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Wildfire Management in South Africa: An Assessment Using Integrated Fire Management

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Abstract

This assessment of South African wildland fire management is part of a broader effort from the International Programs Office of the U.S. Department of Agriculture, Forest Service, to assess the wildland fire situation across Africa. The assessment was guided by an Integrated Fire Management approach, which incorporates a holistic understanding of fire on the landscape and the many trade-offs of management actions. This assessment is based on a survey administered from June—July 2023 and captures the diverse perspectives of 108 survey respondents. Findings from this assessment reveal the following: (1) a perception that wildland fires have damaging unwanted effects in their communities; (2) arson is identified as the leading cause of human-originated wildfires; (3) respondents have mixed perspectives on having enough personnel to deal with wildland fires depending on province; (4) most respondents perceive that the incident command system is used in their community; and (5) perceptions toward restoration guidelines for ecosystems affected by wildland fires are mixed, and regional data suggest potential disparities in recovery efforts.

Keywords: South Africa, Integrated Fire Management, wildfire, bushfire, firefighters

Cover: Firefighter looks over a wildfire in the Cape Winelands District on the Moedverloreberg, Drie Kuilen Nature Reserve. Courtesy photo by Charl Steenkamp, NCC Group.

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¹ Has since been renamed International Programs and Trade

Executive Summary

The general purpose of this assessment is to examine the state of contemporary perceptions of wildland fire managers in South Africa. Our investigation proceeds not through an evaluation of current policies and practices. Instead, we provide the reader access to the perspectives of South African wildland fire managers working in the field. Our goal is to provide South African wildfire managers and the U.S. Department of Agriculture, Forest Service, (and anyone else), with a comprehensive depiction of wildland fire management using the framework of Integrated Fire Management. Learning about the perspectives of fire managers doing the work of wildland fire management opens meaningful lines of research and practice that may not otherwise be apparent without a grounded assessment of programmatic gaps and needs. The assessment was administered virtually from June–July 2023 and includes 108 survey respondents. Results are based on the five Rs of Integrated Fire Management (review, risk reduction, readiness, response, and recovery) for development, administration, analysis, and production of assessment results. Findings from this assessment reveal the following: (1) a perception that wildland fires have damaging unwanted effects in their communities; (2) arson is identified as the leading cause of human-originated wildfires; (3) respondents have mixed perspectives on having enough personnel to deal with wildland fires depending on province; (4) most respondents perceive that the incident command system is used in their community; and (5) perceptions toward restoration guidelines for ecosystems affected by wildland fires are mixed, and regional data suggest potential disparities in recovery efforts. The authors suggest follow-up studies using qualitative data collection to capture greater context and the meanings behind assessment responses, as well as to gain access to provinces with lower response rates.

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Introduction

Purpose of This Study

The purpose of this study is to provide an assessment of wildland fire management in South Africa, specifically within the management framework of Integrated Fire Management (IFM). We proceed with this assessment not through an evaluation of current policies or theoretical frameworks, but instead by providing the reader access to the perspectives of wildland fire managers working in South Africa. Our goal is to provide readers with a comprehensive assessment of wildland fire management in South Africa. Learning about the perspectives of wildland fire managers engaged in fire management opens meaningful lines of research and practice that may not otherwise be apparent without a grounded assessment of programmatic gaps and needs (Flores et al. 2024). This analysis also holds the possibility of adding to underrepresented academic research on wildland fire in Africa despite the African continent being one of the most widely burned regions in the world (Lin et al. 2024).

Background

Wildland fire related programming is in high demand throughout the world, and Africa is no exception. Africa has the highest portion of fire-prone ecosystems in the world, and climate change is creating warmer, drier conditions (Jones et al. 2022). When measured by satellite, the annual burned area in Africa accounts for approximately 67 percent of the global total; impacts are more difficult to measure but run the gamut, both positive and negative (Jolly et al. 2015). At the same time, while the African continent accounts for most of the global burned area (along with Siberia), most wildland fire studies are being conducted in countries with higher levels of development, with the western United States accounting for the majority of wildland fire research publications (Lin et al. 2024). In South Africa, people have used fire to manipulate the landscape for thousands of years and ecosystems have coevolved with fire, resulting in highly resilient fire-adapted landscapes (Rego et al. 2021). At the same time, fire suppression policies, urban development, and changes in extreme weather-related events have increased the complexity of fire management and the role of people living with fire (Dombeck et al. 2004). In South Africa, this is the case across both veld regions (open, uncultivated country or grassland), as well as in the growing wildland urban interface (van Wilgen et al. 2014).

To fully consider the ecological, social, cultural, and economic context in which wildfires occur, we utilize IFM. IFM is a framework that acknowledges increased wildfire complexity by integrating ecology, society, and fire management technologies to address wildland fire beginning with community-based fire management as the initial level of integration (Moore 2019; Rego et al. 2021). Community based fire management is the initial building block for establishing a resilient IFM framework through districts, states/provinces, and national levels across developing and developed countries for effectively living with wildland fire (Moore 2019). Integrated Fire Management recognizes that fire is a natural and necessary ecological process in many ecosystems, playing a crucial role in maintaining biodiversity, nutrient cycling, and overall ecosystem health (Wollstein et al. 2022). However, it also acknowledges that

fire can pose risks to human life, property, and livelihoods (Lambrechts et al. 2023). IFM emphasizes the integration of various strategies and tools to effectively manage fire in a way that minimizes negative impacts while promoting positive impacts, such as ecological health and community safety. This includes acknowledging fire's positive and negative impacts from ecological, economic, and socio-cultural perspectives and the trade-offs that inevitably result from decisions and actions. Moore (2019) defines the tool for systematically developing an IFM framework as the five Rs of IFM:

- Review: Analysis of the fire issue and identification of options for positive change;
- Risk Reduction: Prevention and focusing resources on the underlying causes of fires;
- Readiness: Preparing to fight fires;
- Response: Ensuring appropriate responses to unwanted damaging fires; and
- Recovery: Community welfare, repairing infrastructure, and restoration of fire-damaged landscapes, rest, recovery, and maintenance repair.

The five Rs of IFM begin from the perspective that fire is a catalyst for promoting biological diversity and healthy ecosystems. To improve wildland fire outcomes requires a risk mitigation management approach that moves away from a reactive model of fire suppression and toward a proactive process that accommodates the complex social and ecological context of wildfire (Wollstein et al. 2022). Rather than focusing on full suppression of wildfire for the purpose of minimizing area burned, IFM uses the tools of fire suppression and fire itself to further vegetation and land management goals (table 13.1 in Castro Rego et al. 2021).



Prescribed burn on the Fizantakraal farm on Du Toits Kloof Mountain. Courtesy photo by Charl Steenkamp, NCC Group.

IFM includes and goes well beyond fire suppression to maximize the net benefits of fire and further the strategic goals of fire management for sustainable landscape management.

The following is an assessment of perspectives of South African wildland fire managers on current practices and needs through the lens of IFM across the nine South African provinces Eastern Cape, Free State, Gauteng, KwaZulu-Natal, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape, with the highest participation coming from the province of Western Cape. The assessment is the beginning of a broader effort from the U.S. Department of Agriculture, Forest Service, International Programs to identify potential opportunities to support South African wildland fire managers in strengthening IFM capacity across the nine South African provinces.

After reporting on the methodology used for this assessment, we present the perspectives of South African wildland fire managers within the framework of the five Rs of IFM. We then summarize mixed perceptions, provide management implications, and opportunities for further research.

Methodology

The five Rs of IFM served as the management framework to develop the assessment administered to South African wildland fire managers. Administration of this assessment consisted of snowball sampling beginning with South African fire managers working directly with U.S. Forest Service International Programs. Online surveys were administered from June–July 2023 resulting in 108 total survey respondents. In the following sections, we outline the data collection process by discussing assessment design and structure, demographic information, approach to data processing, and analysis strategy.

Assessment Design and Structure

The data for this assessment were collected online and focused on various aspects of wildland fire management in South Africa. The primary aim of the assessment was to explore respondents' perceptions, experiences, and knowledge concerning wildland fire incidents, response strategies, recovery efforts, and readiness measures. Additionally, we collected demographic data to contextualize responses across different societal and occupational groups. Please note that the data are not open to the public due to confidentiality of personal data. Please contact the U.S. Forest Service International Programs and the authors of this report for additional information on data collection.

The assessment included a mix of open-ended and multiple-choice questions to facilitate both statistical analysis and qualitative insights. Open-ended questions allowed for respondents to provide additional context on certain topics, while multiple-choice questions provided structured, comparable data. This approach enabled us to capture a comprehensive view of respondents' experiences and perceptions related to IFM.

Below is a detailed breakdown of the key areas covered using the five Rs of IFM.

Review: Analysis of the fire issue and identification of options for positive change—

This section of the assessment focused on understanding the broader impacts of wildland fires and analyzing specific aspects of fire management strategies in South Africa. Questions in this section aimed to capture respondents' insights on:

- The negative impacts of wildland fires: Respondents were asked to identify the three most unwanted effects of wildfires, with response options ranging from loss of life to destruction of biodiversity and economic assets.
- Positive outcomes: The assessment inquired about the three most desirable effects of prescribed burns or fire management strategies, with response options focused on ecological benefits such as species diversity and land regeneration.
- Success factors and areas for improvement: Respondents provided their views on the most successful aspects of fire management in South Africa and identified areas that need improvement. This included both managerial practices and ecological outcomes.
- Knowledge sharing: The assessment asked for aspects of fire management in South Africa that could be shared with other African nations, encouraging a potential comparative analysis of management practices across regions.

Risk Reduction: Prevention and focusing resources on the underlying causes of fires—

The risk reduction category of the assessment explored respondents' perspectives on the causes and prevention of wildfires. This section aimed to identify:

- Causes of wildfires: Respondents were asked to specify the top two causes of human-originated wildfires, with options such as arson, agricultural burns, or negligent use of fire.
- Preventive measures: Open-ended questions inquired about measures that can mitigate the risk of wildfires. Respondents shared their thoughts on firebreaks, community awareness programs, and policy measures designed to reduce fire risks.
- Intentional fires: The assessment sought respondents' opinions on the potential motivations behind intentional fires (ignitors), exploring underlying reasons such as land clearing, cultural practices, or malicious intent.

Readiness: Preparing to fight fires—

This section evaluated the level of preparedness within communities and organizations to respond to wildland fires. Respondents provided information on:

- Training programs: The assessment inquired about the existence and efficacy of national training programs or certification processes for fire management

personnel. Respondents shared their experiences or knowledge about the availability and quality of such programs.

- **Sufficiency of personnel:** Questions were aimed at assessing whether there were enough trained professionals to handle wildland fires in the respondents' communities. This section provided insight into the operational readiness of local fire management agencies.
- **Perceptions of brigade readiness** were assessed through rating-scale questions and optional text responses, offering insight into whether fire suppression teams were seen as adequately trained and equipped across regions.

Response: Ensuring appropriate responses to unwanted damaging fires—

The response section delved into the operational capacity of communities and organizations when dealing with fire incidents. This section captured information on:

- **Incident Command Systems (ICS):** Respondents were asked about the utilization of formal ICS during fire incidents in their communities. The ICS is a standardized, on-scene, all-hazards incident management approach, and its presence was an indicator of organized fire management.
- **Equipment and resources:** The assessment sought to capture the types of firefighting equipment and resources available in the community, such as fire trucks, water tenders, helicopters, or personal protective equipment. Respondents indicated whether such resources were government provided or locally sourced.
- **Operational challenges:** Respondents also identified gaps in equipment, personnel protection, and tactical resources that may hinder the effectiveness of fire response operations in their areas.

Recovery: Community welfare, repairing infrastructure, and restoration of fire-damaged landscapes—

This category focused on the strategies and support systems available for community and ecosystem recovery after wildland fire events. Key subsections included:

- **Community support programs:** Respondents were asked whether there were formal programs in place to assist communities in recovering from the effects of damaging wildfires. This included financial aid, mental health support, and rebuilding efforts.
- **Ecosystem restoration:** Respondents were asked about the availability of restoration guidelines or initiatives aimed at rehabilitating fire-affected ecosystems. Respondents shared their knowledge about biodiversity recovery efforts and whether these efforts adhered to standardized environmental restoration practices.

Demographic Information

In addition to the thematic questions about IFM, we also collected detailed demographic data to enrich the analysis. This information allowed for comparison of responses and provided additional context. The demographic data collected included:

- Gender and race: South Africa uses different racial categories than the United States. The survey included racial categories typically used in South Africa. This allowed for an analysis of how experiences and opinions varied across different demographic groups.
- Geographical location: Respondents were asked about the province and district in which they primarily resided, providing insight into regional differences in fire management experiences and challenges.
- Occupation: Respondents provided details about their professional background, particularly if they worked in fire management, environmental conservation, or related fields.
- To streamline analysis and enable group comparisons, variables such as race, gender, and location were synthesized into a single *Demography* field. This integration allowed for efficient comparison, and cross-tabulation of respondents' backgrounds.

The assessment design facilitated comprehensive data collection on various aspects of wildland fire management. By structuring questions around the five Rs of IFM, we gathered both operational and ecological views on fire management in South Africa. Including demographic details enabled analysis of how fire management experiences and challenges differed across societal groups and regions.



Left—Firefighter on the Tygerberg Nature Reserve Fire. Right—Firefighter at the Castle Rock Fire. Courtesy photos by Charl Steenkamp, NCC Group.

Table 1—Demographic overview of survey respondents. Summary of gender, occupation (multiple responses), province, and race of wildland fire stakeholders in South Africa who participated in the survey (n = 108). Western Cape had the highest number of respondents. Occupation categories include professional roles such as Wildland Firefighter, Nature Conservator, and Consultant. Race and province data are self-reported.

Category	Subcategory	Response
Gender	Male	80
	Female	13
	Non-response	15
Occupation (multiple responses)	Wildland Firefighter	40
	Nature Conservator	39
	Firefighter (general)	18
	Consultant	17
	Volunteer Firefighter	15
Province	Western Cape	81
	Mpumalanga	6
	Eastern Cape	4
	KwaZulu Natal	4
	North West	4
	Gauteng	3
	Limpopo	2
	Free State	1
	Northern Cape	1
	Non-responses	2
Race	White and Caucasian	65
	Black African	2
	Coloured	1
	European	3
	White African	1
	Other	1
	Non-response	32

Approach to Data Processing

Step 1: Initial cleaning—

After data collection, the data were exported into a structured spreadsheet containing respondent demographics, answers, and metadata, such as response start and end dates. The initial processing step involved cleaning the raw dataset to ensure usability, removing irrelevant columns, and handling missing or inconsistent values. Columns

such as *IP Address* and optional contact information were excluded to retain focus on core responses. Incomplete entries were either discarded or filled with placeholder values to maintain data integrity. The cleaned dataset, now standardized, included demographic information and responses for further analysis.

Step 2: Categorization of responses—

The second step of the process involved categorizing the responses into predefined categories based on each subject. Questions were divided into six primary categories: *review*, *risk reduction*, *readiness*, *response*, *recovery*, and *miscellaneous*. There was also an additional insight category for questions that fell outside of the predefined categories to allow for new themes to emerge.

The categorization process was guided by a keyword-based mapping strategy. Each question was analyzed against a predefined set of keywords associated with the different categories. For example, questions involving fire management personnel, equipment, and firefighting tactics were categorized under *response*, while questions related to training programs or preparedness efforts were classified under *readiness*. This mapping required a deep understanding of the assessment structure and content.

This step also involved developing an algorithm to detect key phrases within the questions. The algorithm worked by scanning each question, matching it against a list of predefined keywords, and assigning the appropriate category based on the content of the question. This categorization allowed the responses to be organized by theme, making it easier to analyze the data within each respective field. The output of this step was a newly categorized dataset that included the respondent ID, the category of the question, the question itself, and the corresponding response.

Step 3: Merging demographic and categorized data—

The third and final step involved integrating the demographic information of each respondent with the categorized responses. The demographic information included the fields *race*, *gender*, *province*, and *occupation*. The goal was to enrich the categorized data by including these demographic details, allowing for a more comprehensive analysis of the responses.

To achieve this, the cleaned dataset (which contained demographic information) was merged with the categorized dataset (which contained categorized responses). This merge was based on the respondent ID, ensuring that each response was linked to the corresponding respondent's demographic data. A key challenge in this step was ensuring that the demographic fields— *race*, *gender*, *province*, and *occupation*—were appropriately aligned with the responses. The solution was to harmonize these fields, ensuring consistent formatting and handling any missing data carefully. In cases where respondents did not provide certain demographic details, placeholder values were used to maintain the structure of the data.

To further enhance the analysis, a new field, *demography*, was created by concatenating the *race*, *gender*, *province*, and *occupation* information into a single field. This allowed for a quick view of the respondent's demographic profile alongside their responses.

The final dataset consisted of the following columns: respondent ID, category, question, response, race, gender, province, occupation, and demography. This structure enabled detailed analysis across multiple dimensions, such as understanding how responses varied by demographic group or region.

Analysis Strategy

An analysis strategy was designed to extract insights from responses by focusing on the relationships between respondents' demographic information and their responses across different categories of questions. This section details the methodological approach used for the analysis, focusing on the comparative and correlation-based frameworks applied to the dataset.

Approach to comparative analysis—

The comparative analysis aims to understand how different demographic groups responded to various questions. The focus is on identifying patterns and trends across demographic fields such as gender, race, province, and occupation and how these groups perceive and interact with the topic of wildland fire management.

The comparative analysis begins by filtering the dataset to isolate responses to a particular question. Once the relevant data are extracted, the responses are further grouped based on a selected demographic, allowing for the comparison of answers across different respondent profiles. This helps to highlight the influence of factors such as location or occupation on attitudes toward wildland fire management.

For example, if analyzing responses to the question, “What are the top two causes of human-originated wildfires?” the data would be grouped by the selected demographic (e.g., province). The responses would then be compared across provinces to reveal whether geographic location has a significant impact on perceptions regarding wildfire causes. The results of these analyses are visually represented using different types of charts, such as bar charts or pie charts, depending on the data structure.

Findings

The assessment revealed important insights into perceptions and experiences of wildland fire management across South Africa, and are categorized into five thematic areas of IFM: *review*, *risk reduction*, *readiness*, *response*, and *recovery*. Examination of these areas showed regional, race, and potentially gender-based differences in experiences and perceptions related to IFM.

Review: Analysis of the Fire Issue and Identification of Options for Positive Change

Our findings showed that 58 percent of respondents either *somewhat agree* or *strongly agree* that wildland fires harm their communities. Heightened concern was observed in the Western Cape, where 73 out of 81 participants *strongly agree* about the severe negative impacts of wildland fires. Despite high representation from the Western Cape (n = 81), only a subset provided valid open-text responses on unwanted effects. The top three effects based on coded responses were: loss of life, property damage, and

biodiversity loss. Less frequently mentioned themes such as air pollution, infrastructure damage, and fire regime compromise were grouped under *Other Effects*. Table 2 presents the provincial distribution of the most frequently cited effects:

Table 2—Reported negative impacts of wildland fires by province. Types of adverse effects attributed to wildland fires as reported by respondents from various provinces. The impacts include loss of life, property damage, biodiversity loss, and other effects, with Western Cape showing the highest number of total responses (n = 14) and other responses (n= 28).

Province	Loss of life	Property Damage	Biodiversity Loss	Other Effects	Total Responses
Western Cape	6	3	2	3	14
Mpumalanga	2	0	0	0	2
Eastern Cape	2	0	0	0	2
Others (prov)	8	7	5	8	28

At the national level, the responses from all provinces were pooled and categorized by theme. Table 3 presents a frequency-based summary of all coded mentions across the country, totaling 56 mentions. The top three most frequently reported effects were loss of life (32%), property damage (18%), and biodiversity loss (12%).

Table 3—Most commonly reported unwanted effects of wildland fires. A summary of frequencies and relative percentages of the most frequently mentioned negative consequences of wildland fires. Loss of life was the most cited effect (32%), followed by property damage and biodiversity loss. The *Others* category includes diverse issues such as economic loss and tourism impacts.

Unwanted Effect	Frequency	Total mentions %
Loss of life	18	32
Property damage	10	18
Biodiversity loss	7	12
Damage to infrastructure	5	9
Compromise of fire regime in watersheds	3	5
Air pollution	2	4
Others (listed in supplement)	11	20

Note: Frequencies represent mentions, not unique respondents. A respondent could contribute multiple mentions across categories, as each person could list up to three unwanted effects. "Other Effects" includes less frequently cited themes such as economic loss, destruction of grazing lands, tourism impacts, or soil degradation.

Of the two respondents identifying as Black African, one expressed concern about wildland fire effects. Given the small number in this group, no meaningful statistical comparison can be drawn across racial categories. Among gender groups, 80 male and 13 female respondents participated. A higher proportion of males than females selected *strongly agree* regarding wildfire negative impacts.

Risk Reduction: Prevention and Focusing Resources on the Underlying Causes of Fires

Respondents listed perceived causes of human-originated wildland fires. One hundred twenty two coded mentions were extracted from open-text responses and grouped thematically.

The most commonly cited cause was arson, appearing in general and intentional-use contexts. Combined, arson was mentioned 58 times, making it the most frequently reported origin of wildfires. This was followed by grazing-related fires (n = 16), fuel management practices (n = 11), and negligence (n = 7). Other causes included civil unrest (n = 9), invasive alien vegetation management (n = 1), and various sources (n = 20), such as powerlines, campfires, and religious/spiritual burning rituals. The complete summary is presented in table 4.

Table 4—Grouped frequencies of perceived human-originated causes of wildland fires. Summary of the frequency of different human-related causes of wildland fires as reported by respondents. Arson (n = 58) emerged as the most cited cause, followed by intentional grazing (n = 16), fuel management (n = 11), and negligence (n = 7). The data were compiled from both direct responses and thematic coding of intentional fire motives, with additional causes such as powerlines and campfires categorized under *Other*.

Cause of fire (grouped category)	Frequency	Data source
Arson (all cases merged)	58	Causes and intentional fire motives
Grazing (intentional)	16	Intentional fire motives
Fuel management (intentional)	11	Intentional fire motives
Negligence (all variations)	7	Direct cause category
Unrest (intentional)	9	Intentional fire motives
Invasive alien management	1	Intentional fire motives
Hunting (intentional)	0	Intentional fire motives
Other (e.g., powerlines, campfires, unknown)	20	Free-text and miscellaneous entries

Readiness: Preparing to Fight Fires

In the Western Cape, only 19 respondents answered this particular question. Of these, 7 respondents (37%) selected *strongly disagree* with the statement that there are enough trained personnel to handle wildland fires. The small sample size of respondents for this question should be interpreted cautiously.

Regarding brigade training, we found that 42 respondents selected *somewhat agree* and 33 selected *strongly agree* that wildland fire suppression brigades are professionally trained and equipped. This positive outlook on brigade readiness was more prevalent among Black and Coloured respondents, who were more likely to express confidence in the brigade’s preparedness as compared to White respondents (see fig. 1).

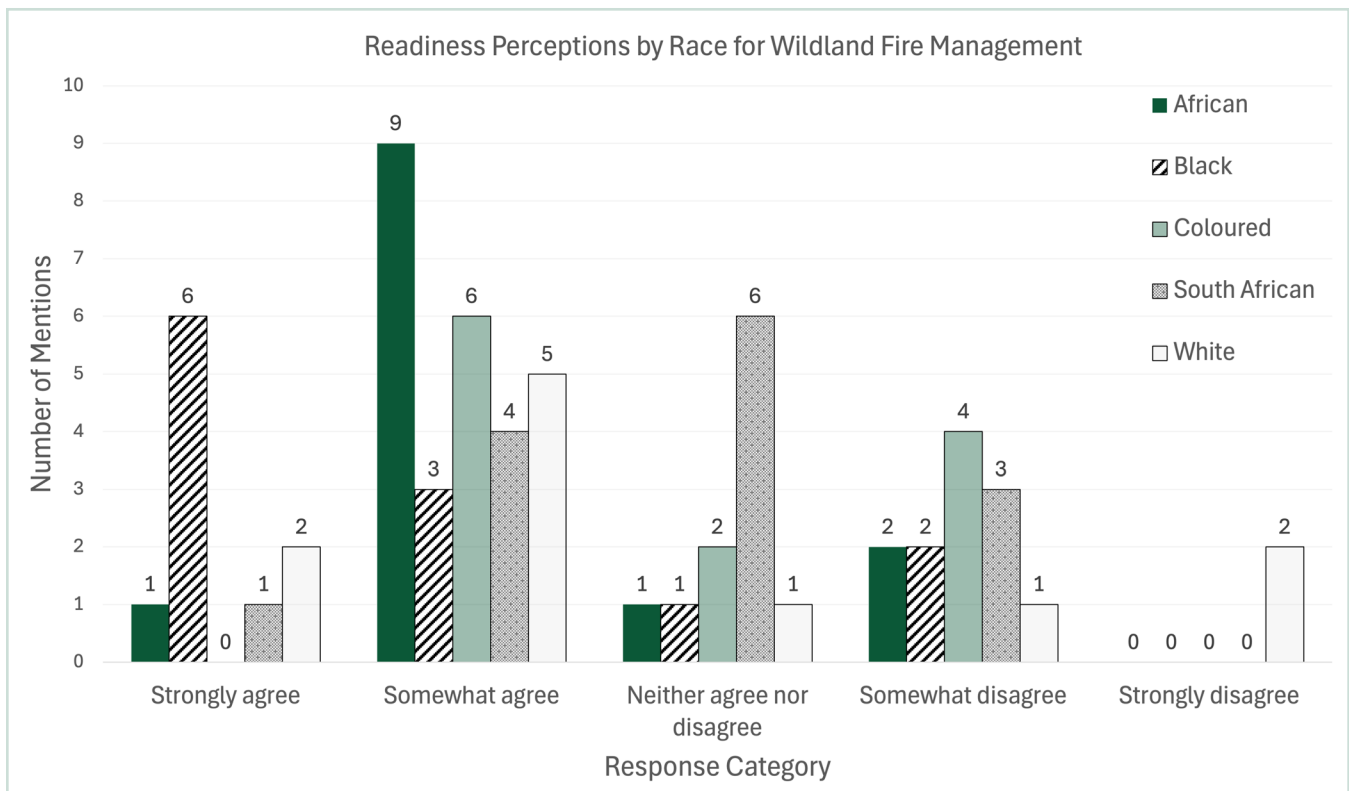


Figure 1—Perceived readiness for wildland fire management by racial group in South Africa. Different racial groups' perceptions of readiness for wildland fire management based on their agreement levels. Responses are categorized from Strongly agree to Strongly disagree, to highlight variations in perception across African, Black, Coloured, South African, and White respondents.

Response: Ensuring Appropriate Responses to Unwanted Damaging Fires

Our findings on the response capabilities to wildfires showed that a substantial number of respondents agreed, 36 *strongly agree* and 36 *somewhat agree*, that a formal ICS is utilized in their communities. However, we also noted regional disparities, with respondents in the Western Cape showing stronger agreement as compared to mixed perceptions in Eastern Cape and Gauteng.

Despite the overall agreement, perceptions varied across provinces (see fig. 2). Respondents from the Western Cape reported the highest level of agreement, with the majority selecting *strongly agree* or *somewhat agree*. In contrast, provinces such as Eastern Cape and Gauteng displayed more varied responses, including mentions of *somewhat disagree*, and *neither agree nor disagree*.

In terms of equipment provision, 75 respondents either *strongly agree* or *somewhat agree* that firefighters are equipped. However, 17 respondents expressed concerns about the quality or availability of equipment. Gender-based analysis revealed that a small portion of female respondents were likely more optimistic about the provision of equipment compared to males.

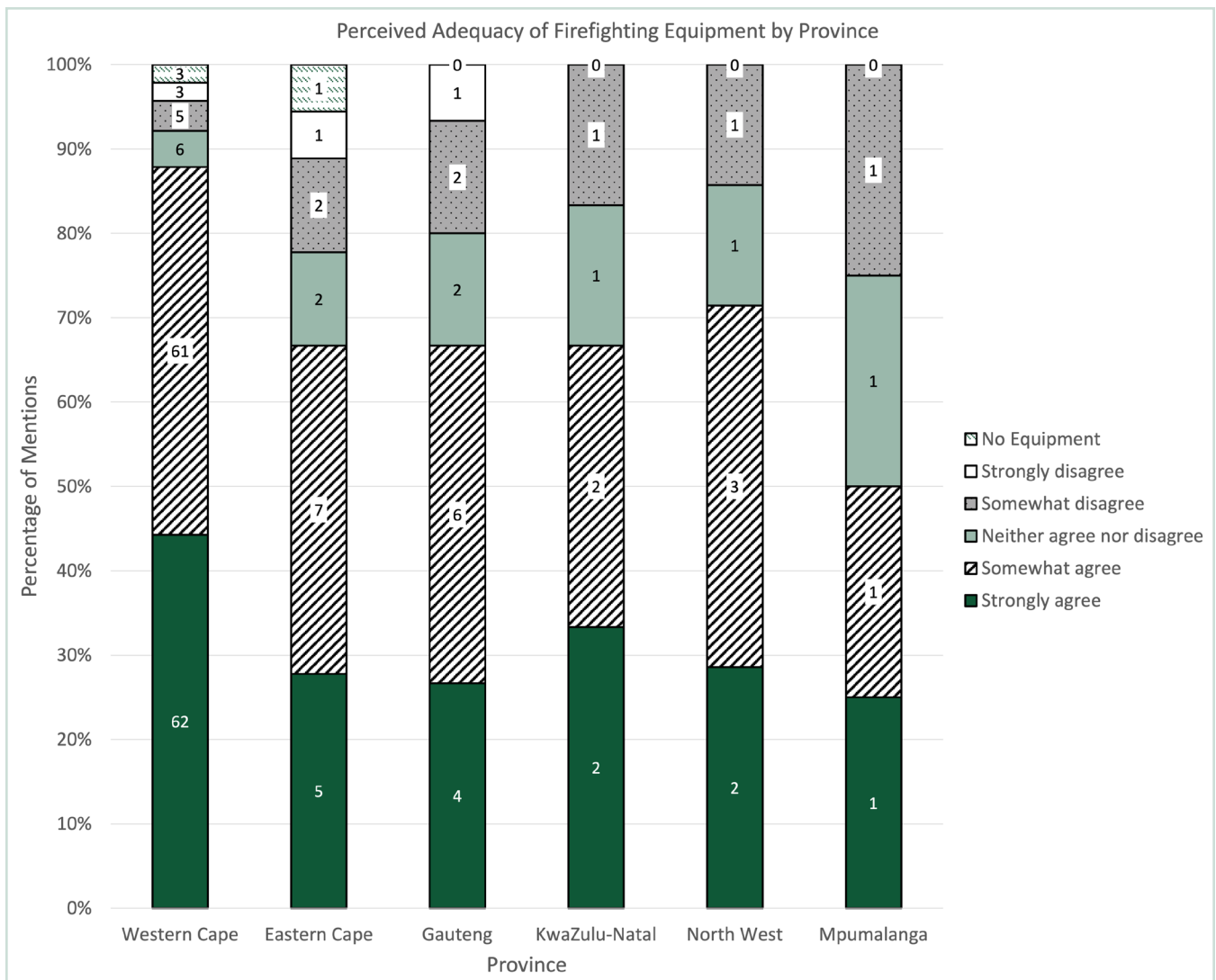


Figure 2—Perceived adequacy of firefighting equipment by province. Bars show the distribution of survey respondents' perceptions across six provinces.

Recovery: Community Welfare, Repairing Infrastructure, and Restoration of Fire-Damaged Landscapes

When asked about recovery efforts following wildland fires, 74 respondents selected one of four agreement options. Of these, 42 expressed agreement that restoration guidelines were in place, with 24 selecting *somewhat agree* and 18 *strongly agree*. In contrast, 32 respondents expressed concern: 20 selected *somewhat disagree*, and 12 *strongly disagree*.

The remaining respondents selected *neither agree nor disagree* or did not respond. This could indicate uncertainty or lack of familiarity with recovery programs.

Regional data suggest disparities in recovery perceptions, particularly in the Western Cape, where responses were mixed regarding the presence of support programs and restoration guidelines after damaging wildfires.

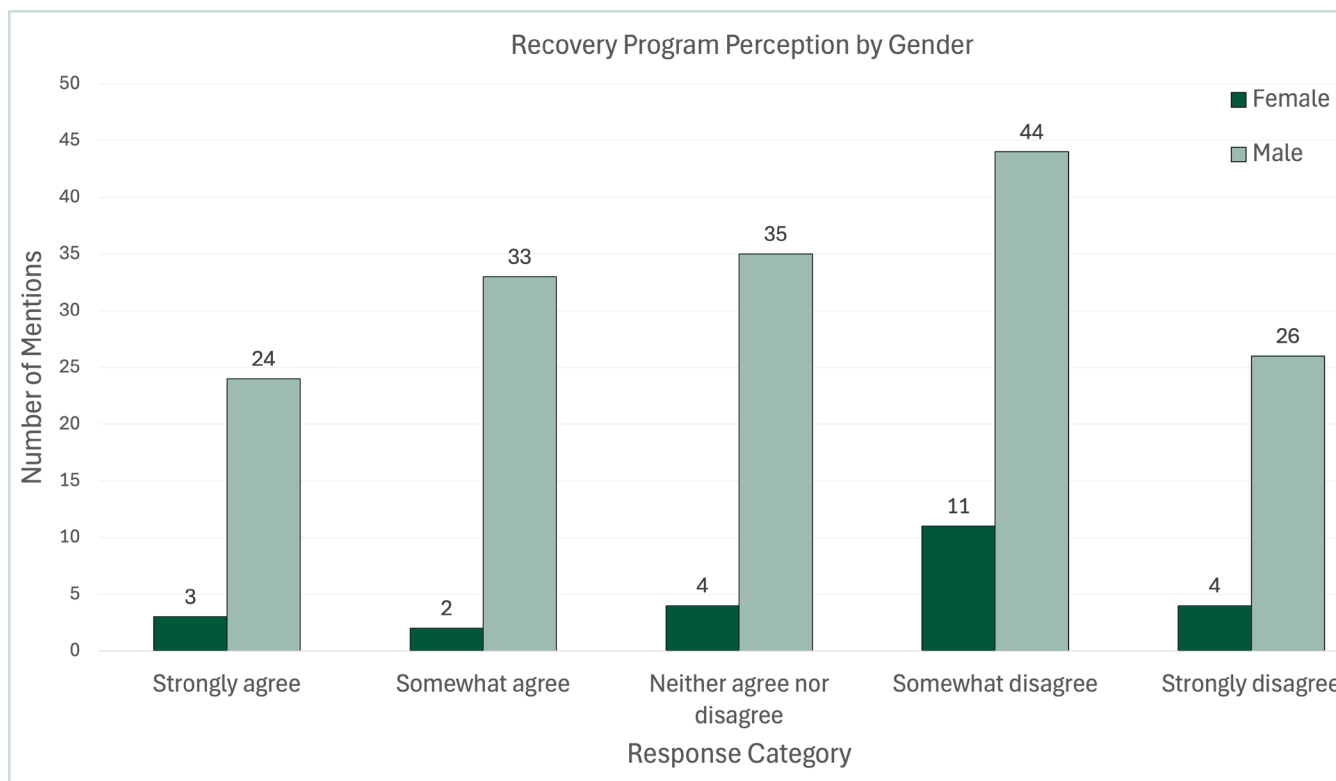


Figure 3—Perceptions of recovery programs by gender. Bars show the distribution of male and female respondents' view on recovery programs across five response categories.

Summary of Results

This assessment found mixed perceptions within each of the five Rs of IFM. Further analysis of demographic variables also revealed trends across race, gender, and province that could be explored further with additional quantitative and qualitative data collection.

Most respondents perceived that wildland fires have damaging, unwanted effects in their communities. Respondents from the province of Western Cape, who are most represented in this sample, expressed a high concern regarding the unwanted impacts of wildland fires. Assessment results also indicated that when considering human originated wildfires, arson is identified as the leading cause followed by negligence. Respondents also identified other human originated causes related to grazing and fuel management. There were diverse perspectives regarding wildland fire personnel readiness in South Africa. For example, respondents had mixed perspectives—depending on the province—of whether they had enough personnel to deal with wildland fires. Thus, additional data collection could explore nuances in level of readiness across provinces.

Most respondents stated that the ICS is used in their community, which indicates that there is indeed a structured response mechanism in place. However, regional disparities showed that respondents from the province of Western Cape perceived a greater ability for response than respondents from provinces such as Eastern Cape and

Gauteng, who showed mixed perceptions regarding response. Moreover, while most respondents believed that firefighters in South Africa are adequately equipped for response, several respondents expressed concern about the actual quality of equipment.

Perceptions toward restoration guidelines for ecosystems affected by wildland fires were mixed. While most respondents felt there were adequate restoration guidelines in place, several respondents still had concerns. Meanwhile, regional data suggest potential disparities in recovery efforts. For instance, in the Western Cape province, perceptions were mixed regarding support programs and restoration guidelines after damaging wildfires. Due to the large number of respondents from Western Cape, topics regarding support programs and restoration guidelines across provinces deserve further exploration.

In sum, assessment findings offer an initial step in exploring perceptions related to IFM in South Africa. For example, the Western Cape is notably concerned about personnel readiness, response efficiency, and recovery efforts. Demographic analyses revealed that there could be differences in perspectives toward wildland fire management across racial demographics. In addition, there could be gender-based differences regarding equipment provision and human-caused fires related to arson. Despite a general acknowledgment of wildland fire challenges, potential regional and demographic differences in perceptions could necessitate targeted fire management strategies that address specific vulnerabilities and perceptions across South Africa.



Firefighters at the Newlands Fire Base Cape Town. Courtesy photo by Charl Steenkamp, NCC Group.

Opportunities for Further Investigation

We suggest that additional quantitative and qualitative research be conducted across South African provinces. Results from this assessment can be used to develop a more targeted survey administration process that includes fire managers outside the province of Western Cape and who are representative of broader racial and gender

demographics across the country. In addition, results can be used to develop qualitative focus groups with small groups (5–8 people) of wildland fire managers for more in-depth understanding of specific quantitative results. Focus groups, which are designed to focus on a singular topic, can be used to gain social context regarding survey questions.

We also suggest conducting a focus group for each of the five Rs of IFM. The U.S. Forest Service's International Programs unit can work alongside South African wildland fire managers to develop a set of focus group questions (five to eight questions) based on the results of this exploratory study. Another qualitative approach is well-designed in-depth interviews of approximately one hour. These interviews can be used to provide insight into the meaning behind responses and may open new ideas on how to approach IFM more deliberately across diverse South African provinces.

Assessment Limitations

South African fire managers from the province of Western Cape worked directly with U.S. Forest Service International Programs. While part of the intent of the assessment was to capture diverse perspectives of wildland fire managers across South Africa, researchers working with fire managers were aware that survey responses would have a skewed gender, demographic, and spatial outcome that would lead to sample bias. As a result, the sample consisted of wildland fire managers who are predominantly male (86% of respondents), White (91% of respondents), and who work in the province of Western Cape (76% of respondents).

The province of Western Cape has a summer wildfire season while the rest of the country's fire season takes place during the winter. Moreover, the Western Cape response system has a broader focus on all hazard events including wildfire and therefore allocates more resources to mitigating risks to all hazards. Thus, although the assessment captured perspectives from provinces across South Africa, the provinces of Free State, Limpopo, and Northern Cape were significantly underrepresented in this exploratory study. The perspectives of female and non-White (Black, Coloured, or other race) respondents were also significantly underrepresented.

Conclusion

This assessment captured the perspectives of South African wildland fire managers with the intent to better understand the context of wildland fire management in South Africa, as well as to uncover the knowledge gaps and resource needs of wildfire managers across the country. The assessment draws upon the wildland fire management framework of the five Rs of Integrated Fire Management (IFM): review, risk reduction, readiness, response, and recovery of wildfires (Moore 2019). The development, administration, analysis, and results of this assessment within the five Rs of the IFM framework focus on perspectives of wildland fire managers directly engaged in fire management rather than testing a specific policy or previous research findings. This assessment reveals perspectives concerning the varied impacts of wildfire preparedness, response, and recovery within the context of South Africa and of the province of Western Cape in particular. The results from this study suggest the importance of including varied perspectives toward wildfire management to avoid implementing a one-size-fits-all approach to IFM across South Africa and instead, applying an approach that is sensitive to local perspectives at each point of the five Rs of IFM.



Firefighter on the Twelve Apostles Fire. Courtesy photo by Charl Steenkamp, NCC Group.

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Appendix A—Africa Regional Wildfire Assessment Program

Preamble:

Often referred to as “The Fire Continent”, wildfires are common across Africa. Fire has been used by pastoralist and hunters for centuries and the vegetation has adapted to this norm. Many vegetation types now need periodic fires to maintain the ecological process and ensure biodiversity. Integrating the safe and beneficial use of fire into land management is paramount.

On the other hand, recent years have also seen devastating wildfires in many regions of Africa. Despite being a continent shaped by fire in many ways, the sheer scale and intensity of wildfires in recent years coupled with population growth and the loss of life, property, air quality, animals, and damage to the environment, specifically the excessive release of carbon into the atmosphere, continue to escalate. Wildfires are predicted to worsen in the coming years and the United Nations Environment Program (UNEP) has warned in its annual *Frontiers* report released 17 February 2022, that Africa was the most affected continent due to wildfires.

Wildfire (anthropogenic and wild alike) may simultaneously serve as an integral part of a healthy ecosystem while posing considerable threats to ecosystem integrity. Fire can be an effective tool for the restoration of degraded landscapes as well as a destructive force causing socioeconomic and ecological damage. Proper understanding and resources are necessary to effectively manage fire in any landscape.

The long history of multiple use management by the U.S. Department of Agriculture, Forest Service (Forest Service), with relevant technical expertise related to fire ecology, forest and protected area management, ecologically-based planning, sustainable livelihoods including tourism, and environmental crime, position the agency well to work with our partners in Africa. With support from the U.S. Agency for International Development (USAID) and the U.S. Department of State, the Forest Service provides technical expertise to strengthen the capacity of international partners on a range of fire-related issues. These experts work across all management tiers, from national-level policy, to communities, civil society, and the private sector. The Forest Service provides technical assistance and capacity building related to wildfire in more than 50 countries around the world. In Africa, the Forest Service currently works in 15 countries including Angola, Botswana, Democratic Republic of Congo, Ethiopia, Kenya, Madagascar, Malawi, Morocco, Mozambique, Namibia, Rwanda, South Africa, Tunisia, Zambia, and Zimbabwe.

This project is designed to assess the current state of wildfire patterns and management capacity in Africa, to summarise the current state of fire science knowledge in Africa, and to recommend and prioritise possible opportunities for Forest Service technical assistance in Africa. There is however no guarantee that the Forest Service will implement all or any of the recommendations and this survey is not intended to set any expectations for the responders.

Please respond to all the questions provided and where required add further detail to further explain your response.

Definitions:

- Wildfire—A wildland fire originating from an unplanned ignition, such as lightning, rock falls, volcanos, unauthorised and accidental human caused fires, and prescribed fires that are declared wildfires.
- Wildland Fire—Any non-structure fire that occurs in vegetation or natural fuels. Includes wildfires and prescribed fires.
- Institution—Agency, ministry or other entity with authority and responsibility of a public character.
- Fire/Fuel Break/Barrier—A fuel barrier is a strip or block of land in which native vegetation has been reduced or modified so that surrounding fires can be controlled with preparation, control, and safety.
- Prescribed Fire—A prescribed fire is a controlled application of fire mimicking natural fire on the landscape. When introduced under acceptable parameters, a prescribed fire can improve conditions such as wildlife habitat, increase plant diversity, and reduce fuels lowering risk of destructive wildfire.

Questions for South Africa Wildfire Assessments

A. Overview

1. What Province do you live in?
 - a. Eastern Cape
 - b. Free State
 - c. Gauteng
 - d. KwaZulu Natal
 - e. Limpopo
 - f. Mpumalanga
 - g. North West
 - h. Northern Cape
 - i. Western Cape

2. What district/metropolitan municipality do you live in?
- a. Alfred Nzo District Municipality
 - b. Amajuba District Municipality
 - c. Amathole District Municipality
 - d. Bojanala Platinum District Municipality
 - e. Buffalo City Metropolitan Municipality
 - f. Cape Winelands District Municipality
 - g. Capricorn District Municipality
 - h. Central Karoo District Municipality
 - i. Chris Hani District Municipality
 - j. City of Cape Town Metropolitan Municipality
 - k. City of Johannesburg Metropolitan Municipality
 - l. City of Tshwane Metropolitan Municipality
 - m. Dr Kenneth Kaunda District Municipality
 - n. Dr Ruth Segomotsi Mompati District Municipality
 - o. Ehlanzeni District Municipality
 - p. Ekurhuleni Metropolitan Municipality
 - q. eThekweni Metropolitan Municipality
 - r. Fezile Dabi District Municipality
 - s. Frances Baard District Municipality
 - t. Eden District Municipality
 - u. Gert Sibande District Municipality
 - v. Harry Gwala District Municipality
 - w. iLembe District Municipality
 - x. Joe Gqabi District Municipality
 - y. John Taolo Gaetsewe District Municipality
 - z. King Cetshwayo District Municipality
 - aa. Lejweleputswa District Municipality

- bb. Mangaung Metropolitan Municipality
- cc. Mopani District Municipality
- dd. Namakwa District Municipality
- ee. Nelson Mandela Bay Metropolitan Municipality
- ff. Ngaka Modiri Molema District Municipality
- gg. Nkangala District Municipality
- hh. OR Tambo District Municipality
- ii. Overberg District Municipality
- jj. Pixley ka Seme District Municipality
- kk. Sarah Baartman District Municipality
- ll. Sedibeng District Municipality
- mm. Sekhukhune District Municipality
- nn. Thabo Mofutsanyana District Municipality
- oo. Ugu District Municipality
- pp. uMgungundlovu District Municipality
- qq. uMkhanyakude District Municipality
- rr. uMzinyathi District Municipality
- ss. uThukela District Municipality
- tt. Vhembe District Municipality
- uu. Waterberg District Municipality
- vv. West Coast District Municipality
- ww. West Rand District Municipality
- xx. Xhariep District Municipality
- yy. Mgcawu District Municipality
- zz. Zululand District Municipality

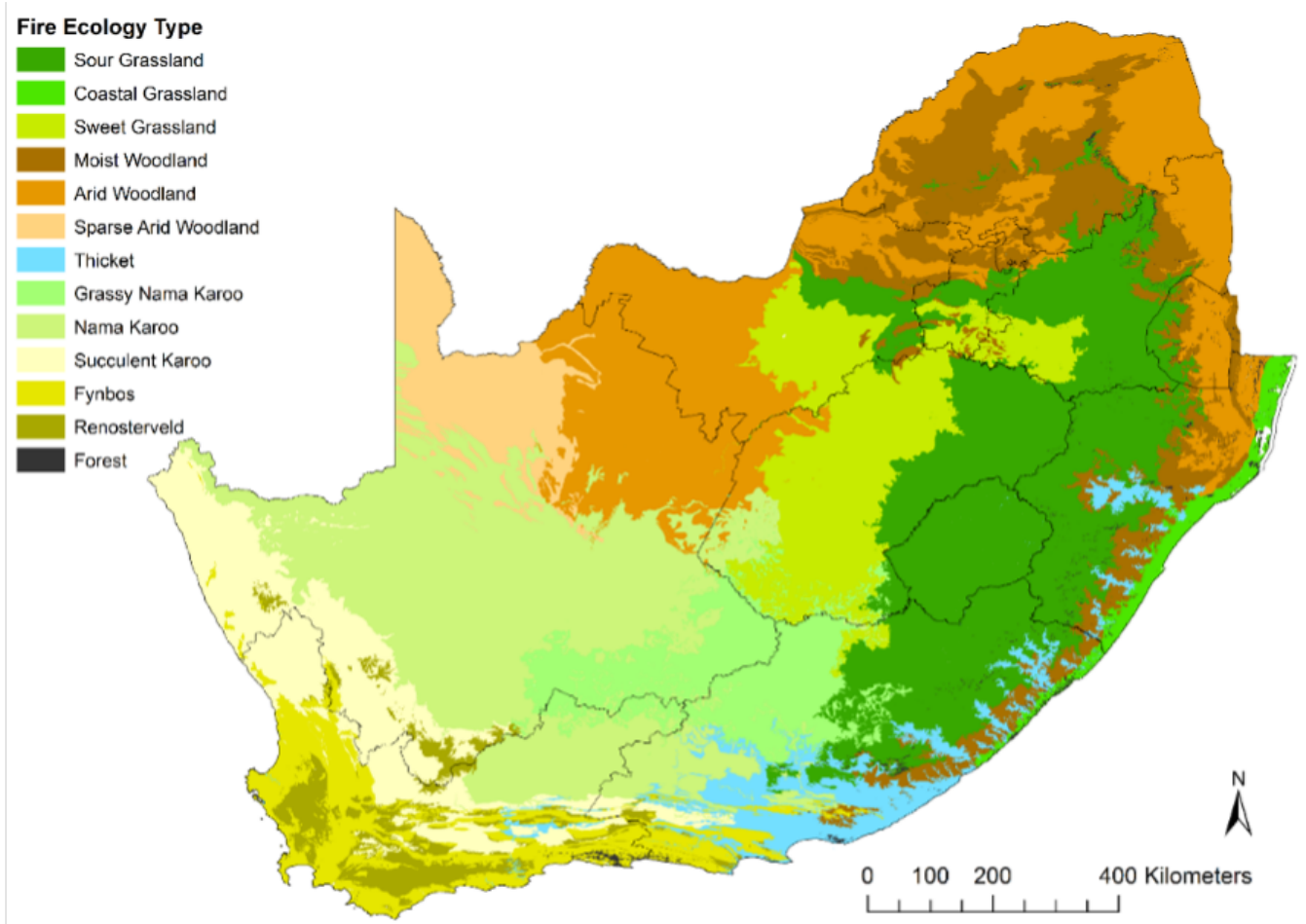
3. Your profession – pick the most appropriate one
 - a. Firefighter (general)
 - b. Structural Firefighter
 - c. Wildland Firefighter
 - d. Volunteer Firefighter
 - e. Forester
 - f. Nature Conservator
 - g. Politician
 - h. Lawyer
 - i. Scientist
 - j. Lecturer
 - k. Landowner
 - l. Pilot
 - m. Consultant
 - n. Farmer
 - o. Emergency Services
 - p. Disaster Management
 - q. Law Enforcement
 - r. Retired
4. What are the three most significant unwanted effects of wildland fire in South Africa?
 - a. _____
 - b. _____
 - c. _____

5. What are the three most significant desirable effects of wildland fire or prescribed fire in South Africa?
 - a. _____
 - b. _____
 - c. _____
6. What are three aspects of wildland fire management that are most successful in your country?
 - a. _____
 - b. _____
 - c. _____
7. What are three aspects of wildland fire management that could use improvement in your country?
 - a. _____
 - b. _____
 - c. _____
8. What are three aspects of wildland fire management that your country could share with other African countries?
 - a. _____
 - b. _____
 - c. _____

B. Wildfire Summary

9. What types of fuel burn most often in wildland fires in your area?
 - a. _____
 - b. _____
 - c. _____
 - d. _____

10. Please identify 3–4 biomes that, in your opinion, burn most frequently?
- a. Sour Grassland
 - b. Coastal Grassland
 - c. Sweet Grassland
 - d. Moist Grassland
 - e. Arid Woodland
 - f. Sparse Arid Woodland
 - g. Thicket
 - h. Grassy Nama Karoo
 - i. Nama Karoo
 - j. Fynbos
 - k. Renosterveld
 - l. Forest



11. For wildfires caused by humans, what are the two main causes?
 - a. _____
 - b. _____
12. For fires that are set intentionally, what is the expected benefit?
 - a. Unrest
 - b. Grazing
 - c. Hunting
 - d. Fuel Management
 - e. Invasive Alien Management
 - f. Arson
 - g. Other:
13. What ecological benefits are seen from wildland fire (e.g. species, ecosystem processes, etc)?
 - a. _____
14. What negative ecological effects are seen from wildland fire?
 - a. _____
15. Is wildland fire related research adequate in your country?
 - a. Yes
 - b. No - If not, which topics could use further study?
 - i. _____
 - ii. _____
 - iii. _____
 - iv. _____
16. Are there official processes for investigating the origin and cause of wildland fires in your province?
 - a. Yes
 - b. No

C. Risk Reduction

17. Is there a national or regional wildland fire prevention and fire management program or plan?
 - a. Yes
 - b. No
18. Are rural and Indigenous communities considered in the fire prevention program?
 - a. Yes
 - b. No
19. Does your community use fuel barriers (fuel/fire breaks), either made by machines or by hand, to protect against wildland fires?
 - a. Yes
 - b. No

D. Readiness

20. Are there annual operational plans or programs for fire management?
 - a. Yes
 - b. No
21. Is there a national training program / certification for wildland fire response and management?
 - a. Yes
 - b. No
22. Are there personnel trained in wildland fire management in different topics and levels: basic, intermediate, and advanced?
 - a. Yes
 - b. No

E. Response

23. Are there sufficient personnel to deal with wildland fires?
 - a. Yes
 - b. No

24. Are wildland fire suppression brigades professionally trained and equipped?
- a. Yes
 - b. No
25. What kind of equipment does your community have to fight wildfires (choose all applicable)?
- a. No Equipment
 - b. Hand tools
 - c. Backpack Pumps
 - d. Portable Pumps
 - e. Large Water Storage Tanks
 - f. Structure Fire Engines
 - g. Wildland Fire Engines
 - h. Water Tenders (Tankers)
 - i. Heavy Equipment (Tractors, Dozers, etc.)
 - j. Helicopters
 - k. Fixed Wing Air Tankers (Bombers)
 - l. Fixed Wing Command & Control Aircraft
 - m. Drones
 - n. Small Skid Units (Bakkie Sakkies)
 - o. _____
26. Are firefighters equipped with fire protection materials by the government or the community (cotton jumpsuits, boots, gloves, flash hoods, goggles, helmets, etc.)?
- a. Yes
 - b. No
27. Is there a coordinating agency or ministry for national and/or local emergencies (including non-fire emergencies)?
- a. Yes
 - b. No

F. Aerial Response

28. Who decides to use/approve the use of aircraft?
- a. _____
29. Are Unmanned Aerial Systems (UAS)/drones/Robots used for wildland fire management purposes?
- a. Yes
- b. No

G. Recovery

30. Are there programs to support communities at high risk of being affected by wild fires?
- a. yes
- b. No
31. Are there restoration guidelines for ecosystems affected by wildland fires?
- a. Yes
- b. No

H. Protected Areas

32. Are wildland fires managed differently in protected natural areas?
- a. Yes - if so, how?
- i. _____
- b. No
33. Is research carried out on the ecological effects of fire in the protected areas?
- a. Yes
- b. No
34. What is your opinion on the need for NPAs to have their own fire management plan to strengthen their management program?
- a. _____

Appendix B—Interview Questions For South Africa Wildfire Assessment

Name: _____

Province: _____

Title: _____

Date: _____

Interview Questions:

1. Does your province have an Integrated Wildfire Management Plan (IFM)?

Yes No

If so: _____

- 1.1 Can you provide a copy of the plan?

- 1.2 Is it being implemented?

2. Do you have annual wildfire statistics for your province?

Yes No

- 2.1. Annual number of fires

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

- 2.2. Hectares burnt

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

- 2.3. Lives lost

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

- 2.4. Damage caused

2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022

3. Do you have data with regards to devastating wildfires for your province?

Yes No

3.1. Date/timeframe

Date								
Timeframe (how long did the fire burn)								

3.2. Hectares burnt

Date								
Hectares burnt								

3.3. Lives lost

Date								
Lives lost								

3.4. Damage caused (crops, wildlife, structures lost, etc)

Date								
Damage/loss								

3.5. Suppression costs

Date								
Suppression costs								

4. Are there fire prevention and community outreach programs taking place in your province?

Yes No

4.1. If so, do you have examples?

5. Do you think that the objectives as listed below is a true reflection of what is happening in South Africa? Would you recommend any changes?

As South Africa is a large country with two distinct fire season and numerous ecological landscape types, requiring different fire regimes, it is not possible to have set national objectives. However, some of the key components of South Africa's fire management objectives are:

- ***Fire Prevention:*** Preventing wildfires from occurring in the first place is a primary objective. This includes promoting fire-safe practices in rural and urban areas, enforcing regulations related to fire prevention, and educating the public about responsible fire use.
- ***Early Detection and Rapid Response:*** Implementing systems for early detection of wildfires is crucial for effective management. This involves using technology such as fire lookout towers, satellite monitoring, cameras and community reporting to quickly identify and respond to new fire starts.
- ***Prescribed Burning:*** Prescribed or controlled burns are intentionally set fires conducted under specific conditions to reduce vegetation fuel loads and manage ecosystems. These burns help prevent larger, uncontrolled wildfires by reducing the available fuel.
- ***Ecosystem Management:*** Recognising that fire is a natural process in many South African ecosystems, the country's fire management objectives often include maintaining a balance between natural fire regimes and protecting sensitive habitats and species.
- ***Community Engagement:*** Involving local communities in fire management efforts is important. Educating communities about fire safety, encouraging responsible land use practices, and involving them in the decision-making process can lead to more effective fire prevention and response.
- ***Integrated Fire Management:*** South Africa often employs an integrated approach that combines traditional knowledge, modern science, and technology. This approach considers the ecological, social, and economic factors related to fire management.
- ***Invasive Alien Plant management:*** As noted numerous times in this report, invasive alien plants have an impact on the landscape and in the case of fires, a significant increase in the availability of longer burning fuels that burn more intensely than local species. South Africa has numerous programs that try and reduce these invasive species – the Working for Programs such as Working for Water, Working on Fire, etc are just two of these types of interventions.

- ***Firefighting Capacity:*** Developing and maintaining firefighting capacity is crucial for responding to wildfires effectively. This includes training firefighters, equipping them with appropriate gear, and establishing coordination and communication networks.
- ***Research and Monitoring:*** Ongoing research and monitoring help inform fire management strategies and assess their effectiveness. Understanding fire behavior, ecosystem responses, and the impacts of fire on biodiversity is essential for making informed decisions.
- ***Climate Change Considerations:*** Recognizing the influence of climate change on fire behaviour and frequency, South Africa's fire management objectives may also include adapting strategies to changing climatic conditions.
- ***Collaboration:*** Fire management often involves collaboration between various government agencies, local communities, non-governmental organizations, and other stakeholders. This collaborative approach ensures a holistic and coordinated response to wildfires.
- ***Adoption of ICS:*** As is well known, the Incident Command System (“ICS”) is a standardised management system used for the command, control, and coordination of emergency response efforts during various incidents, including natural disasters, accidents, and other emergencies. Adopting the ICS can and has offered several benefits for South Africa when it comes to managing all hazard incidents including wildfires. It's important to note that while the benefits of adopting the ICS are significant, successful implementation requires commitment, training, practice, and ongoing refinement to ensure that the system works effectively in various types of incidents. This is where the USFS and USAID programs have provided some of the most significant impacts to the South Africa’s IFM program.

6. In the context of your province, do you agree with the statement:

The Five main causes of wildfires in South Africa are:

- ***Intentional***: Arson/malicious and criminal act of deliberately starting fires.
- ***Smoking***: Discarded cigarette butts can also cause wildfires, either from workers working in the fields or bush, passing pedestrians or motorists.
- ***Cooking fires***: Open fires for cooking and discarded hot ashes can cause wildfires, particularly in nature conservation areas or on farms.
- ***Burning of debris***: Permitted and unpermitted burning of debris, if badly managed or if weather conditions change suddenly, can cause fires.
- ***Lightning***: Lightning is a cause of both wildfires and structural fires.

Yes No

6.1. If no, what do you believe are the top five causes of wildfires in your Province?

6.2. Do you have any statistics/date/research papers to support your comments above?

7. Is there anything you know of or do in your province with regards to IFM that is unique to your province?

8. What IFM resources are available in your province?

9. For those provinces that border neighbouring countries, are there any arrangements for cross border assistance in the event of a wildfire?

10. Is there any Military involvement in IFM in your province?

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