents the theoretical and conceptual framework of the study. In addition to key theories on disaster risk reduction, essential concepts are defined. The phenomenon of early warning systems is explored in greater detail, along with its key components, such as response planning and risk communication.

2.1 Theoretical Framework

To provide a clear direction for the study and define key concepts, the theoretical framework will be based on the Sendai Framework for Disaster Risk Reduction. This framework serves as the foundation for understanding disaster risk reduction, early warning systems, and response planning.

2.1.1 Sendai Framework for Disaster Risk Reduction 2015-2030

Disaster risk reduction (DRR) focuses on strengthening resilience and promoting sustainable development by reducing and preventing both existing and future disasters (UNDRR, 2017). The strategies and policies within DRR define goals using different intervals, targets, and indicators. The most significant framework today is Sendai Framework for Disaster Risk Reduction 2015-2030, a global agreement of policies approved by the UN General Assembly. The framework advocates for "[T]he substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries" (ibid).

To achieve the goals outlined in the Sendai Framework, seven targets have been established globally (UN, 2025). Among these, the final target presents multi-hazard early warning system, which should be available and accessible for everyone worldwide by 2030. Additionally, the framework presents four priorities for action: (1) understanding disaster risk, (2) strengthening disaster risk governance to manage disaster risk, (3) investing in disaster risk reduction for resilience, and (4), enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction (ibid). Investment in effective EWS is critical to achieve the fourth priority. These investments must occur at all levels – global, region, national and local – to ensure comprehensive disaster preparedness and response.

2.2 Conceptual Framework

To lay a good foundation for the study, some key concepts will be presented. These key concepts help define and clarify the central themes of the research and provide a basis for understanding the context of early warning systems and disaster preparedness.

2.2.1 Early Warning Systems

Early warning systems are systems designed to provide timely and effective warnings about hazards, allowing individuals and communities to act in ways that reduce the impact of disasters (WMO, 2017). EWS are the central focus in this thesis. By analysing how local actors interact with and use EWS, the research can identify potential gaps and areas for

improvement in their use. To get and maintain an effective EWS there are four elements that must work together (UNDRR, 2023). The four elements are: Disaster risk knowledge, forecasting and monitoring, dissemination and communication and, preparedness and response capabilities.

The first element, disaster risk knowledge, refers to the stage where you identify and assess hazards, vulnerabilities, exposure and capacities of people and systems to cope with and respond to the impacts (UNDRR, 2023). The aim of this step is therefore to "[s]ystematically collect data and undertake risk assessments" (Egerton et al., 2022 p. 17). These risk assessments should be used to identify the locations of vulnerable groups, critical infrastructure and assets and should be used to design evacuation strategies including routes and safe areas (UNDRR, 2023).

The second element, forecasting and monitoring, refers to the development of hazard monitoring and early waring services (Egerton et al., 2022). For there to be early warnings there need to be data and forecasting. Therefore, detection, monitoring and hazard forecasting are essential (UNDRR, 2023). Monitoring of hazard parameters and their precursors continuously is critical for generating accurate and timely warnings, providing affected communities with enough time to implement preventative measures. Detection and monitoring systems, whether automated or manual, should adhere to strict quality control standards, aligning with international guidelines wherever possible (ibid).

The third element, dissemination and communication, is about how you communicate risk information and early warnings (Egerton et al., 2022). To enable early actions and responses that can help safeguard lives and livelihoods, warnings need to reach the people at risk, in a timely manner and with clear messages that contain all essential information needed to take effective action (UNDRR, 2023). Several factors influence how a warning is responded to; it is equally important how the warning is communicated as how it is received. Another important aspect of effective risk communication is trust, which can take time to establish. If the sources that provide information is not reliable, the people at risk might not respond proactively to the warnings (ibid).

The fourth element, preparedness and response capabilities, is about building national and community response capabilities (Egerton et al., 2022). This part is about translating early warnings into life-saving actions. For people at risk to be able to act on warning for evacuation, evacuation strategies must be developed in advance, and they must be informed about safe behaviour to protect themselves and others (UNDRR, 2023). According to León et al. (2007), community preparedness requires the participation of both formal and informal education sectors. The included parameters, preparedness and response, are further presented in sections 2.2.2 and 2.2.3 below.

2.2.2 Response Planning and Preparedness

Response planning involves the strategies and processes developed to mitigate the immediate impacts of a disaster, such as evacuation plans and coordination among stakeholders (European Commission, u.d.). Preparedness refers to the proactive measures taken before a disaster occurs to reduce risk, minimise vulnerability, and ensure an effective response (ibid;

Coppola, 2020). Coppola (2020) mentions that preparedness is achieved through accurate information and appropriate tools, as well as operational planning, training and exercises, and must be included at both governmental and individual levels.

According to U.S. Chamber of Commerce Foundation (2025) and Frennesson et al. (2021), every dollar invested in emergency preparedness saves communities up to $13 in economic impact, damage, and clean-up cost. Despite this, emergency preparedness and disaster risk reduction remain significantly underfunded and underprioritised globally. This is partly due to that it is wrongly perceived as politically risky: to fund an event that might never happen within a political term (UNDRR, n.d).

Response planning and preparedness are also fundamental components of EWS and disaster management. According to the Sendai Framework for Disaster Risk Reduction (2015), EWS are essential for building an effective and resilient response system.

2.2.3 Disaster Response Capabilities

According to UNISDR, response capability is the fourth and final element that an effective early warning system should include (Maripe et al., 2022). Response capabilities refers to how actions plans are integrating with forecasting, risk-knowlegde, and risk communication (Haque et al., 2023). Accoring to Wang et al. (2022), emergency response capabilities are the abilities of governments to predict, monitor, control and coordinate responses and successfully mititgate the negative effects of emergencies. It involves the enhancement of disaster prevention and mitigation capacity through resources, technology, and organisational structures (ibid). Callaghen (2016) also stresses the importance of real-time disaster response capability, which advocates for a constant real-time information flow, collection of localised information from citizens, citizen engagement, and internet based collaboration tools.

Hauqe et al. point out that this element is the most critical, as action plans should be design to reduce risk of the community both in the short term and long term (ibid). This element is highly dependant on response planning and preperedness, which consist of updated hazard and vulnerability assessment, accurate and correct targeted respons plans, and regular simulation exercises (Maripe et al., 2022). Additionally, this phase is location-specific and influenced by the comminity's geography, whether it is rural or urban, socio-economic conditions, and cultural charactersitics (Haque et al., 2023).

2.2.4 Communication

Communication is described by Valentzas & Broni (2014) as the act of conveying information for the purpose of accomplishing a shared understanding through, for example, speech, signals, writing or behaviour. Crucial for a successful communication is a mutual language or method of understanding (ibid).

Coordination and communication enable different organisations, authorities, and governments to collaborate effectively (Jahre et al., 2016), both at a horizontal and vertical level. This is especially important in disaster situations where multiple stakeholders are involved in the process. Effective communication ensures that relevant information, such as needs assessment, resource availability, and operational plans, is shared among all

stakeholders (ibid). In addition, timely and precise communication builds trust and foster long-term relationships. Jahre et al., also mentions that involving the local communities in the communication and coordination process is critical to make sure that responses are following the contextual and cultural values for the community (ibid).

When a disaster occurs or threatens, communication is crucial. According to WHO (2025), risk communication is a real-time transaction of information and opinions between experts and the people at risk, aimed at addressing their health, social well-being, and economic concerns. The purpose of risk communication is to reduce the impacts of threats by dissemination of information about hazards and their potential impacts while empowering at-risk population to make informed decision and take timely actions (Maripe et al., 2022; WHO, 2025). Falkheimer et al. (2009) emphasise that the ideal phase in risk communication occurs when people's risk perception and concerns are no longer viewed as a communication issue, but instead that communication leads to action.

Both Falkheimer and WHO also highlight the importance of community engagement and inclusiveness, where trust among stakeholders is crucial. Community engagement strengthens relationships within the emergency response chain and ensures that solutions are acceptable for everyone involved (WHO, 2025). According to Sättele et al., (2015), trust and community engagement is also highly influenced by the frequency of false alarms of compliance.

Enhancing complexity is also mentioned by Gigerenzer & Gaissmaier (2011) as an important factor to consider within risk communication and decision making. For example, people's perception of risk varies based on how information is presented, as well as the balance between perceived risks and benefits. Fishhoff (2010) and Slovic (2016) also states that more complex systems require greater knowledge and time for users to understand and act on.

Risk communication is vital in emergency preparedness and response (ibid). Furthermore, effective risk communication is a critical component of EWS, playing a key role in designing systems that effectively achieve their intended purpose (Maripe et al., 2022).

2.2.6 Key components and considerations for effective early warning systems

A complete and effective early warning system consists of all four key elements (previously mentioned in chapter 2.2.1), with strong interconnections and efficient communication channels between them. Best-practice EWS not only provides timely and accurate warnings but also ensures seamless coordination across these elements to enhance disaster preparedness and response (UNISDR, 2006; WMO 2018; UN, 2015).

Along with having all four elements in place there are several overarching factors that contribute to the success and sustainability of EWS. Well-developed governance structures and institutional frameworks are essential for ensuring that early warning systems remain functional, effective and adaptable over time (ibid). Additionally, EWS should adopt a multi-hazard approach, and therefore address multiple threats rather than focusing on a single threat. This broadens their functionality and can make them more reliable in responding to various risks and improving public awareness of potential threats (UNISDR, 2006).

Another crucial aspect of EWS's functionality is its ability to reach all members of the community, including those in remote and rural areas - a task that has proven to be challenging for most African countries (Kamati et al., 2024). Community engagement also plays a crucial role in EWS. Actively involving local communities in the development and implementation fosters a sense of ownership, ensuring that warnings are actionable and relevant to the specific communities (Coppola, 2015; Cooperative Governance & Traditional Affairs, 2022a). Furthermore, inclusivity and cultural considerations must be integrated into EWS design. Incorporating gender perspectives and recognising cultural differences ensure that all groups within a community are reached, and that their unique needs are addressed in disaster preparedness planning (UN, 2015).

The development, improvement and implementation of effective EWS require collaboration between multiple key actors. Disaster management agencies play a central role in coordinating preparedness and response efforts, while vulnerable communities remain fundamental to people-centred EWS, ensuring that warnings are accessible and actionable at the local level (Basher, 2006). National governments are responsible for establishing regulatory frameworks, policies, and funding mechanisms that support the sustainability of early warning systems. Additionally, regional institutions and organisations provide specialised knowledge and advisory support, contributing to the technical development and enhancement of EWS (WMO, 2017; UNISDR, 2006). Non-governmental organisations (NGOs) also play a significant role by raising awareness, educating communities and advocating for inclusive disaster risk reduction strategies (ibid).

A well-functioning EWS must be supported by strong response capabilities to ensure that communities can act effectively when warnings are issued (UNISDR, 2006; Maripe et.al., 2022). A response preparedness checklist in UNISDRs report highlights several key factors that strengthen disaster response (2006). Disaster preparedness and response plans should be well-established, regularly updated and clearly communicated to all relevant stakeholders, including local communities, something that is also mentioned in the Sendai Framework for Disaster Risk Reduction (UN, 2015). Regular training and simulation exercises are also crucial, allowing emergency plans to be tested and ensuring that all involved actors are familiar with their roles and responsibilities (Forsyth et.al., 2010). Additionally, a well-functioning EWS must be integrated with emergency services, as many disaster response actions rely on the readiness of fire brigades and other rescue teams (Basher, 2006). Keeping response plans up to date, ensuring coordination between agencies and maintaining adequate resources for emergency responders are essential for effective disaster management.

By strengthening these components, EWS can significantly improve disaster resilience and ensure that warnings lead to timely, effective and coordinated actions that saves lives and protect livelihoods (UNDRR, 2015; WMO, 2017).

In the South African context, despite efforts to strengthen disaster risk reduction and management (DRR-M), institutional and legislative gaps remain, hindering effective coordination between government agencies and the integration of risk reduction strategies (SADC, n.d.). These challenges were particularly evident at the municipal level in 2014,

where limited capacity and funding prevent DRR-M from being fully implemented (Department of Environmental Affairs, n.d.). One key recommendation is to support the continued shift from a reactive to a proactive approach to disaster management, with early warning systems playing a crucial role in this transition. Strengthening EWS will require enhancing institutional capacity at all levels, ensuring that stakeholders can effectively interpret and respond to warnings given (ibid).

3 The study context

This chapter outlines the context in which the study was conducted and provides a summary of relevant laws and regulations governing disaster risk management and fire services in South Africa.

3.1 Eastern Cape

Located on the east coast of South Africa, between the Western Cape and KwaZulu-Natal provinces, Eastern Cape is known for its remarkable natural diversity. One of its main features is its spectacular coastline along the Indian Ocean. Despite its beauty, it remains one of the poorest provinces in South Africa, encompassing large areas of the country's former homelands (South Africa Municipalities, n.d.). South Africa is a multilingual country with 11 official languages. The four most spoken languages are isiZulu, isiXhosa, Afrikaans and English. Cumulatively, these languages and are spoken by approximately 60% of the population (Republic of South Africa, 2022).

The province is divided into two metropolitan municipalities, Buffalo City and Nelson Mandela Bay Metropolitan Municipality, and six district municipalities, which are further subdivided into 31 local municipalities. It is the second largest of South Africa's nine provinces and one of the first areas to be settled by the Portuguese and British (Province of Eastern Cape, 2023).

According to the South African Human Rights Commission, rural poverty remains endemic across much of the province, exacerbating other human rights violations (2022). Vulnerable groups such as women, children, and persons living with disabilities are disproportionately affected, particularly due to sharp increase in poverty.

A risk assessment conducted in 2010 by the Council for Scientific and Industrial Research analysed the exposure of social, economic, and environmental assets to veld fire hazards in the province. The results indicated that 48% of the province fall within the extreme veld fire risk category (Forsyth et.al., 2010). As mentioned in Chapter 1.1, further data from 2017 revealed that provinces with sour grassland are more susceptible to veld fires, making the Eastern Cape naturally prone to fires (ECUFPA, 2017).

This report primarily focuses on Sara Baarthman District Municipality (SBDM) and Nelson Mandela Bay Metropolitan Municipality (NMBMM) in the Eastern Cape. Among the approximately 50 hazards listed in a dataset, veld fire scores the second highest in SBDM and fourth highest in NMBMM (Cooperative Governance and Traditional Affairs, 2022c). Formal and informal urban fires score the third highest in both municipalities.

The report by Cooperative Governance and Traditional Affairs (2022c) also present data from a combined relative disaster profile and a resilience profile. SBDM ranks second lowest in the relative disaster profile, but notably, it also ranks second lowest in the resilience profile. NMBMM falls somewhere in the middle in both profiles. To improve municipal resilience, the report highlights the importance of building municipal resources and increasing budget allocations to improve response to disasters and emergencies.

3.2 Legal Framework for Disaster Risk Management in South Africa

In 2002, the Disaster Management Act 57 (DMA) was developed to establish an integrated and coordinated disaster management policy in South Africa (Republic of South Africa, 2003). DMA emphasises DRR and preparedness as important priorities, requiring collaborative efforts from all spheres of government, civil society, and private sector. It also contributes with a disaster response framework to enable mobilization of resources, capabilities, and technologies (ibid). In 2005, a Policy Framework was published for a better implementation of the DMA by ensuring that all stakeholder's roles and responsibilities are clear (IFRC, 2022). It also highlights the importance of regional co-operation before, during and after a disaster (Republic of South Africa, 2014). The last amendment was made in 2015, meaning that it has been ten years since it was last updated (IFRC, 2022).

3.2.1 Role of Disaster Management Centre

A Disaster Management Centre (DMC) is a national institution aimed at promoting an integrated and coordinated system of disaster management (Cooperative Governance & Traditional Affairs, 2022b; Republic of South Africa, 2003). It involves national, provincial, and local authorities, as well as communities and other key stakeholders. Each province has its own Provincial Disaster Management Centre (PDMC), operating within a department assigned by the Premier (ibid). Disaster management responsibilities are shared between national and provincial governments, where municipalities play a key role, especially since the last amendment of the DMA in 2015 (Cooperative Governance & Traditional Affairs, 2022b).

Pre-disaster coordination is mentioned as an important step in disaster preparedness and effective disaster management (Cooperative Governance & Traditional Affairs, 2022b; Republic of South Africa, 2003). This requires establishing institutional arrangements, conducting risk assessments, and preparing contingency plans for priority hazards. This includes analysing risks, engaging partners, sharing public information, issuing early warnings, and enhancing preparedness (ibid). DMC is an example of a key-role player in disaster management, as well as health-care representatives, fire services, NGOs, police services, and department of water and sanitation (Cooperative Governance & Traditional Affairs, 2022b).

When a disaster is imminent or currently occurring, the PDMC assesses its severity, informs the National Centre and alerts relevant stakeholders, and implements contingency plans (Cooperative Governance & Traditional Affairs, 2022b; Republic of South Africa, 2014; Republic of South Africa, 2003). The National Centre then directs the coordination of resources and response efforts. The Head of the National DMC (National Executive) is finally responsible for formally classifying a disaster and delegating responsibilities (ibid). However, a disaster declaration is only issued when existing arrangements are inadequate to handle the situation (ibid). Throughout the process, various spheres of government (national,

provincial, and municipal) cooperate closely together, as well as with local government, local authorities, local actors and the affected communities.

According to Cooperative Governance & Traditional Affairs (2022b), several challenges hinder the effectiveness of national disaster management efforts, including institutional, financial, and operational aspects. For example, limited institutionalisation within sector department results in damaged coordination and a lack of standardised approaches across government structures. In addition, weak municipal arrangements and lack of contingency plans also undermine disaster response at the local level, where effectiveness, preparedness and knowledge are crucial (ibid). Moreover, disaster management efforts experience selective and non-committed participation by stakeholders (ibid). Finally, limited disaster-specific budgeting limits the implementation of different strategies to mitigate consequences of disasters (ibid).

3.2.2 Role of Municipal Disaster Management Centre in NMB and SBD

Apart from PDMC, the DMC is also divided into Municipal Disaster Management Centres which play an important role in the implementation and coordination of disaster risk management within the municipality (Cooperative Governance & Traditional Affairs, 2022b). The Nelson Mandela Bay Metropolitan Municipality DMC (NMB DMC) is primarily responsible to managing local accidents and disasters and works on implementing the national Policy Framework for the municipality (Nelson Mandela Bay Municipality, 2007). Further, NMB DMC must develop contingency plans for those at risk as well as engage in joint planning with neighbouring municipalities to ensure effective coordination and cross-boundary disaster response. To achieve an extensive and coordinated approach to multi-disaster preparedness and response, the NMB DMC must work side by side with emergency services, such as fire and rescue services (ibid).

Following, the Sarah Baartman District Disaster Management Centre (SBD DMC) also works toward the Disaster Management Act and Framework, as well as having a hazard-specific contingency plan in place (Sarah Baartman District Municipality, 2021). The SBD DMC plays a crucial role in disaster management within the district, with an extensive focus on fire services. For example, it is responsible for the planning, coordination, and regulation of fire services, including specialised firefighting services such as mountain, veld, and urban firefighting operations (ibid). Since SBDM is divided into seven local municipalities, the DMC must provide good partnerships and enhance good collaboration and communication efforts in disaster response (ibid). SBD DMC also ensures that resources in terms of material, personnel, and infrastructure are adequate within the district.

Both NMB and SBD DMC are responsible for the dissemination of early warning systems within the municipalities (Nelson Mandela Bay Municipality, 2007; Sarah Baartman District Municipality, 2021). This involves technical identification and monitoring, the preparation and issuing of these systems, as well as ensuring good communication mechanisms and strategies to ensure warnings reach the whole at-risk area.

According to Sarah Baartman District Municipality (2021), early warnings can be received from various sources. These sources include local, provincial, and national advisory forums.

However, the South African Weather Service (SAWS) is the only local authority responsible for producing weather and climate information, as well as issuing early warning alerts. Mandated by the Weather Service Act, 2001 (Act No. 8 of 2001), SAWS collaborates with government departments, private institutions and community organisations to gather, interpret and disseminate climate related data for various hazards (Republic of South Africa, 2001). SAWS is assigned by the state to deliver weather services to identified clients, either by public goods services funded by the government, or paid-for commercial services (South African Weather Service, 2025).

According to the Department of Environmental Affairs (n.d.) some key components of the system's success include:

- The implementation of multi hazard early warning system (MHEWS) that integrates multiple monitoring systems based on international best practices
- Addressing a range of hazards, including floods, heavy rain, wildfires, storm surges and windstorms
- The National Disaster Management Centre (NDMC) playing a crucial role in coordinating disaster preparedness efforts and ensuring that severe weather warnings are effectively communicated to relevant stakeholders, including local communities.

Moreover, One of SAWS' assignment is to provide relevant stakeholders, for example FPA and fire services, with a Fire Danger Index (FDI) (World Meteorological Organization, 2025). The FDI rates the fire risks from 0 – 100, which are divided into five colour coded categories: Blue (insignificant) (0-20), Green (low) (21-45), Yellow (moderate) (46-60), Orange (high) (61-75) and Red (extremely high) (75<). Early warnings are only issued when FDI is over 75 (ibid).

3.2.3 The role of organisations involved in fire rescue response

According to South African Constitution, firefighting services are a local government function with consistent provincial and national legislative competence (Republic of South Africa, 2013). The Fire Brigade Service Act, 1987 (Act no. 99 of 1987) (FBSA) primary regulates fire services, and aims to provide establishment, maintenance, employment, co-ordination and standardisation of fire services (Republic of South Africa, 1987).

The FBSA establishes key structures and roles for fire services and mandates the formation of a Fire Brigade Board responsible for determining fire services, requiring local authorities to maintain the fire service according to regulations (Republic of South Africa, 2013; Republic of South Africa, 1987). It also provides establishment of designated services outside the control of local authorities. Furthermore, the act regulates the appointment of Chief Fire Officers to lead fire service operations. To enhance a more efficient response, the act facilities agreements between different fire services as well as granting both the minister and local authorities the power to issue rules and regulation for the fire services (ibid).

The purpose of FBSA includes the following (Republic of South Africa, 2013):

- "Preventing the outbreak or spread of fire;

- Fighting or extinguishing a fire;
- The protection of life or property from a fire or other danger;
- Subject to the provisions of the Health Act, the rendering of an ambulance service as; an integral part of the fire brigade service; and
- The performance of any function connected with any of the matters referred to above."

The Municipal System Act, 2000 (Act No. 32 of 2000) outlines the mechanisms for the provision of services, which include fire services, by municipalities (Republic of South Africa, 2013). Further, the Municipal Structure Act, 1998 (Act No. 117 of 1998), provides for the establishment of municipalities in line with the requirements associated to different categories and types of municipalities, as well as the relevant function and authorisation between categories of municipalities (ibid). The functions and authorisations include, for example, planning, coordination and regulation of fire services, specialised services, and the coordination of the standardisation (ibid).

The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998) (NVFFA), focuses on preventing veld, forest and mountain fires across South Africa (Republic of South Africa, 1998). To achieve this, the NVFFA constitutes various institutions, methods and practices, and develops a National Fire Danger Rating System (Republic of South Africa, 2013). In addition, the act demands a "duty of care" on all landowners (both public and private) whose land are at risk of fires (ibid). Therefore, if a landowner sees a fire on their or neighbouring land, it is their responsibility to notify the landowner and the Fire Protection Association (FPA). Additionally, it is the landowner's duty to fight the fires (ibid). The NVFFA is managed by the Department of Forestry, Fisheries and the Environment (DFFE), where the Minister should assist both landowners and the FPA in their work to eliminate and fight veld fires (Department of Forestry, Fisheries and the Environment, 2025).

In South Africa, Fire Protection Association (FPA) was established in 1973 to allocate specialised fire safety management technical and service to members within fire and rescue services, industry, commerce and the general public (Fire Protection Association of Southern Africa, 2025). Fire management entails three central aspects (Department of Environmental Affairs, 2016):

- "suppression of wild fires
- implementation of control burns
- the preparation of fire breaks"

As a requirement mentioned in the NVFFA, the Eastern Cape Umbrella Fire Protection Association (ECUFPA) was founded in 2012 to offer comprehensive coordination and assistance to local FPAs (Eastern Cape Umbrella Fire Protection Association, 2022). However, the act does not give them any specific mandates. Instead, the Act outlines the realignment of the mandates by the Minister. Within the Eastern Cape, ECUFPA supports FPA participation in the management of fire related risks and is governed by an executive Committee (ibid).

Four years later, the Sarah Baartman West FPA (SBW FPA) was formed with its main role to prevent loss of lives and property as well as reducing environmental impacts in veld fires (Sarah Baartman West Fire Protection Association, 2025). It strives to continually manage all high fire risks, and at the same time promoting the benefits of veld fires. Therefore, educating its members in fire safety is crucial.

All levels of government play a crucial role for fire services to be effective. The national government provides a framework for municipal capacity building and support while also establishing broad policies and procedures such as capacity-building programs and resource allocation (Republic of South Africa, 2013). The provincial government focuses on support and coordination for municipalities, ensuring oversight and alignment among local authorities (ibid). Finally, the local government is directly responsible for fire service delivery and community engagement, ensuring that fire safety measures are effectively implemented at the community level (ibid).

4 Methodology and methods

In this chapter the methodology, referred to as the study design, and the methods used in this thesis are described.

4.1 Study Design

An interview-based qualitative research method was employed to address the research questions, as it allowed to capture the respondents' answers in their own words. This approach was suitable for gaining a deeper understanding of their roles in EWS and their preparatory measures before incidents or disasters.

The overall logic of inquiry for this thesis is abductive research. Abductive research focuses on the social domain and is a bottom-up approach (Becker, 2024). The research begins with observations and seeks to understand how the actors perceive the world, instead of looking from the researcher's perspective. This approach then works toward developing a theory to test (Blaikie, 2010). Since the aim was to understand how local actors think and what they need from an early warning system (EWS), abductive reasoning is well-suited to this study. It allows the incorporation of their perspectives into the analysis. Additionally, abductive research is described as well-suited for descriptive research, which constitutes the primary focus of this study.

This study is a case study, as described by Creswell (2013), where a specific issue (EWS) is explored within a bounded system (local actors in the Eastern Cape). Creswell (2013) also notes that case studies are well-suited for descriptive research (as well as exploratory) which aligns with the aims of this study.

4.2 Method

After formulating the research questions, an initial literature study on EWS was conducted to establish a foundation for the study. Data was then collected through semi-structured interviews. The collected data was then coded and analysed leading to the generation of results, conclusions and the final report. The overall process is illustrated in Figure 1 below, and each step will be explained in greater detail in the following sections.

Figure 1. Overview of the process by which the study was conducted.

AI tools were used during the process primarily for inspiration and to a certain degree to assist with grammar and improving the flow of the text. AI tools were also used as help during the transcribing process.

4.2.1 Literature Study

An initial literature study about EWS was conducted to provide a solid grounding to the study and gather knowledge about EWS and the factors that influence how successful these systems are. A small literature study was also conducted to lay a foundation for the interviews by examining the legislative framework governing fire services and the regulations that apply to them. The aim was to gain a better understanding of the various actors in the Eastern Cape involved in managing fire-related hazards.

Literature used in the literature study was mainly retrieved from search platforms such as Google Scholar, ScienceDirect, ResearchGate, Lund University Libraries, Sage Publishing and Academia. The Google search engine was used to some extent when it came to finding for example UN reports about EWS and DRR. Initially key words such as "early warning systems + fires", "disaster preparedness", "response capabilities", "disaster risk reduction" were used when searching for literature. To get insight into the legislative part of EWS both globally and locally, key words used were: "fire services easter cape", "fire brigade eastern cape", "fire services South Africa" and "legal framework South Africa".

4.2.2 Interviews

Data will primarily be collected through interviews with local actors, such as emergency services and similar organisations involved in preparedness planning in the Eastern Cape. This approach aligns with the seven steps of abductive research described by Becker (2024), where the process begins with collecting relevant data to understand how these actors perceive and interpret the phenomenon (EWS).

This research focuses on understanding how local authorities perceive and interact with EWS. Interviews are an ideal method for capturing their insights, challenges, and needs. They offer the flexibility to delve deeper into specific topics as they emerge during conversations, which can be particularly useful for exploring complex, context-specific issues such as disaster preparedness. As Blaikie (2010) notes, interviews allow researchers to access the meanings and interpretations of social actors regarding their experiences and interactions, which aligns closely with our research objectives.

The interviews in this study were of the type semi-structured interviews. This type was chosen to be able to have a freer conversation and allowing follow up questions to be asked. Because the researchers wanted to get answers to some specific questions, this interview type fit well with the study.

All interviews were recorded. The interviewees were asked before the interview if being recorded was okay and had the opportunity to decline. However, all participants provided informed consent to being recorded.

Participant Selection

Since the study focuses on understanding how local authorities interact with and utilise EWS, participants who are directly involved in or have expertise in disaster preparedness and response were intentionally selected. This made purposive sampling an appropriate method. As Blaikie (2010) explains, purposive sampling relies on judgment to determine which

participants or organisations are most relevant to the research. Given that the goal of this study was not to generalise findings to the entire population but to gain deeper insights from those with specific knowledge of the research problem, this approach was well-suited to this study.

With the help of Prof. Dewald Van Niekerk from African Centre of Disaster Studies, people involved in disaster preparedness and response were identified. This involved fire and rescue services, DM personnel and weather services. Additionally, the researchers reached out to FPAs in the area to interview.

The interviews performed

The interviews in this study were conducted in March 2025. A total of 14 interviewees were interviewed during 13 interviews, meaning that during one interview there were two participants. An overview of the interviews is presented below in Table 1. The length of the interviews varied between 15 and 70 minutes, depending on how much they were involved or knew about the subject.

Table 1. Summary of conducted interviews during the study

Interview number	Interviewee number	Role
1	1	Regional manager SAWS
2	2	Forecaster SAWS
3	3	Fire Chief
3	4	DM Specialist
4	5	FPA Tech
5	6	FPA Fire Protection Officer
6	7	FPA Chairman
7	8	Fire Chief
8	9	General Manager FPA
9	10	FPA Chairman
10	11	Fire Chief
11	12	Fire Chief
12	13	DMC Representative
13	14	DMC Representative

All interviews were conducted in English. As all participants were comfortable with the language, no interpreter was needed, and no significant language barriers were observed. However, since English was not the first language of either the interviewers or the interviewees, there is a possibility that some nuances or details may have been lost or misunderstood, potentially influencing the results.

The interviews took place at the participants respective workplaces, which contributed to a familiar and comfortable setting. According to Creswell (2013), conducting interviews in a familiar setting to the interviewee is important to help create an environment in which the participants feel at ease and are free to express their thoughts openly.

Two different interview guides were created and used for the different types of interviews conducted. One was made for interviews with rescue services (fire chiefs) and one for the interviews with Disaster Management Centres, SAWS and FPAs. The interview guides were used to direct the interviews and to ensure that all relevant topics were covered. The two interview guides can be found in Appendix A.

4.2.3 Data extraction and analysis

As Creswell (2013) describes, in case studies, data analysis involves organising and classifying the data. For case studies, categorical aggregation is recommended to establish themes or patterns, dividing the data into appropriate categories. Blaikie (2010) further explains that an abductive research approach (as ours is) ideally should take a "low stance," developing technical concepts and theoretical propositions from participants' accounts in their own words.

The analysis process therefore started with the researcher transcribing the interviews and thoroughly reading through the data to get a good understanding of the content. Following, this categorical aggregation was used to identify common themes and patterns. By grouping similar insights, the data can be organised into broader themes that address the research questions (Creswell, 2013). Everything was manually coded. This ended up in eight main codes with several subcodes under each (33 in total). The two researchers started with coding one transcript together to ensure that they were doing it in the same way. After that two more transcripts were done by both researchers and then compared to again make sure that the coding styles were the same. The rest of the transcripts were divided between the researchers to be more time efficient.

4.2.4 Ethical Considerations

When it came to ethical considerations, there were multiple aspects to think about. Firstly, it was important that the participants were fully informed about the research purpose, procedures and potential risks and benefits before consenting to participate, as described by the Social Research Association (2021). This was ensured by obtaining written consent from all interviewees, while also ensuring that they understood that they could withdraw at any time without any consequences. The consent form used for the interviews can be found in Appendix B. Personal information about the participants was kept confidential, and anonymisation techniques were used when reporting the findings. Our local contact played a crucial role in supporting us during the field research, as he was familiar with the area and had established strong relationships with the actors to be interviewed through his previous work.

Given the potentially sensitive nature of the research, particularly if individuals have experienced trauma related to natural hazards, it was crucial to get explicit consent before conducting any interviews. It was important that interviewees fully understood the topics we planned to cover and the purpose of the study before we began. When interviews took place in or near people’s workplaces, we made sure to respect their customs and routines, as Creswell (2013) highlights the importance of following cultural norms during field research.

Our local contact was once again invaluable in helping us navigate the areas and their specific cultural practices.

The interviews primarily focused on local actors, with participants contributing to their professional roles. This meant that the interviews did not address personal matters.

5 Results

This chapter presents the findings from the interviews conducted. The results are organised according to the main themes that emerged during the analysis.

5.1 Early warning systems

In this chapter results from the interviews about how the warnings are disseminated today, what communication methods are used and what challenges they face will be presented.

5.1.1 Warnings today

According to the South African Weather Services (SAWS), they are the only authorities, by legislation, that can issue weather warnings as formal early warning systems. Representatives from SAWS use a Fire Danger Index (FDI) as an early warning. A computer program calculates this Fire Danger Index (FDI) based on weather data, such as temperature and rainfall, and highlights affected areas using colour codes on a map. The FDI ranges from 0 to 100, with higher numbers indicating greater fire risk. An early warning for fire is only issued if the FDI is above 75, which is marked in red. These warnings are sent out two days in advance via SMS and two separate emails. Emails are generated automatically through a running platform and are not written physically. The SMS and the first email only include the warning itself, while the second email contains a PDF providing more detailed information about the situation.

In addition, FDI is used as part of a weekly weather update sent to relevant actors, such as fire services and Fire Protection Associations (FPA). If the FDI value is low, fire services and FPAs can issue a burning permit to farmers and landowners. All the permits are distributed via relevant WhatsApp groups.

Other sources used as warning systems

However, both fire chiefs and FPA representatives refer to other sources of information as formal early warning systems. For example, the FPA uses a private weather forecasting company to generate a fire risk index called the fire danger rating index (FDRI), which is only accessible to members of the FPA. According to the FPA, in most provinces and within most FPAs, “word of mouth” is used as the most reliable warning system. As described by one FPA representative, word of mouth means that when a landowner sees smoke, they check if there is a burning permit issued or not and then report the fire via WhatsApp or phone calls. Due to collaboration with fire services, these services are also informed in this way.

FPA representatives also mentioned that larger forestry companies detect fires with cameras. The cameras take multiple images of an area and compare one frame to the next. If a change is detected, an alert is automatically sent to a detection room via a direct link. Relevant landowners maintain direct radio contact with the detection room and are notified instantly.

Dissemination of warning information

In the interviews, SAWS representatives stated that FPAs are the only actor who directly receives their warnings. However, both the disaster management center (DMC) in Nelson Mandela Bay Metropolitan Municipalitiy (NMBMM) and the fire services in Sarah Baartman

District Municipality (SBDM) reported that they are receiving warnings directly from SAWS as well. The interviews also revealed differing views on how warning information is disseminated to the public. Most fire chiefs clearly stated they receive the warnings from SAWS and then rely on FPAs to assist with dissemination. According to some FPA participants, however, the fire services may have already disseminated the information by the time the FPAs receive it.

Both fire services and FPAs disseminate the warnings through various communication methods. WhatsApp groups were most commonly mentioned, but other methods – such as Facebook, municipal websites, radio stations, radio communication, word by mouth, SMS, and phone call – are also used to some extent depending on the actor. Challenges associated with these communication methods are mentioned in chapter 5.1.3 below.

DMC representatives mentioned that when they receive warnings from SAWS, both their staff and the joint operation center are activated. The warnings are then sent out to various municipal departments. The DMC informs ward councilors and community leaders, which thereafter relay information to the public. According to one DMC interviewee, the choice of communication methods for warnings depends on the target audience and the expected impacts (for more detail, see chapter 5.1.2).

Included information in early warnings

Regarding what information should be included in the early warning to ensure an effective response, most of the representatives agreed. First, they emphasised the need for clear information about the risk itself – what is going to happen? Next, information about the consequences where highlighted – who will be affected, where, and how severely? Finally, they expressed a need for guidance on how to deal with the effects. One of the interviewed fire chiefs particularly focused on being notified early with exact details of what is going to happen:

"(...) it's critical that you get at least your, you know, notified early that of severe conditions that are approaching in in advance to a specific area that could be,

(...) and that's what I'm interested in - is to know exactly what to expect on a severity level," – Interviewee 8

However, one representative from DMC stated that weather forecasting is not exact:

"(...) but the, you know, predicting weather is not an exact science." - Interviewee 14

5.1.2 The most effective communication method

WhatsApp is mentioned by almost all interviewees from FPAs, fire services, and DMC as a commonly used communication method. However, opinions on its effectiveness and accessibility vary. The FPA in SBDM agrees that WhatsApp groups are the quickest way to disseminate information and issue warning messages, since all the farmers use the platform daily. Farmers also rely much on word of mouth; they spot a fire and then use WhatsApp groups to report it to the FPAs. While emails are used to some extent, the interviewed FPA chairperson noted that people often ignore them:

"These days, since most of the landowners are farmers in the agricultural sector, the WhatsApp groups tend to be the most useful way or the quickest way of really disseminating information. Email, not really so much. People tend to ignore their email, so you read your emails maybe the end of the week or the day, so that's not effective for warning systems. So, WhatsApp is the most appropriate way" – Interviewee 10

On the other hand, the general manager for the FPA in SBDM pointed out that not everyone has access to WhatsApp, and emails should still be used additionally:

"... to send out additional over and above a WhatsApp message [...] So it is a matter of, you can check it on WhatsApp, or if you don't have WhatsApp, because not everybody's got WhatsApp, then you have access to your email and it's there" – Interviewee 9

The umbrella FPA also recognised WhatsApp groups as a functional communication method but expressed concerns about its effectiveness, reliability and timeliness of the responses. The Fire Protection Officer (FPO) mentioned that serious fires should not be discussed over WhatsApp groups, but rather through telephone calls. He noted phoning someone would immediately confirm that the recipient has received the warning. WhatsApp could then be used as a follow-up tool after ensuring that direct contact has been conducted.

On the other hand, a representative from the FPA in SBDM mentioned that when a serious warning is issued, the fire services disseminate information directly from SAWS through WhatsApp. However, one fire chief did not even mention WhatsApp when asked about the best communication method for weather warnings to the public:

"Emails, websites, internet. Instagrams and those things. I think that is. Because we don't do anymore those fliers and things." – Interviewee 11

In addition, the same fire chief also noted that they are part of WhatsApp group directly linked to SAWS, through which they receive weather updates on a weekly basis.

According to SAWS, their primary method of issuing early warnings to relevant stakeholders is via email - one mail with the warning itself and another with more detailed information – accompanied by an additional SMS. Simultaneously, warnings are broadcast through local radio stations where the public can access information. When answering which communication method works best, one SAWS representative considered SMS and email fairly equal:

"I think in the fire industry probably SMS is one of your better ones because a lot of the people are out in the field, but nowadays are getting emails on cell phones quite easily as well, so to me still emails, (...)" – Interviewee 1

Nonetheless, almost all interviewees agreed that cell phone reception in farmlands and rural areas is often non-existent. One FPA representative also brought up loadshedding as a reason that the communication system should not be completely dependent solely on telephones.

One fire chief believed that, in his aera, the most reliable communication method for sending out early warnings is radio communication. While they do have established WhatsApp group, there are times when the telephones are broken, and massages are not received in time:

"I would think in our area, reliable is more radio communication. Because you've got cell phone communication that is breaking up, you've got those phones, those phones are currently not even working." – Interviewee 12

Some FPA members also noted once a warning is confirmed, on-ground communication and coordination are being used to a greater extent between farmers and FPOs when working on the fire.

Additionally, the DMC in NMBMM highlighted that the best way to communicate warnings depends on the target group:

"[T]he target audience for the effect or the message that you want to send will determine what type of communication means you would use." – Interviewee 13

For example, WhatsApp is used to communicate with ward councilors and community leaders, who then will send out someone to inform the people living in informal settlements in person, as they often lack access to phones or the internet. For commerce and industry companies, email followed by phone call was mentioned as the most effective communication strategy.

5.1.3 Challenges within EWS

One initial challenge identified in the interviews was the lack of shared definition of what makes an EWS. When asked about the EWS currently in place, some respondents referred to the FDI and weather warnings provided by the SAWS, which is the formal EWS in place right now.

"[T]he early warning system for fires is basically, it's managed, and the responsibility is with the South African weather services." - Interviewee 14

Other respondents, however, meant that no formal EWS is currently operational:

"We don't have, per se, a formal early warning system of processes in place. But we are supported by SA Weather Services." - Interviewee 11

"Currently, there are zero early warning systems in place because of budgetary constraints. We would like to have early warning systems. (...) So we're looking at the fire danger index, so we're using that as well, as an early warning system." - Interviewee 12

Some went further to state that there is no formal EWS and that weather forecasts and FDIs alone do not qualify as an EWS:

"That's a difficult question, what early warning systems? We get daily weather reports, warning as for high fire danger conditions (...) but that cannot really be regarded as a warning system." - Interviewee 10

"There's none in there. They don't work. (...) What's early warning systems? It is Nothing. For the Eastern Cape is nothing, OK? And that's the truth. We've got very good localised systems. Yeah, for local companies." - Interviewee 6

Limitations with the current system

Although the SAWS warnings and FDIs are currently the primary tool used, several limitations were raised during the interviews.

A commonly mentioned issue was that the spatial scale of SAWS warnings is too broad. Respondents noted that a warning may cover a large district, even though only a small area is at high risk:

"The problem that we have with that is the warning is too, is not granular enough. The area is too big" - Interviewee 5

SAWS confirmed this limitation and noted ongoing efforts to improve precision by introducing interactive FDI maps that would allow users to zoom into their specific location.

Other problems mentioned by the different actors interviewed, is the time aspect and the accuracy of the warnings. Sometimes these warnings might come too late to be able to act on or just not be accurate enough to rely on:

"So that's another thing that I realised with it and, most importantly, doesn't reach us in time, you know, so that we can do our preparation. And then sometimes it's not accurate. Sometimes we are not even going to get it completely." - Interviewee 4

Several actors noted that warnings are sometimes issued mid-day, despite referring to high fire danger conditions that are present throughout the whole day. This delay means that hazardous conditions may have already been for hours before actors are informed, limiting the time for preparation.

Another issue raised in the interviews was the occurrence of false alarms. One fire chief explained that they had on one occasion, informed the public about an incoming threat based on a warning, only for it to not happen. This, according to the interviewee, led to a loss of public trust, as people were less likely to believe or respond to future alerts. It is however mentioned by some interviewees that climate change may be a reason for the difficulty of providing accurate warnings, highlighting it as a growing challenge for future forecasting.

SAWS representatives acknowledged that the computer-based system used for issuing warnings can face technical issues or delays, particularly when system weaknesses occur, or weather shifts unexpectantly. There were also some other technical limitations of the FDI mentioned, particularly in terms of applicability. It was mentioned that:

"So, the problem with the South African FDI index, per the definition, it was designed as a low felt FDI. Our low felt area is on the East Coast in the low-lying areas. So that's where it was developed. So it's not really applicable for our whole country." - Interviewee 1

Though it was also said by the SAWS representative that several fire chiefs had stressed the need for a simple system, even if a more accurate index is developed, noting that overly technical models may not be practical for everyday use in the field.

Another challenge relates to the dissemination of warnings. SAWS noted that there is little follow-up after a warning is issued:

> *"So, what happens after I send it out, that's very much, I don't know that too well, unfortunately. I guess a bit of a weakness in the system, perhaps." - Interviewee 2*

This lack of two-way communication was described by others as a structural issue, leading to non-working warning chains and gaps in feedback.

> *"So, there's a lot of lack in dissemination of information throughout. Not just throughout the district, throughout our province and South Africa." - Interviewee 3*

Reaching the public

Warnings are primarily disseminated via WhatsApp, SMS, email or social media, but several respondents pointed out the challenges in reaching communities with limited cell coverage or internet access, particularly those living in informal settlements and landowners in rural areas.

> *"If this thing is going to be instant when it is a weather warning, everyone in South Africa that have got a cell phone must get that weather warning." - Interviewee 4*

While FPA members (e.g. farmers) are typically equipped with phones due to their operational needs, vulnerable populations might lack access to these platforms.

Challenges with language and understanding

Another issue raised was the language used in warnings. Some warnings issued to local actors are sometimes only in English which is not spoken or understood by all community members. For example, one representative stated that:

> *"And they must also make sure that these weather warning messages are also distributed in different languages to cater those people that they don't know English." - Interviewee 4*

In practice, local actors such as fire services and FPAs often translate warnings and share them in local languages to improve reach.

Beyond language, the understanding of the information in the warnings was also mentioned as a challenge. Some respondents doubted whether the public fully understands the content or even takes warnings seriously:

> *"I would say that most people in the public, they don't understand really what it is. I don't even think they really bother to listen at it. Some people might, some people won't." - Interviewee 2*

Others emphasised that awareness and education are some main components that needs to be included. That it is the actor's responsibility to get people to understand the warnings:

"But you know, disaster knows no boundaries then therefore we need to help those people that don't understand." - Interviewee 4

This point will be discussed further later in the section on preparedness measures.

5.2 Coordination and collaboration

In this chapter the results from the interviews about communication and coordination will be presented.

5.2.1 The importance of collaboration

Collaboration between actors came up as a key theme across interviews. Both fire chiefs and FPAs consistently emphasised that working together is essential for effective fire preparedness and response. Fire services and FPAs were multiple times described as aligned in their goals, facing similar challenges and therefore collaboration was found as both natural and necessary. As one fire chief stated:

"[W]e need the FPAs onboard (...). We have some regular, not formalised, engagements with them. So they are also critical when it comes to their members and to an extent they are fairly resourced when it comes to early warning signs." – Interviewee 11

The idea of the actors "fighting the same battles" was mentioned by several interviewees strengthening the idea of shared responsibility. This was also mentioned once again:

"In terms of stakeholders, we do have a lot of mechanisms where we do, we are making sure that we involve each and every one because disasters are not a one man or one department job." - Interviewee 4

In some cases, where formal communication from SAWS or district municipalities was delayed, interviewees noted that fire chiefs acted as an alternative channel, ensuring that information reached the public and FPA members.

Further, some interviewees noted that actors often operate across different roles. For example, some fire chiefs also act as FPOs, which enhances the coordination between communal fire services and FPAs.

Beyond formal institutions, collaboration extends to community members and landowners. As FPAs are member-driven, they rely heavily on the engagement of individuals whose livelihoods are directly threatened by fire. Farmers and landowners are described as actively involved in reporting fire risks and therefore playing a vital part of the early warning and response chain. This dynamic was also seen in some communal areas, where close working relationships exist between fire chiefs, community members and farmers. These relationships support good reporting and quick action during fire events.

Interviewees explained that collaboration and information sharing often take place through forums and advisory committees, where stakeholders such as FPAs, municipal fire services, DMCs and SAWS are present. These platforms are intended to facilitate coordination, planning and debriefing incidents.

However, perspectives on their effectiveness varied. One fire chief noted that meetings allow actors to reflect on what went well or poorly during past incidents. Still several participants expressed concern that not all relevant parties are consistently engaged. For example, SAWS representatives described their role as disconnected from operational response:

"We don't coordinate with them at all. Don't send them. Well, we just send them the stuff, and that's the end of the line, almost. Like I mentioned, very one-sided communication at this point in time." - Interviewee 2

This lack of coordination was, from SAWS perspective, also raised as a challenge during live fire events:

"But during the event of a fire breaks out, there's very little collaboration between us and the firefighters. So I think that again is where the challenge is." - Interviewee 1

These examples suggest that while formal channels exist, information is not always fully utilised, and opportunities for real-time collaboration may be missed.

5.2.2 The importance of trust between the actors

Trust between actors was seen as both a critical enabler and a potential barrier to effective collaboration. While some interviewees described high levels of trust, particularly between DMCs and SAWS, others mentioned concerns about limited resources or inconsistent engagement from certain actors. Interviewee 13, for example, expressed full trust in SAWS warnings:

"Yes, no, I think there's a high level of trust between the disaster management Centre and the South African weather services. We always react on the warnings. We never question the warnings" - Interviewee 13

However, not all shared this confidence. Some expressed doubt about the reliability of warnings but the trust is still there even though they might question the accuracy of their warnings at times.

"So, you continue to see that because each and every time when we get the early warning - it is not accurate. That's one I'm sure about it. They're not accurate at all (...)" – Interviewee 4

The disaster management specialist then continued to say:

"I still trust them [SAWS] because what we're, what I'm talking about, it does doesn't mean that it's completely inaccurate. At some point, it's going to be accurate." - Interviewee 4

Some FPA representatives raised concerns about the reliability and capacity of municipal systems:

"Municipal services, especially in our municipality, are very thin. They don't have enough resources. So we do have to rely on landowners themselves to respond to fires. We cannot really rely on the municipal systems." - Interviewee 10

This extended to disaster management structures as well, particularly at provincial and district levels:

"Our impression of the effectiveness of disaster management is perhaps not so good. I don't think we can totally rely on disaster management structures. Not only on a district level, perhaps more on a district level, but on a provincial level, there's lots of difficulty." - Interviewee 10

5.3 Involvement in the design

The answers regarding involvement in the design and operation of EWS varied among the different actors. Among the FPA representatives it was clear that they do not rely on the warning system issued by SAWS. As noted earlier (in Chapter 5.1.1), many FPAs instead utilise alternative technologies, including private forecasting services, satellite detection and camera-based fire monitoring systems. While they are active users of these tools, their involvement in the design or management of the systems is typically limited. However, it was mentioned that the FPAs sometimes might come with advice or recommendations on how these systems should be managed.

Another representative highlighted that while they determine how warnings are used within their local context, their influence beyond that is limited, particularly when it comes to collaboration with municipal entities.

"No, I don't think so. We have a say in what we do locally in our own fire protection association, but our relationship with municipal fire services are sometimes strained. We do not get good cooperation from some municipalities, some we do, so I don't think we have much impact." – Interviewee 10

Among fire chiefs, involvement with the EWS, particularly SAWS warnings, was more direct although their thoughts on the extent of their influence varied. Some emphasised that it is formally a district function which limits the control on local level:

"You see, the early warning, you see, currently, as it stands now, there's disaster management, is not a local authority function, it's a district function." – Interviewee 3

There were mixed views on whether fire services could influence the content of the warnings or only provide feedback on how the information is received and used. One interviewee noted:

"We can't change the actual information that they disseminate to us, but what we say is how to get the information, whether that information is coming too slow or (...)" – Interviewee 8

In contrast another interviewee said that fire services can provide input that leads to adjustments in the content of warnings:

"So if we have challenges and gaps in the information that is provided through this early warning system by SA Weather, we engage with them and so they align their information to what fits our needs." – Interviewee 11

Despite this, the perceived level of collaboration differs from how SAWS describes the interaction. Both SAWS representatives indicated that they receive very little feedback on the warnings they issue and described the process as very one-sided communication.

Perspectives from DMC representatives also varied. One representative emphasised that SAWS has legal authority over the issuing of warnings, and did not describe a strong operational role for the DMC:

"Not really, the South African weather services is by legislation responsible for all weather warnings. And they then issue those warnings, and they are the only authority that can actually issue warnings as such." – Interviewee 14

Another DMC representative stated that developing and integrating an EWS is a key responsibility of disaster management, as part of their municipal disaster risk plan:

"Yes, definitely. Definitely, we should have a say. As a Disaster Management Centre, we are responsible to draft a disaster management plan for the city. And part of the disaster management plan is to have an early warning system in place for the city." – Interviewee 13

5.4 Preparedness and response

In this chapter results about preparedness measures and the challenges with response will be presented.

5.4.1 Preparedness measures

As part of preparedness efforts, interviewees frequently referred to meetings and advisory forums, where they discuss how to act when an incident occurs. These meetings often serve to develop or strengthen protocols for various emergency scenarios, with the goal of ensuring that all relevant stakeholders know what to do when a fire breaks out. However, several respondents noted that these protocols are difficult to implement effectively if the warnings they rely on are inaccurate. As one disaster management specialist stated:

"So, you continue to see that because each and every time when we get the early warning - it is not accurate. That's one I'm sure about it. They're not accurate at all, and it then affecting our planning in terms of preparedness for such." – Interviewee 4

This highlights the interdependence between accurate forecasting and operational readiness, and that protocols alone are not sufficient if they cannot be activated at the right time.

The shift from reactive to proactive work

A recurring theme in the interviews was that disaster response in South Africa tends to be reactive rather than proactive. This was viewed by several respondents as a systematic issue, historically rooted in how emergencies are managed:

"Ha ha ha, I'm sorry I'm laughing and sorry to say that, but in in South Africa, generally, we don't. I'm sorry to say that, but that's a reality to say - we are not proactive. We like to be reactive" – Interviewee 4

Despite this, actors expressed a desire to shift toward proactive risk management, recognising its value in both economic and other terms:

"Better to spend 1 rand or €1 for disaster management planning than spending, say hundreds for response." – Interviewee 4

"So we want to be, we don't want to be reactive, we want to be proactive and try to save what we can save" – Interviewee 3

However, there are some challenges expressed about this. Some mention that they are doing proactive work, or at least trying to, but that it's hard to get funding to prepare for something that might not ever happen.

"We prepare for that one day, never mind the other 999. It is very difficult nowadays with funding, to get funding for something that is not realistic and tangible, for the politicians and the directors to understand." – Interviewee 12

Preparedness measures done today

In terms of what they do today within preparedness, other than protocols, some actors focus on strategically distributing available resources to enhance readiness. For example, FPAs reported placing firefighting equipment in high-risk areas to improve access and reduce response times. Similarly, some fire chiefs are reorganising their vehicle structures or planning to open new stations to improve geographical coverage.

Fire breaks were also frequently cited as a key preparedness strategy. These are done by burning vegetation in strategic areas, thereby slowing or containing the spread of potential fires. While they are not a solution to stop fires completely, fire breaks give firefighters a tactical advantage:

"[I]t's not necessarily that it will stop a fire, but it gives you a point of attack too." – Interviewee 5

Training and exercises were also mentioned as a component of preparedness. Respondents described various fire drills conducted in schools, malls and other public spaces, typically coordinated by fire chiefs. In some cases, these exercises are done jointly with other emergency services, to improve coordination in real incidents. These activities ensure that both personnel and communities are practiced and ready to respond effectively. However, some interviewees mentioned that due to budget and time restrains, they are not able to conduct these as often as they wish.

Many respondents emphasised the importance of educating the public on how to understand and act on early warnings. Awareness campaigns and educational initiative were cited as essential parts of preparedness:

"You need to constantly sensitise people about fires, the dangers of fires, but also about the importance of fires." – Interviewee 9

Examples include FPA awareness materials for farmers, covering topics such as firebreaks and cooking fire safety. Several fire chiefs and FPAs highlighted efforts to educate children, particularly in schools, noting that that audience is more receptive.

5.4.2 Challenges with response

According to the interviews limited resources and complex vegetation and vast geography are the main challenges when it comes to response.

Limited resources

Most interviewees agreed that limited resources are the main challenge for an effective response to severe veld and urban fires. In general, fire chiefs referred to funding, personnel, equipment, and infrastructure as the key areas where they face the greatest shortage.

Although fire services are formally the district's responsibility, fire services are mostly municipality driven. As a result, their capabilities very greatly over the country. Several fire chiefs stated that fire services are not prioritised in local budgets, leading to funding far from sufficient. One fire chief mentioned that firefighting equipment is extremely expensive and, therefore, they will always be short in supply. Three out of four interviewed fire chiefs believed that funding was the number one priority, while the fourth highlighted manpower. For example, one fire chief reported that his municipality only has one fire truck and five firefighters, who must be divided across three stations.

Besides from funding, poor maintained equipment was also mentioned as a limiting factor:

"If you go around the country, you'll find half the fire engines are probably under in a garage, being maintained or broken down, or they did have disaster management did go out. They bought a lot of fire trucks and fire tenders and that, but they're not really properly maintained" – Interviewee 1

Most interviewed participants from DMC, FPA and SAWS agree that the capabilities of fire services are not sufficient. For example, the representatives from DMC in NMBMM stated that the number of fire fighters nor the available equipment is nowhere what they need. One interviewee from FPA stated that:

"They [fire services] are not as geared up and as advanced as they should be." – Interviewee 5

One SAWS representative agreed:

"I don't think our firefighters in South Africa are sophisticated or up to date with technology as what they are in other parts of the world." – Interviewee 1

However, the FPA and DMC themselves also lack the resources they need to respond effectively. FPA representatives in SBDM stated that they are unable to service all their members, despite covering only around 40% land of the region's area. Additionally, equipment maintenance is also a major problem:

"[His municipality], 2 fire trucks, 1 bakkie. And all of them are broken at the moment, so they're not functional. No. So there's absolutely nothing working." – Interviewee 6

From the FPA's perspective, they cannot respond because they are not a firefighting organisation. Their main objective is to prevent fires. Firefighting is the fire services responsibility. One FPA representative stated:

"(...) we do have some equipment which we can make available to members, but we do not have resources to actively fight fires. That is the job of the municipal fire services. Actually, the district fire services, but in this country it's subcontracted or delegated to the local authorities." – Interviewee 10

Further, the same FPA participant then pointed out the limited reliability of local municipal services:

"Municipal services, especially in [his local municipality], are very thin. They don't have enough resources. So, we do have to rely on landowners themselves to respond to fires. We cannot really rely on the [local] municipal systems." – Interviewee 10

However, there were also differing views regarding the landowners' capability to respond to fires. While one representative from ECUFPA believed that FPA member landowners have sufficient resources to respond to fires, one FPA representative disagreed, stating that private landowners generally lack the capacity to manage severe fires.

Within the DMC in NMBMM, views regarding sufficient resources vary. One representative stated that the resources are adequate to a day-to-day basis, although there will always be room for improvement. The other representative said that their capacity is not adequate:

"[W]e do not have the capacity to fully fulfil our responsibility" – Interviewee 13

Further he elaborated that staff shortage, budget limitations, and inadequate equipment are common issues across governmental departments. A disaster management specialist in one of SBDM's largest local municipalities also noted that he is the only person working with disaster management, making him solely responsible for all equipment and personnel-related issues in the fire service.

Complex vegetation and vast geography

In addition to the resource gap: geography, vegetation and long distances are identified as other factors that limit their response capabilities. These included complex terrain, such as rocky mountain areas, cliffs, and dense plantations, which are difficult to reach and pose high fire risks. They also mentioned that long driving distances, up to one hour to reach remote areas, further complicate effective response in large municipalities.

5.5 Policy Framework and Acts

In the following chapter the results about policy framework and relevant acts will be presented.

5.5.1 Legislation challenges

When asked about their views on the policy framework, relevant acts and legislation, the interviewees provided highly diverse answers. For example, one representative from DMC believed that the role and responsibilities are clear, and that the legislation is appropriate:

"Yes, definitely. I think the legislation is appropriate and I think it's quite adequate. Yes, I think it's fine." – Interviewee 13

On the other hand, one interviewee from SAWS did not agree:

"The actual Act itself is very weak. It's, it's not... It can be tightened up; it can be improved upon" – Interviewee 1

Further, a representative from FPA shared the same critique and brought up implementation as a problem:

"No, no, no. So, no. I don't, this only thing about legislation, I think the legislation is a problem, but we rely too much on legislation. (...) Yes, we may need a bit more legislation. We need to clarify things, but it's no good to make more legislation if we don't first implement what we have and that and that's actually the big problem" – Interviewee 6

5.5.2 Poor implementation

One common answer among the interviewees was that implementation is a big issue. Several participants stressed that legislation must be accompanied by a budget and sufficient resources to make implementation possible. One representative also pointed out that things get promised in the acts - such as training to be a registered peace officer – but are rarely fulfilled in practice. Additionally, according to FPA, the DFFE is expected to assist and capacitate FPA and local municipalities, as stated by the acts. However, they felt that this support is not happening. Therefore, FPA representatives said they believe that most people think that, as well as local municipalities, they are toothless organisations with no enforcements.

One participant from the DMC said that, while the framework may be clear, it is not being implemented throughout the municipality, but rather only within the disaster management centre:

"(...) it's just not being implemented throughout the municipality as an institution, it's just the disaster management center that is trying to implement what the disaster management center needs to implement" – Interviewee 13

5.5.3 Confusion over jurisdiction and roles

The interviewees indicated that there might be some confusion about the fire services becoming more of a municipality driven function rather than a district function, as they are often referred to as municipal services. However, one FPA representative explained that it is actually a district function:

"That is the job of the municipal fire services. Actually, the district fire services, but in this country it's subcontracted or delegated to the local authorities. But it's actually a district responsibility." – Interviewee 10

One participant suggested that if there are acts on a national level, it should also be on a municipal level through bylaws. In addition, the fire chief also suggested restructuring the governance of fire services, as in most districts (except NMBMM), fire services are placed

under the Disaster Management Centre. The fire chief argued that this structure leads to a blockage of their funding. Similarly, the disaster management in SBDM mentioned that there is an ongoing argument that disaster management is in the wrong place. Therefore, it cannot command its powers because it is located underneath the department. He continues to argue that disaster integration and budget are central within every governmental sector:

"It needs to be reviewed and forcing every government sector to have a budget for disasters. There is not even monitoring whether all the government entities do integrate disaster in their own functional areas and so on, there's nothing like that." – Interviewee 4

5.5.4 Unclear responsibilities and legislative gaps

Continuing with roles and responsibilities in the acts, the SAWS representatives are clear on that the legislation does not clearly assign responsibilities for disaster response. In addition, one of the participants noted that the act does not even specify who is responsible for issuing burning permits:

"That issues it, so, even the ACT doesn't say who should be issuing the burning permit […] how do you hold somebody accountable if there's no act that says you are responsible for doing that permit" – Interviewee 1

SAWS also highlighted that the legislation around FPAs are not clear and should be better regulated:

"It is a lot of it that is left up to their own interpretation and their own, their own sort of its volunteers, basically, and you know that type of thing. So, I think it needs to be a little bit more regulated." – Interviewee 1

FPA representatives agree that the current legislation regarding responsibilities is impractical. For example, the National Veld Fire Act places much of the responsibility for firefighting on landowners. However, some of the landowners are unaware of this, leading to inaction. There are also large parts of the Eastern Cape where there are no land titles, meaning many residents do not feel responsible for managing the land:

"(…) that's a massive, massive area in the Eastern Cape where there's no title needs. So the people staying on the land can't do anything for it's not my land, so why do I look after it. And that's a massive problem, and we need to sort that and that's where it really station" – Interviewee 6

Finally, some participants mentioned that the acts are old and outdated. Currently, the fire service act from 1967 is reviewed. However, this may create conflict with the other acts, and one fire chief highlighted that all the acts should be upgraded and synchronised.

6 Discussion

In this chapter the key findings of the study will be interpreted and reflected upon in relation to the theoretical framework. The sources of error in the study will also be discussed.

6.1 The current Early Warning System and its challenges

Although South African Weather Service is the only formal authority for issuing early warnings for fires, the results from the interviews revealed that a variety of alternative methods of warnings are used. Based on the result, this is largely due to several identified factors: limited understanding among relevant stakeholders of what an early warning system entails, perceptions of SAWS forecasts as insufficiently accurate or timely, confusion over roles and responsibilities in issuing and disseminating warnings, and the absence of a unified communication system.

The interviews highlighted a lack of a clear unified definition of early warning systems in the fire industry. Despite this, official documents - such as those by Cooperative Governance & Traditional Affairs (2022) and Republic of South Africa (2003) – emphasise that contingency plans, including EWS, are crucial components in disaster preparedness and response. However, results from the interviews indicated a lack of contingency plans and aligns with the institutional challenges mentioned in Chapter 3.2.1. The Sendai Framework also highlights the importance of access to a multi-hazard early warning systems and disaster risk information (UN, 2015).

Given that fire services and FPAs are key stakeholders in ensuring disaster preparedness and response (Republic of South Africa, 1998), it is important that they do not only understand the concept about EWS but also adopts a unified definition that can be understood and implemented in practice. As stated in Chapter 2.2.6, Basher (2006) points out that a well-functioning EWS must integrate emergency services to ensure timely and effective response when warnings are issued.

Although SAWS are the only authority to formally issue early warnings (South African Weather Service, 2025), the interviews indicated uncertainty regarding the actual responsibility for both issuing and dissemination of EWS. This has led to use of other informal systems in practice. But as stated in Chapter 3.2.2, the DMC in Nelson Mandela Bay Municipality (2007) and Sarah Baartman District Municipality (2021) are mandated to technically monitor, issue, and disseminate warnings to the public. The centres must also ensure effective and clear communication methods, and that warnings reach everyone. The lack of clarity regarding both the definition and responsibilities within EWS appears to be in contrast with Sendai Framework's emphasise on muli-stakeholder coordination and clearly defined roles. Further, these unclarities might also hinder local actors' involvement in the design and development of EWS, as well as influence how the resources and funding should be prioritised.

Another reason for the use of additional EWS systems, according to the interviews, is that the formal warnings they receive from SAWS are not accurate or timely enough to rely on. The

warnings, often issued for broad regions, were described as too general to inform actionable decisions. Some interviewees expressed desires for more geographically targeted warnings, such as interactive maps, but also acknowledging that a more complex system would be inaccessible or too difficult for everyone to understand. As noted in Chapter 2.2.6, the importance of accuracy in warnings is well stated. However, more complex systems do also require greater knowledge and time for users to understand and act on (Gigerenzer & Gaissmaier, 2011), as mentioned in Chapter 2.2.5. In addition, the literature further emphasises the importance of including complexity in decision making. For example, people's perception of risk varies based on how information is presented, as well as the balance between perceived risks and benefits (Fishhoff, 2010; Slovic, 2016).

Some fire chiefs and FPA representatives also indicated limited understanding about the forecasting progress, expecting exact predictions of what, where, when, and how an event will unfold. However, as also mentioned by a few representatives, forecasting is not direct science. One DMC representative continued to mention that, even though he was critical to the accuracy of SAWS' warnings, he believed climate change may be making weather patterns more difficult to predict. This perspective aligns with findings from the study by Guido et al. (2021). The study observed that farmers in Zambia, Kenya, and Jamaica reported decreased trust in weather forecasts due to climate change, leading to reduced reliance on both traditional and formal forecasting methods. This reduction of trust also underlines the critical role of risk perception in decision-making.

Both DMC and fire services also expressed concerns regarding false alarms, which inaccurate warning may lead to. When an early warning is issued, response services are mobilised, staff and equipment are placed in expected affected areas, and evacuations may be ordered. However, it has been times where the warnings were not as severe as estimated, and interviewees explained that public trust in future warnings are compromised. As mentioned in the background chapter, the third element within EWS about communication trust is a fundamental component of the communication element within EWS (UNDRR, 2023). These findings also align with the study by Sättele et al., (2015): the probability of compliance, indicating how well the warnings are followed in practice, is highly dependent on the probability of false alarms due to a loss of trust, also known as the cry-wolf syndrome.

Another barrier that affects the trust between public and local actors, as well as between different local actors, is the lack of regulated and unified communication system for warnings. Based on the results of the interviews, many different methods were used - including WhatsApp, mails, phone calls, and SMS - all of which depend on mobile devices and network connectivity. Yet almost all the representatives acknowledge that cell reception in remote areas and farmlands is highly unreliable. In informal settlements, not everyone has even access to telephones. Additionally, South Africa has experienced electricity supply challenges since 2008, with loadshedding often leaving regions without power for several hours (Sarah Baartman District Municipality, 2021), further limiting the reliability of digital warning systems.

Only one interviewee mentioned radio communication, which do not require cell phones and does not rely on internet access, as the most reliable option. Only a few representatives mentioned that they send out people to physically inform people in informal, or similar, areas. These finding suggest that it may be difficult to reach out to the public, including farmers and people living in remote and poor areas, leading to exclusion. These findings align with similar studies conducted in Africa (Maripe et al., 2022; Kamati, 2024).

In addition, South Africa has 11 official languages, and therefore, language barriers were also mentioned in the interviews. Interviewees explained that the warnings sent out to the public usually only translates to the four most spoken languages: isiZulu, isiXhosa, Afrikaans and English. However, as mentioned in Chapter 3.1, these languages are only spoken by approximately 60% of the population (Republic of South Africa, 2022). A shared language or method of understanding is essential for building communication and trust, especially as part of the third pillar of EWS. Ensuring inclusive communication is also tied to global objectives, particularly Sustainable Development Goal 10: Reduced Inequalities (UN, 2015).

6.2 Coordination and collaboration

During the interviews, most respondents mentioned the importance of collaboration and trusting relationships among actors, recognising this as a key factor for effective preparedness and response. This aligns with literature highlighting the value of coordination in disaster risk management (Jahre et al., 2016; UNDRR, 2023).

However, the strength of these relationships varied. The collaboration between FPAs and fire chiefs was generally strong. Several interviewees noted that these two entities are “fighting the same battles”, and therefore naturally aligned in their objectives. This kind of alignment is consistent with the UNDRR’s (2006) framing of people-centred EWS, which work best when local actors are actively engaged and mutually supportive. In some cases, individuals even operated across both structures, such as fire chiefs who also serve as FPOs, further integrating governmental and non-governmental roles. Despite this, trust and reliability were not consistent across relationships. Some FPA representatives expressed concern that in certain municipalities, fire services are under-resourced and therefore less reliable during high-risk events.

In addition to fire services, several FPA representatives expressed dissatisfaction with the level of engagement from the DMC, stating that they sometimes feel that the DMC is not as involved or active in planning and preparedness activities. It is positive that they feel the need to be more involved, as both the DMA (2002) and the Sendai Framework (2015) emphasise the importance of clear institutional arrangements and collaboration across all levels. However, as mentioned in Chapter 3.2.1, there are still challenges such as limited coordination and a lack of standardised approaches across governmental structures (Cooperative Government & Traditional Affairs, 2022) which aligns with the results from this study.

Another recurring concern was the limited collaboration with SAWS. While they hold the legal authority to issue weather related warnings, some actors described the interaction with

SAWS as lacking feedback loops. A SAWS representative confirmed this issue, calling the communication from their side as very one sided. It is positive that this challenge is recognised, as it aligns with the literature that stress the importance of user engagement and two-way communication (UNDRR, 2023; WMO, 2017). Interestingly, while SAWS reported receiving little feedback, other actors claimed to be offering input or indicated that SAWS is not always present at their meetings. This suggests a broader communication gap.

Formal meetings and advisory forums were mentioned as mechanisms for enhancing collaboration. These platforms were described as providing a space for collective planning, debriefing and strengthening coordination between actors. This aligns with literature, which emphasises the importance of fostering inclusion and shared decision making (UNDRR, 2023). However, if these mechanisms are not fully utilised as indicated by SAWS, their potential to strengthen coordination is undermined and valuable opportunities for support and improvement might be missed.

In addition, as noted by the Department of Environmental Affairs (n.d), challenges within collaboration and coordination across governmental levels are usually also a result of insufficient capacity and funding. The results from this study indicate that limited response capabilities, due to insufficient funding and resources, reduces the trust from other actors and therefore hinders an ideal collaboration.

6.3 Involvement in the design

As seen in the results section, the level of involvement in the design and development of EWS varied among actors. However, it became clear from the interviews that overall involvement is generally low and, in some cases, not as much as the actors might wish or expect. Most actors reported that they use the EWS in place but are not actively involved in the system design. The importance of involving a broad range of stakeholders in the development and implementation of EWS is well established in the literature. Coppola (2015) highlights that including various actors in the development and implementation of the EWS ensures that warnings are actionable and relevant to the specific users.

A key challenge revealed in the interviews is the confusion or lack of consensus on what an EWS actually entails. Some actors saw it solely as SAWS responsibility or were unsure of their own role in the system. This might hinder the participation in the development of the EWS as actors may not engage in processes which they do not realise they are meant to be part of. While the Policy Framework was established in part to clarify roles and responsibilities across spheres of government, several interviewees suggested that these responsibilities may be outlined in legislation but not effectively communicated to or understood by those expected to fulfil them.

The SAWS representatives noted the lack of user feedback as a barrier to improving the system and expressed interest in more engagement from stakeholders. This recognition aligns with recommendations from UNISDR (2006) and WMO (2017), which stress that regional institutions and organisations can provide specialised knowledge and advisory support contributing to the technical development and enhancement of EWS.

FPAs reported that they do not rely on the formal EWS from SAWS, but instead use alternative systems more tailored to their specific needs. While this suggest they are not involved in the design of the official system, they do play a role in selecting, using and enhancing the systems they rely on, for example by giving feedback directly to their service providers. However, these systems are limited to their members and not integrated into a broader public warning system.

6.4 Preparedness and response

In this chapter the results about preparedness measures and response capabilities will be discussed.

6.4.1 Preparedness measures

Preparedness was mentioned by all interviewees as a central part of their fire risk management strategies. The respondents described several preparedness measures currently in use, including firebreaks, strategic distribution of firefighting equipment and the implementation of drills and training exercises. As described by the interviewees these activities aim to ensure that actors are ready to respond immediately when a fire warning is issued.

These findings align with what is said in the South Africa Disaster Management Act (DMA, 2002), which mandates that preparedness planning should be developed, regularly updated and communicated across government spheres and communities. These findings also align with other literature where the importance of preparedness, well-developed plans and exercises are mentioned (Coppola, 2020; Forsyth et al., 2010).

Meetings and advisory forums were also frequently mentioned in the interviews, that serve not only as communication platforms but also as tools to enhance preparedness. This supports the shared development of protocols and allow local actors to refine planning and response strategies in a collaborative setting. This also reflects best practice as outlined in the Sendai Framework, which recommends that disaster preparedness plans should be co-produced between stakeholders, clearly communicated and routinely revised (2015).

However, interviewees also noted that the effectiveness of preparedness is strongly influenced by the accuracy of early warnings. When warnings are delayed, too general or falsely given, it can hinder timely decision making and may also affect the trust among both responders and the public. This aligns with the findings from UNISDR (2006) and WMO (2018) which state that the best practice EWS must both provide accurate and specific information, while also maintaining good coordination between all elements (the four pillars) to enhance disaster preparedness and response. This shows that not only do one need to be prepared, but there are also more factors in the chain that lead to effective response.

In parallel to operational preparedness, interviewees frequently described education and public awareness campaigns as a vital tool for disaster preparedness. Many fire services and FPAs reported working proactively with communities to ensure that people understand both the risks and how to act during an event. In line with the literature (León et al., 2007; WMO,

2017; UNISDR, 2006) being proactive is very important and involves community preparedness. Community preparedness requires involvement from multiple actors, both governmental and NGOs, to be able to ensure inclusive approaches to disaster risk reduction.

Despite the positive work with education and public awareness campaigns, several interviewees emphasised that moving from a reactive to a proactive approach remains a challenge. One fire chief cited political and financial barriers, explaining that decision makers sometimes struggle to justify investment in disaster prevention. This is consistent with international findings since preparedness is frequently underfunded, despite its cost effectiveness (UNDRR, n.d). As one interviewee stated - it is better to spend one euro in preparedness than hundreds in response, which aligns with literature. U.S. Chamber of Commerce Foundation (2025) and Frennesson et al. (2021) stresses that investments in preparedness can save a lot in response damage and recovery costs. As mentioned by the Department of Environmental Affairs (n.d), it is an ongoing work in South Africa to continuing the shift from reactive response to more proactive work, and EWS are playing a crucial role in this transition.

6.4.2 Challenges with response

It became clear during the interviews that unequal resources and unclear protocols reduces the effectiveness in response and can be a big challenge. As seen in the fourth pillar of EWS, protocols and response plans must be clear for people to be able to act on early warnings (UNDRR, 2023). And as stated by UNISDR, (2006) and Maripe et.al. (2022), a well-functioning EWS must be supported by strong response capabilities to ensure that communities can act effectively when warnings are issued.

One big problem that, according to the interviews, creates issues with the response capabilities is the lack of funding. Budget restrains limits their access to good equipment and personnel, which also aligns with challenges across the world (UNDRR, n.d). It was also made clear during the interviews that access to resources for fire services varied greatly across the region since fire services is municipality (local) driven but, formally, it is a provincial responsibility.

In the interviews poor maintenance of equipment was mentioned as an additional challenge to funding. The result is that fire service equipment is not regularly maintained, and that in some areas there are no working equipment available. However, maintenance is difficult if there is not sufficient equipment and budget, suggesting that these are highly connected.

Another challenge when it comes to response capabilities mentioned during the interviews was the complex vegetation and vast geography in the areas, making it hard for response agencies to reach everyone at risk. This is something that aligns with literature as a worldwide problem and it’s stated that response capabilities are highly location-specific and influenced by the community’s geography (Haque et al., 2023).

6.5 Policy frameworks and acts

South Africa's policy framework for disaster risk reduction has been recognised as one of the best in the world, even serving as a model for other countries (Environmental Affairs, 2016). However, a well-designed framework is only effective if it can be properly implemented. According to multiple interviewees, the primary challenge lies not in the content of the framework or associated legislation, but in its implementation. Although the Policy Framework was published to improve the implementation of the DMA by clarifying roles and responsibilities (IFRC, 2022), the key barriers identified in the interviews for implementation include unclear roles and responsibilities across government levels. Other factors include insufficient funding, weak institutional structures and outdated legislation.

Several interviewees noted that disaster management roles and responsibilities at the district and municipal levels remain unclear. This confusion contradicts the Act's original intent to empower local authorities and inhibit locally driven preparedness planning. One DMC representative suggested that national legislation should be complemented by municipal-level bylaws to mandate disaster preparedness integration at all levels of governance.

As discussed in Chapter 6.4.1, funding is a big challenge in many parts of the world, leading to insufficient resources and response capabilities. In the South African context, the organisational structure of disaster management appears to play a significant role in reinforcing this problem. Currently within SBDM, fire services are located beneath the disaster management centre and therefore, based on the interviews, limits their access to dedicated funding. This structural arrangement creates a bottleneck, preventing fire services from fully executing their responsibilities. In NMBMM on the other hand, DMC and fire service work besides each other. While this setup may appear more conducive to effective coordination and funding distribution, the limited number of interviews conducted in NMBMM means this report cannot conclusively assess its effectiveness.

Further, the National Veld and Forest Fire Act acknowledges the importance of FPAs in wildfire management. However, the interviews reveal that FPAs are insufficiently integrated into formal strategies, despite their extensive on-the-ground knowledge and systems, making them feel like a toothless organisation. Therefore, their motivation and ability to take part in disaster preparedness, as well as the design and development of EWS, may be compromised.

Finally, concerns were raised about the outdated nature of some legislative acts, which were described as misaligned with current challenges and contributing to conflicts of interest in practice. For example, outdated definitions within the National Veld and Forest Fire Act do not reflect the increasing role of climate change in wildfire patterns, nor do they clearly define the responsibilities of modern stakeholders such as private landowners or local FPAs operating under evolving risk conditions.

6.6 Limitations related to chosen data collection method and study sample

A key source of error in this study is the limited number of interviews conducted, which included participants from four different types of actors. The variation in responses suggests that perspectives may differ significantly across roles and regions.

Most interviews were conducted in SBDM and NMBMM, with the exception of ECUFPA that work across a larger geographical area. While these areas were the focus of the study, the findings cannot be generalised to the entire province. A larger number of interviews across a larger geographical range would likely have provided more comprehensive insight, but this was not feasible due to time and resource constraints. For example, it would have been valuable to hear landowners' perspective, since they are often mentioned by the FPA as an important actor in the response to fires.

Some interview biases are also relevant to this study. For example, some interviewees may adjust their answers based on what the researchers want to hear or based on their own experiences and frustrations, meaning that the results from the interviews may be highly personalised.

Even though English was spoken and understood by everyone, it is not the researchers or the interviewees first language. This could have led to that some nuances may have been lost or misinterpreted.

6.7 Future research

During the interviews, it was mentioned that various communication methods are used to share fire alerts, but there was no clear consensus on which is most effective. Future research could explore which communication methods are considered the most reliable and accessible by both the public and local actors. Such a study could help optimize EWS for fires for greater effectiveness.

Local actors reported limited trust not only among themselves, but also between the actors and general public. However, since the general public was not interviewed in this study, further research is recommended to investigate public trust in local actors more thoroughly and to substantiate these perceptions of mistrust.

Inadequate organisational structures within the policy framework were highlighted by several interviewees. In particular, concerns were raised regarding whether fire services should be located under the Disaster Management Centre. Future research is needed to examine the potential structural benefits and challenges of DMC and fire services operating in parallel.

One point mentioned during the interviews was that the EWS for fires might be more effective in other provinces compared to the Eastern Cape. A comparative study could examine how EWS for fires work in different provinces of South Africa. By comparing the Eastern Cape with other regions, the research could identify best practices, common challenges and regional differences that influence the effectiveness of EWS for fires.

7 Conclusions

This chapter summarises the main findings of the study and presents them in relation to the research questions.

Local actors' role in the design of EWS for fires in Eastern Cape, South Africa
Local actors such as fire services, Fire Protection Associations, Disaster Management Centres and the South African Weather Service, are central to preparedness and response but have limited involvement in the design of formal early warning systems. A key issue identified is the lack of clarity regarding roles and responsibilities across both the preparedness and response phase within the Early Warning System (EWS) framework. Moreover, there is no unified understanding among stakeholders of what actually constitutes an early warning system. Although collaboration exists between actors, it is often informal and inconsistent, which limits the actor's ability to develop, implement, and improve EWS. In addition, insufficient resources - including inadequate funding, outdated or non-functional equipment, and a shortage of personnel - further hinder local actors' possibility to implement and act on early warnings.

To improve the effectiveness of EWS, there is a need for clearer definitions of roles in both policy and practice, greater inclusion of local actors in the design and development of warning systems, better establishment of structured communication and feedback mechanisms, and improved funding. These measures will help ensure that warnings are contextually relevant, actionable, and trusted by all stakeholders involved.

Information and preparation needs
The findings of this study highlight several key factors regarding Early Warning Systems and local preparedness in the Eastern Cape. Response actors emphasised the need for timely, geographically specific warnings that reach the whole public, including short and easily understandable descriptions of the risks and consequences of an event. Many actors noted that the warnings they currently receive are often too general or inaccurate, and stressed the need for improved accuracy to build trust both between actors and with the public, which is essential for effective response.

Furthermore, the study findings show a strong desire to continue the shift toward a more proactive approach. Key preparedness measures such as firebreaks, regular drills, coordination meetings, public awareness campaigns and ensuring sufficient resources were identified as crucial. However, structural barriers in legislation and funding were recognised as significant challenges that continue to hinder the full transition towards proactive preparedness.

To strengthen local response capabilities, the findings underline the importance of improving educational initiatives, fostering more inclusive collaboration and communication, and strengthening proactive disaster management planning.

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9 Appendices

The appendix includes additional information, including interview guides and consent form, that is informative but not essential in the report.

Appendix A – Interview guides

This appendix includes the two different interview guides that were used during the interviews conducted for the study. The two different guides were used for Fire Chiefs and for DMC and other government and authority figures

Interview guide for Fire Chiefs / Rescue Services:

Role and Involvement - Please introduce yourself and what you do

- How long have you worked for this fire service/brigade, and what is your role?
- How are the fire services structured in your municipality/region?
- What is the brigade's involvement with the disaster risk management center?
- Do you respond to both urban and veld fires?
- How do challenges differ between urban and rural areas in Eastern Cape in terms of fire response and EWS?

EWS – Can you briefly describe the EWS for fires in Eastern Cape/ your municipality and how they work?

- Can you briefly describe the EWS for fires in the Eastern Cape?
- Is there an existing EWS for fires in your region? How long has it been here?
    - What are the key components of the current EWS for fires in this region, and how well do they function?
- Can you describe your role in the design, operation, and management of early warning systems for fires?

Critical Information Needs – Can you describe how EWs are communicated to relevant stakeholders and what information is needed to respond effectively?

- How are early warnings for fires communicated to relevant stakeholders, such as fire brigades or community leaders?
    - Any challenges in ensuring timely and accurate communication of warnings?
- What information do you need in an EW to act on it?
    - Any specific details needed for it to be useful to your team? (e.g., location, intensity, expected impact, response recommendations)
    - Do you need real-time updates during an evolving disaster, or is a single early warning sufficient?
- What communication methods work best for receiving early warnings?
- Are there challenges in accessing or understanding the warnings? How can the format or language be improved?
    - Are there situations where you received a warning but were unable to act effectively due to a lack of information?

- Can you explain the chain from the ones that issue a EW till it reaches the public?
- What is your role in this?

Coordination and Collaboration – Can you describe how the communication and collaboration works within EWS with other response agencies, both horizontally and vertically, as well as neighbouring municipalities?

- How does your team coordinate with other agencies when a veld or urban fire warning is issued, both horizontally and vertically (e.g., other emergency services, DMC and different government levels etc.)
- How does the communication chain work, both horizontally and vertically?
- Do you feel that all the actors in the chain trust you? Do you trust them?
- Does your fire service assist neighbouring municipalities that do not have their own fire services?
    - Are there formal agreements in place for this type of assistance? And how are requests for assistance communicated?
    - Any challenges with this? (personnel shortages/ equipment limitations) What could make it easier?
    - How do you balance responding to veld fires in your own municipality while helping neighbouring areas?
- How do you collaborate with other stakeholders (e.g., fire brigades, municipalities, or meteorological agencies) to maintain and improve the EWS?
- What is your role in this?

Preparedness and response capability – Can you elaborate on your disaster preparedness; what preparedness measure do you have in place and how well you can respond to severe urban and veld fires?

- What preparedness measures are in place to ensure that fire services can act quickly when a fire warning is issued?
    - Any more needed?
- What actions are triggered when warnings are received?
- Are there sufficient resources (personnel, equipment, funding) to enable a quick response to a predicted large-scale fire when you receive early warnings?
    - What are your main obstacles that limit your response capabilities?
- How does the availability of water, road infrastructure, or staffing shortages impact your response times?
- Are there specific exercises or simulations conducted to improve response preparedness?
- Are EWS included in the fire risk-related drills and training exercises? How often are these conducted?
- What is your role in this?

Policy framework – How do you view the support from the policy framework and relevant acts, and do you think the legislation is appropriate?

- Relevant acts such as The Fire Brigade Service Act, 1987 (Act no. 99 of 1987) and The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)
- How well do you think current legislation and policies support the development of effective EWS?
- Are there clear guidelines and protocols for fire services within the national disaster management framework?
- Are there national or international standards that you follow when managing fire risks?
- What legislative changes could strengthen preparedness and response capacity?

Lastly:

- What do you think are the most pressing needs for adequate EW in at-risk communities?
- Who are the groups most excluded from EW and systems?

Interview guide for DMC / other government and authority figures:

Role and involvement – please introduce yourself and what you do

- Please introduce yourself and what you do
- How long have you worked here and what is your role?

Early warning systems - Can you briefly describe the EWS for fires in Eastern Cape/your municipality and how they work?

- Can you briefly describe the EWS for fires in the Eastern Cape?
- Are there any existing EWS for fires in your region? How long has it been here?
- Can you describe your role in the design, operation, and management of early warning systems for fires?
    - What are the key components of the current EWS for veld fires in this region, and how well do they function?
    - Are there any challenges you face in maintaining or improving the early warning system?

Critical information needs - Can you describe how EWs are communicated to relevant stakeholders and what information is needed to respond effectively?

- What information do you need in an EW to (enable agencies to) act on it?
    - Any specific details needed for it to be useful to your team? (e.g., location, intensity, expected impact, response recommendations)
    - Do you need/provide real-time updates during an evolving disaster, or is a single early warning sufficient?
- What communication methods work best for receiving/sending early warnings?
- Are there challenges in accessing or understanding the warnings? How can the format or language be improved? What works well?

    - Are there situations where you received a warning but were unable to act effectively due to a lack of information?
- What is your role in this?

Communication and coordination - Can you describe how communication and collaboration works within EWS with other (response) agencies, both horizontally and vertically?

- … Such as government, local authorities, weather services, DMC, fire services, public?
- How are veld and urban fire warnings generated and communicated to relevant stakeholders, such as fire brigades or community leaders?
    - Are there any challenges in ensuring timely and accurate communication of warnings?
- How does your team coordinate with fire brigades and other agencies when a fire warning is issued?
    - What works well?
- What is your role in this?

Preparedness and response capabilities - Can you elaborate on your disaster preparedness; what preparedness measure do you have in place and how well you can respond to severe urban and veld fires?

- What protocols are in place to manage responses to high-risk fire events?
- How do you ensure that local actors and communities are prepared to respond to both urban and veld fire incidents?
- Are there specific exercises or simulations conducted to improve response preparedness?
- Do you feel that the current capacity and resources of stakeholders (e.g., fire brigades, FPA, municipal authorities) are sufficient to respond to fire warnings?
- What are the main resource gaps or limitations that hinder effective disaster management for veld and urban fires?
    - What works well?
- Is there a formal system to evaluate the effectiveness of the EWS and response efforts after fire events?
- What is your role when it comes to preparedness and response?

Policy framework – How do you view the support from the policy framework and relevant acts, and do you think the legislation is appropriate?

- Relevant acts such as The Fire Brigade Service Act, 1987 (Act no. 99 of 1987) and The National Veld and Forest Fire Act, 1998 (Act No. 101 of 1998)
- How well do you think current legislation and policies support the development of effective EWS?
- Are there clear guidelines and protocols for fire and rescue services within the national disaster management framework?

- Are there national or international standards that you follow when managing fire risks?
- What legislative changes could strengthen preparedness and response capacity?

Lastly:

- What do you think are the most pressing needs for adequate EW in at-risk communities?
- Who are the groups most excluded from EW and systems?

Appendix B – Consent form

Before the interviews were conducted all interviewees had to sign a consent form. Below the form is presented.

FORM OF CONSENT

By signing this form, I confirm that I understand the following:

- I can withdraw from the interview at any time or decline to answer any question without any consequences.
- I will not receive any payment for my participation.
- To ensure confidentiality, identifying details will be stored separately from the interview transcripts.
- I may request access to my interview recording or transcript at any time.
- Only the primary researchers, their supervisor, and academic colleagues with whom they may collaborate will have access to interview transcripts.
- Extracts from this interview may be quoted in the planned thesis and potential future publications.
- I can contact the research team at any time for clarification or further information.
- I consent to take part in the research project.

Recording Consent (please tick one):

❑ I consent to my interview being recorded

❑ I do **not** consent to my interview being recorded

Quotation Preferences (please tick one):

❑ I consent to being identified in any quotations

❑ I prefer to remain anonymous in any quotations

Follow-Up Contact (please tick one):

❑ I am open to being contacted for follow-up questions. My contact information is: **(telephone/email):**

_____

❑ I do not wish to be contacted again.

Participant's name (texted): _____

Signature: _____

Date: _____