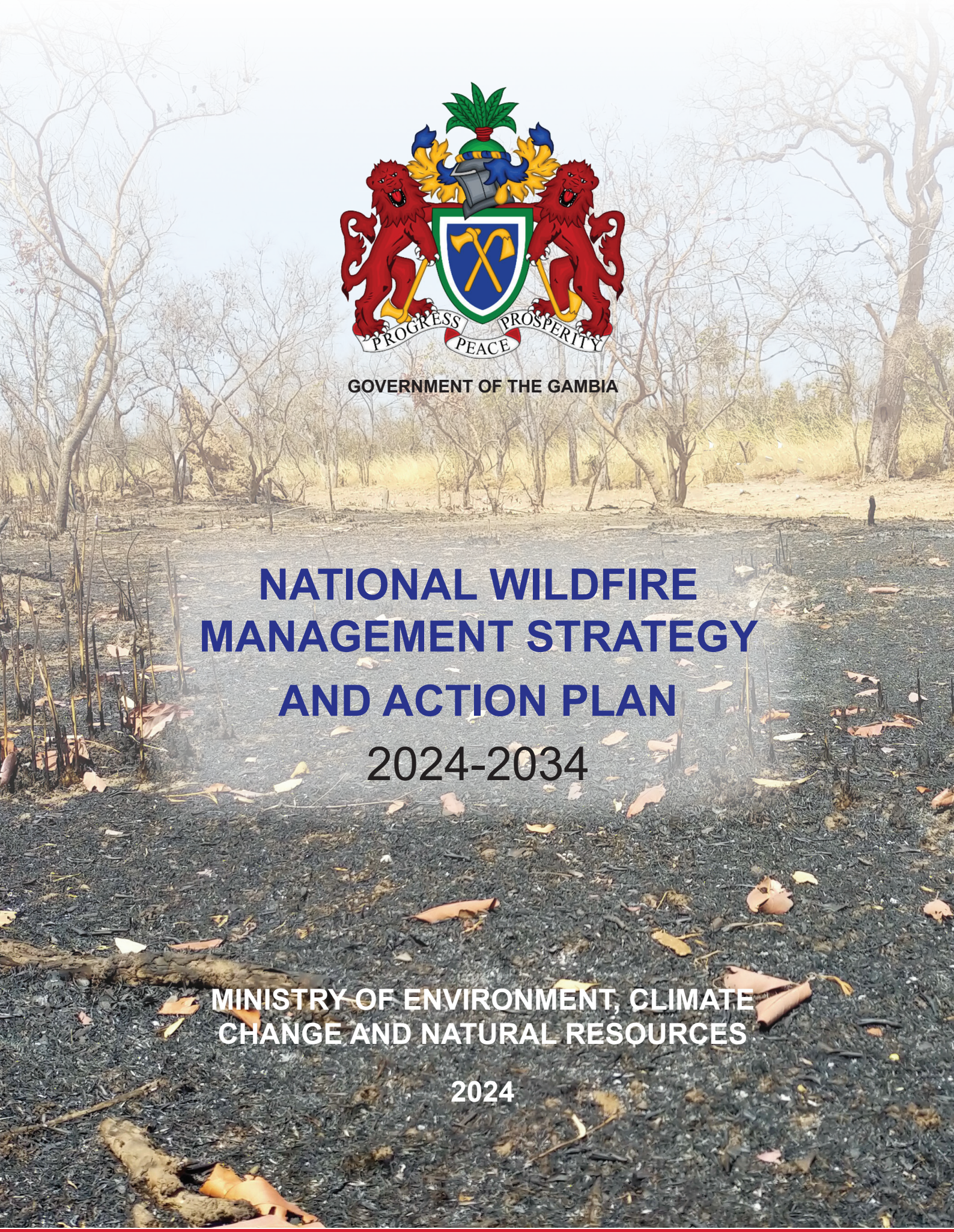


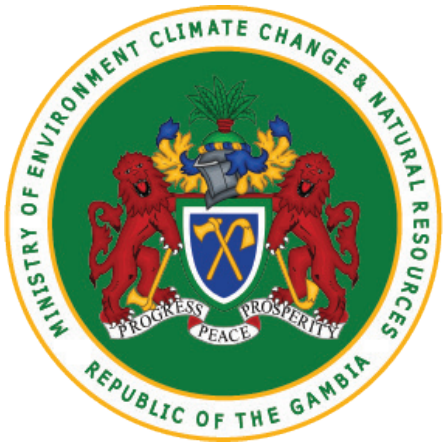
GOVERNMENT OF THE GAMBIA

NATIONAL WILDFIRE MANAGEMENT STRATEGY AND ACTION PLAN

2024-2034

MINISTRY OF ENVIRONMENT, CLIMATE CHANGE AND NATURAL RESOURCES

2024



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The EbA Project: Large-scale Ecosystem-based Adaptation Project in The Gambia

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PREFACE

Wildfires remain a major bottleneck to the restoration drives in The Gambia. Its occurrence is always associated with the loss of ecosystems and their ability to regenerate services, and the loss of lives and livelihoods. In The Gambia, wildfire is considered a major threat to forests, with the Second Nationally Determined Contributions (NDC) establishing that afforestation and fire prevention and control can mitigate up to 373 $GgCO_2e$ by 2030. Wildfire affects over 70% of the country's forests and grasslands which are vital for biodiversity conservation, livelihood support, carbon capture and sinking, and economic development. The extent of wildfire impacts vary in different regions, with the Lower River Region and Central River Region remaining the most affected due to the abundance of high-density vegetation, including forests, woodlands, and grasslands. This situation is further aggravated by changing climatic conditions characterized by increasing temperature and reducing moisture patterns, creating an ideal environment for wildfire spread. As such, there is an urgent need for concerted research, policy, and practice efforts to address the wildfire challenges in the country.

This National Wildfire Management Strategy outlines how wildfires in the Gambia can be addressed. It details the major aggravators of wildfires and provides key strategic objectives that, if well delivered, can significantly reduce the recurrence of wildfires. The development of this strategy is a significant milestone at the national and regional levels as it establishes a solid policy foundation for mainstreaming wildfire management in different ministries and line departments. It provides a basic overview of wildfire management, its evolution, potential, and wildfire-related policies and initiatives in The Gambia. The strategy captures the views and aspirations of Gambians who were widely consulted in the development of the strategy for wildfire management. These included local community groups and representatives, local and national non-governmental organizations, farmer groups, research and academic institutions, representatives from regional and national governments, and the development sector actors. Effectively implemented, this strategy promises to critically transform several sectors of the country, particularly the agriculture and forestry sectors. Further, it will aid in building on and strengthening the restoration efforts being implemented in building resilience towards addressing the impacts of climate change and variability.

Hon. Rohey John Manjang,

Minister of Environment, Climate Change and Natural Resources (MECCNAR),

The Gambia.

ACKNOWLEDGEMENT

The National Wildfire Management Strategy and Action Plan (2024-2034) is a product of a multistakeholder and multiagency consultative and participatory process, involving local communities and community groups, government and its agencies, private and business sector, research and academia, development agencies, among other interest groups. The strategy development was led by the World Agroforestry (ICRAF) as an output of the project, 'Large-Scale Ecosystem-Based Adaptation in The Gambia: Developing a Climate Resilient, Natural Resource-Based Economy' (EbA Project). The project was launched in The Gambia in 2017, with funding from the Green Climate Fund (GCF), through the United Nations Environment Program (UNEP) as the Accredited Entity (AE), and The Government of the Gambia through the Ministry of Environment, Climate Change and Natural Resources (MECCNAR) as the Executing Entity (EE). The overall goal of the project is to build a climate-resilient natural resource base for communities across three intervention regions of The Gambia - Lower River Region (LRR), Upper River Region (URR), and Central River Region (CRR) - North and South. Among the project's targets is restoring 12,800 ha and 3,000 ha of degraded forests and agricultural lands, respectively, creating a unique opportunity for sustainable forest management. We appreciate the support from the EbA Project Management Unit (PMU) staff, project regional coordinators, government departments, particularly the Department of Forestry and other project implementing partner agencies, and local communities who will be the beneficiaries of this strategy. We also appreciate diverse stakeholders and key informants representing different thematic areas and sectors for their constructive feedback that improved the quality of this strategy. Specifically, we acknowledge the feedback from the Technical Review Team that met on 16th April 2024 at the EbA PMU Office, Bijilo for a detailed review of the strategy.

ACRONYMS / ABBREVIATIONS

ANR	Assisted Natural Regeneration
CRR	Central River Region of The Gambia
DoA	Department of Agriculture
DoCD	Department of Community Development
DoF	Department of Forestry
DLS	Department of Livestock Services
DPWM	Department of Parks and Wildlife Management
DWR	Department of Water Resources
EbA	Ecosystem-Based Adaptation
EbA Project	Large-Scale Ecosystem-Based Adaptation in The Gambia: Developing a Climate Resilient, Natural Resource-Based Economy
ECOWAS	Economic Community of West African States
GBoS	The Gambia Bureau of Statistics
GCF	Green Climate Fund
GDP	Gross Domestic Product
GHG	Green House Gases
GMD	The Gambian Dalasi
ICRAF	International Centre for Research in Agroforestry (World Agroforestry)
LRR	Lower River Region of The Gambia
MECCNAR	Ministry of Environment, Climate Change, and Natural Resources
NACOFAG	The National Coordinating Organization for Farmers Association in The Gambia
NALOA	National Livestock Owners Association
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NARI	National Agricultural Research Institute
NBR	North Bank Region of The Gambia
NDC	Nationally Determined Contributions
NDMA	National Disaster Management Agency
NEA	National Environment Agency
RDMC	Regional Disaster Management Committee
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
URR	Upper River Region of The Gambia
USD	United States Dollar
WCR	West Coast Region of The Gambia

EXECUTIVE SUMMARY

Wildfires are a global phenomenon and have been recognized as a major threat to the integrityand functionality of landscapes, especially the forests. Most of these fires are induced by human activities, such as honey harvesting, timber and non-timber products harvesting, charcoal burning, game hunting, and land preparation for agriculture and settlements. In The Gambia, wildfires are becoming more frequent and widespread, with increasing harmful effects on lives, livelihoods, and ecosystems. The National Wildfire Management Strategy and Action Plan aims to lay a strong foundation for integrated wildfire management in the country. It builds on various existing policies and strategies in the country with an emphasis on managing the widespread impacts associated with wildfires across different sectors. The strategy development was led by World Agroforestry (ICRAF) as an output of the Large-Scale Ecosystems-based Adaptation (EbA) Project funded by the Green Climate Fund (GCF) and implemented by The Government of the Gambia with support from the United Nations Environment Programme (UNEP).

The strategy sets a broad, strategic, and national-level direction as a foundation for the implementation of fire management actions across the country. It is informed by national and regional analyses, including an in-depth risk-based analysis that delves into the specifics of national fire management challenges, underlying causes, and the management opportunities available to address them. The strategy identifies potential actions, respective roles of various stakeholders, potential management strategies, and proposes an action plan to operationalize it. It is organized into six chapters:

- Chapter One broadly looks at the outlook of wildfires from global to regional perspectives and their positive and negative impacts.
- Chapter Two characterizes wildfire in the Gambia at both national and regional levels.
- Chapter Three sets out the vision and mission of the strategy.
- Chapter Four explores the policy and institutional context in which wildfires can be managed.
- Chapter Five sets out the recommended policy and practice actions under six broad strategic objectives.
- Chapter Six details the monitoring, evaluation, and reporting framework.

The strategy identifies three broad fire management planning approaches. The priority area should be wildfire prevention and preparedness approaches using diverse strategies such as controlled burning, development, and maintenance of fire belts, and strengthening climate information systems for adequate planning. In the event of fire occurrence, the priority approaches should entail fire response and suppression. The country continues to employ traditional approaches to fight fires, such as using water, soil, and fire beaters. This strategy recommends incremental investment in technology such as modern firefighting equipment and surveillance and real-time reporting. After the fire incidents, recovery and restoration

plans such as replanting and resettling displaced people should be prioritized. This should also involve documenting learning to improve fire preparedness, suppression, and restoration in the future. In addition, the strategy also looks into various success stories related to wildfire management, including incentives such as insurance schemes and carbon credits, as well as increasing co-management approaches to enhance community participation.

The broad goal of the strategy is to safeguard forest and agricultural resources as well as lives and livelihoods from the adverse effects of wildfires through integrated and participatory approaches. This is in line with a broad vision of the strategy that aims to achieve a country with thriving forestry and agricultural ecosystems that provide multiple goods and services with reduced wildfire incidences. To achieve the vision and plans of the strategy, six strategic objectives are established in the strategy as summarized below. The details of each objective are further discussed in terms of the desired outcome(s), outputs, baseline situation, indicator(s), and responsible institution(s) for implementation in the later sections. A summary of the strategic objectives and their aims is presented below.

Strategic objective	Aim
1. Effective wildfire management awareness and communication enhanced in The Gambia	Information and data related to wildfires in the Gambia improved to guide the decision-making process through, inter alia, developing national systems for wildfire data collection, analysis, and dissemination
2. Regional and local level frameworks for wildfire monitoring and reporting developed and strengthened	Regional and district operational systems and frameworks for wildfire monitoring and reporting are established and strengthened to perform their roles
3. Mechanisms for fuel load management developed and implemented.	Fuel load management mechanisms developed with enterprise options to incentivize fire management
4. Integrated fire management approaches developed and rolled out	Fire management systems that integrate traditional and contemporary technologies developed and rolled out for use by different stakeholders
5. Multistakeholder collaboration on wildfire management promoted	A forum for wildfire policy and institutional integration established, bringing together multistakeholder and interest groups to deliberate on wildfire management with clear policy outcomes, forge partnerships, and collaboration on wildfire management.
6. Restoration and recovery after fire incidents enhanced	A clear protocol for livelihood and ecosystem recovery co-designed and mainstreamed within the national and regional frameworks

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CHAPTER ONE

INTRODUCTION

1.0 Outlook on Wildfires

Across the globe, wildfires are becoming more severe and frequent with recent years recording some record-breaking wildfire outbreaks. UNEP (2022) reports that wildfires are likely to rise by between 14% and 50% between 2030 and 2100, leading to massive damage to forest cover, ecosystems, biodiversity, natural habitats, human health, and national infrastructure. The causative agents of wildfires are broadly divided into natural (such as lightning strikes, droughts, heat waves, and high winds) and anthropogenic (such as deforestation, logging, burnings, and land use changes). However, an estimated 90% of the wildfires are caused by anthropogenetic factors (Mike, 2011). Notably, the risks of wildfires are increasing with climate change and variability, changes in land use and land management practices, and demographic changes, with areas that traditionally never experienced fire reporting fire outbreaks. The forestry sector is the most affected by wildfires, with Mike (2011) estimating that they burn 10-15 million hectares of boreal or temperate forests, 20-40 million hectares of tropic rainforests 500-1,000 million hectares of tropical and subtropical savannah woodlands, and open forests.

Different parts of the globe have experienced some of the most devastating and largest wildfires. An overview by Igini (2022) highlights some of the most impactful global fires. They include the 2003 Siberian Taiga Fires in Russia that led to the destruction of over 22 million hectares of land. The impacts of the fire spread across Asia in countries such as Siberia, China, Mongolia, Japan, and Russia, and it's documented among the worst wildfires in human history. The Australian Bushfires of 2020 in New South Wales and Queensland led to the destruction of 17 million hectares of land in addition to destroying thousands of buildings, killing millions of animals, destroying biodiversity, and leading to huge government emergency expenditures through human evacuation and resettlement. The fires were triggered by human activities and accelerated by increasing temperature and a reduction in precipitation patterns. In Canada, the 2014 Northwest Territories Fires led to the destruction of over 3.5 million hectares of forests as a result of human activities. An estimated US $ 44.4 million was spent on firefighting costs alone, with more costs incurred through evacuation, resettlements, and loss of properties. In the US, the Alaska Fire Season destroyed over 2.6 million hectares of land. Factors such as lighting strikes and human activities were attributed to the fire occurrence. Other countries that have witnessed devastating wildfire occurrences include Bolivia Forests Fires in South America in 2010 that led to the loss of about 1.5 million hectares of Bolivia's Amazon forests, and 2011's Richardson Backcountry Fire that led to the loss of over 688,000 hectares of boreal forests in Canada.

Most of the wildfires in Africa remain largely undocumented at local, national, and regional

levels. However, high temperatures and human activities have been cited as among the major contributors to wildfires (Zubkova et al. 2019). In Eastern Africa, most of the fires are recorded in the Savannah ecosystems during dry periods, as well as farming and harvesting periods where farmers use fire to clear their fields. Whereas fires have been used as a cheap way of clearing lands, controlling pests and diseases, and facilitating vegetation regeneration, it has also led to agroecosystems destruction with with devastating effects on biodiversity, deforestation, humans, wildlife, and the national economy. In Kenya, wildfires are a major contributor to deforestation and loss of savanna biodiversity especially during the dry periods, with the period between 2001-2022 reporting a loss of over 2.17 kha of tree cover from wildfires (Global Forest Watch, 2023). Human factors such as logging and forest degradation and fragmentation in major forests such as Aberdares and Mau Forests have exposed them to wildfires. The ranging heatwaves in North Africa in July 2023 led to the death and displacement of dozens of Algerians and Tunisians, in addition to high costs related to fire suppression and evacuation. In 2021, Algeria also witnessed ranging wildfires that killed almost a hundred people both civilians and soldiers during the rescue mission, including other fire-related damages. The Knysna fires of 2017 in South Africa remain notable in the country's history, which were attributed to high winds and storms and led to significant deaths, displacements, destruction of properties, and huge costs related to fire suppression.

A study by the International Monetary Fund (n.d) links climate change to disaster frequencies globally. The trend over time establishes that wildfires have topped the list of frequent disasters linked with climate change for over four decades as summarized in Figure 1.

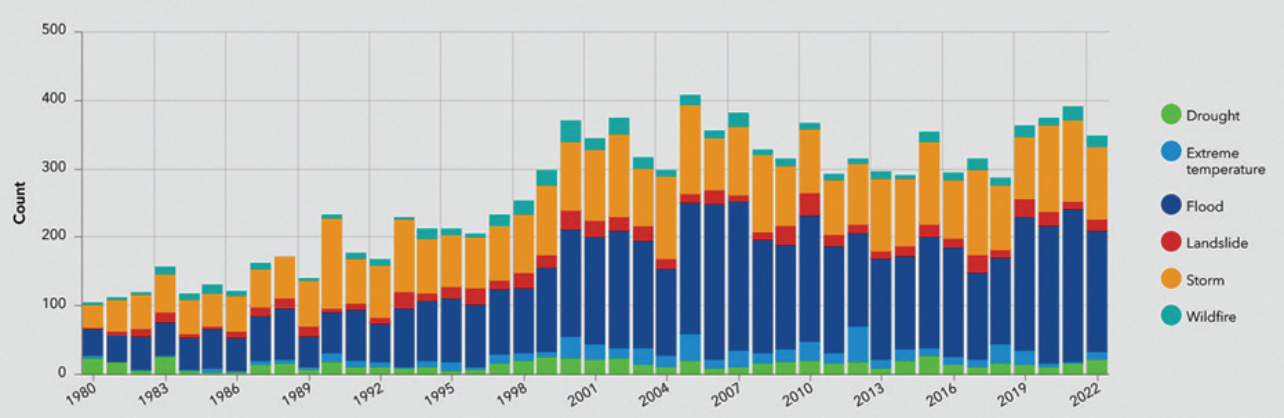

Figure 1 Frequency of natural disasters globally (Source: https://climatedata.imf.org /pages/climatechange-data)

In the Gambia, bushfires affect over 70% of the country's forests, parks, and grasslands, posing a major challenge to the economy, biodiversity, and community livelihoods. The Gambia Government notes the challenges associated with the wildfires and through the Second Nationally Determined Contributions has established that afforestation and fire prevention and control activities can mitigate up to 373 $GgCO_2e$ by 2030.

Some of the key drivers of wildfires include increased fuel load from Andropogon grass

(Andropogon gayanus), increased wood litter in the parks and forests, varying temperatures and precipitation patterns resulting from climate change, and human-driven activities. Data from Global Forest Watch (2023) establishes that the period between 2001 and 2022 witnessed a loss of over 1 ha of tree cover from forest fires. The issues of fire seasonality are critical in the country based on the weather patterns, with the dry months experiencing the highest intensities of wildfires as opposed to wetter seasons. The dataset also establishes that the peak fire seasons begin around mid-January and last for about 15 weeks. It is also notable that there is a wide fire variance across the country, whereby Lower River Region (LRR) has the highest incidence of fires with an average of about 80%, while West Coast Region (WCR) have the lowest incidence of about 46% due probably to an effective community participation (KPMG, 2021).

1.1 Impacts of Wildfires

Wildfires have both positive and negative factors on the environment, livelihoods, and local, national, and global economy. Notably, the extent of both impacts varies depending on the duration of the wildfires, intensity, and geographical coverage, among other factors.

1.1.1 Impacts of the wildfire on the ecosystems and biodiversity

Wildfires have devastating effects on the environment and pose a major threat to ecosystem functionality. Earth's life primarily depends on planetary natural cycles such as air and water purification, nutrient recycling, and soil formation, among others. Wildfires can interrupt and damage these functions resulting in ecosystem imbalances. According to the Global Forest Watch Data (www.globalforestwatch.org), the period between 2001 and 2022 witnessed a loss of 126Mha of tree cover globally from fires, an estimated 27% of total global tree cover loss. Among the leading countries, in terms of annual tree cover loss due to fires include Russia (2.54MHa), Canada (1.28Mha), the United States (566kha), Brazil (475kha) and Australia (287kha). Such fires often translate to the killing of seedlings, sprouts, and young trees affecting the natural regeneration process. In addition, fires also damage biodiversity and their natural habitats within and outside the forests including areas such as conservancies, grasslands, riverine and communal lands. The extent of damage varies with the fire intensity, seasonality, speed of the wind, and geographical context, with most dry areas experiencing huge impacts. Some of the biodiversity impacts include the displacement of birds and mammals from their territorial habitats, loss of threatened and endangered animal and plant species, loss of fruits and foods for animals and birds, and an overall reduction in population. It also affects the natural balance of the food web and chain, resulting in human-animal and animal-animal conflicts, leading to some ecosystems becoming inhabitable. Increased soil and water temperatures resulting from the fires contribute to the destruction of life on the land (such as arthropods and other microorganisms) as well as the death of aquatic wildlife such as fish.

1.1.2 Wildfires impact on lives and livelihoods.

Wildfires have always led to deaths resulting from direct burns. Further, fires also result in the death of domestic animals such as cattle, sheep and goats, which communities directly depend

on as a source of their food and economic support, resulting in food shortage, especially in communities that are dependent on them for survival. It also causes massive destruction of the silvopastoral systems through the destruction of trees and grasslands that the livestock feed on causing feed shortages and consequently interfering with the community livelihood systems. Notably, about 80% of wildfires occur in grasslands (Leys et al., 2018), which are the leading source of pasture for livestock and wildlife, especially in the savannah grasslands, leading to the destruction of the botanical composition of pasturelands and the natural regeneration cycle. Most of the seeds that are essential for regeneration are found on the soil surface and largely get destroyed by the fires. At the farmland level, soil fires contribute to soil property destruction and affect soil organic matters that contribute to low soil productivity and ultimately affect food security. Soil nutrients such as nitrogen that are found in the soil are reduced by wildfires. Boosting productivity through mechanisms such as chemical fertilizers can be costly leading to high costs of food products in the affected areas.

Wildfires are also a major contributor to respiratory diseases, especially when persons are exposed to extreme heat for a prolonged period. Burning food and other materials leads to the emission of a mixture of gases and fine particles that once inhaled affect the respiratory system. Some of the common complications include asthma, headaches, chest pains and irritated sinuses, which could be deadly in the long run if proper medication is not administered. This is more profound in developing countries where medical systems do not work at optimal levels. The most susceptible populations are the children and older generations whose health systems are more exposed to the effects of wildfires. Livelihood assets that communities depend on for their living are also largely affected by the wildfires. These assets are both materials and social resources and activities required by the communities to support their living, which are broadly divided into human capital, social capital, physical capital, natural capital, and financial capital (Baijanath-Rodino et al., 2021). Some of the direct impacts include the destruction of infrastructure and properties, loss and displacement of social and human capital, loss and destruction of homes and houses, and financial losses resulting from fire destruction. This translates to loss of income and increased vulnerability which affects both the households and national level income. Indirectly, wildfires also contribute to the disruption of the labor market which affects labor supply and productivity and as a result, reduces national and regional productivity. Other sectors that are directly affected by wildfires include transport and infrastructure through the destruction of connectivity in different regions. The costs of evacuation and resettlement are also high and affect national development.

1.1.3 Wildfires and Climate Change

Climate change and variability have a direct impact on increasing wildfires across the globe and vice versa. The planet is warming at a fast rate, and it's projected to continuously increase resulting from both human and natural factors. As a result, climate change effects have contributed to increased dryness of landscapes due to high temperatures and reduced precipitation, consequently creating an ideal environment for larger and more frequent wildfires. A study by MacCarthy et al. (2023) notes that the boreal regions are the most affected

by forest fires, with the 2001-2022 period witnessing the loss of over 110,000 hectares of tree cover through wildfires. Boreal forests store between 30-40% of terrestrial carbon globally, thus when they burn most of this carbon is released into the atmosphere. Further, the exposed soil which plays a carbon sinking role may end up emitting the stored carbon if there is no plant regenerating. The net effect of wildfires is turning such ecosystems from carbon sinks to carbon emitters.

In the tropical forests that cut across America, Africa, and Asia, fire-related tree cover loss is increasing at an annual rate of about 5% (over 36,000 hectares) accounting for about 15% of the global loss of tropical rainforests, with subsequent increase in carbon emissions due to tree cover loss. A study by Aragão et al. (2018) established that tropical forest fires accounted for over half of the carbon emissions in the Brazilian Amazon, and the possibility of this landscape turning into a new emitter if the status quo remains. There is a clear connection between wildfires and climate change, in the sense that changing climate leads to dryness of different landscapes making them susceptible to extreme fires, and as a result of this fire more carbon is emitted to the atmosphere to further aggravate the effects of climate change. This calls for concerted efforts to address both climate change effects and wildfire occurrences, simultaneously.

1.1.4 Positive effects of wildfires

Wildfires have positive attributes to the environment. Notably, some plants require fires for seed dispersal, after which they rejuvenate after the fires. Burning also stimulates flower and seed production of specific species of grass due to the fertilization effect of mineral nutrients released by ash. Perennial grasses grow more prolifically when the burned areas receive rainfall bringing new rejuvenated life to the previously affected areas. It is also notable that newly grown grass is healthier and easier to feed and digest for most animals compared to old dry grass. Some of the hard seeds also require fire to crack seed coats, trigger germination, and allow new growth. This ensures continuity and regeneration for the natural ecosystems once the wildfires cease. Wildfires are also agents of pests and disease management mainly through destroying insects and diseases causing parasites. In addition, wildfires eliminate the aggressive pests that cause vector, viral, and fungus diseases to trees and grass. It naturally removes the weak and affected trees, shrubs, and grasses from the ecosystems allowing for regeneration of strong vegetation that is more suited to their environment. In addition, fire also aids in breaking down nutrients bound up in the litter, in the process aiding in soil nutrients recycling, enhanced soil fertility, and consequently increased productivity as Datta (2021) notes.

Wildfires promote healthy ecosystems and balanced soil nutrients through neutralizing soil acidity and creating an alkaline condition for soil that allows better vegetation growth. Fire occurrence in dense forests creates more opening that allows sunlight penetration for underground growth and regeneration (Pausas & Keeley, 2019). The heat generated from the fire produces a chemical trigger that allows some trees and plants to germinate. In most ecosystems, fires remove exotic species, weeds, and undesired plants to give an edge to the

native and well-adapted species to regenerate. Most of these have a hard bark that can resist certain heat generated by the fire for survival and allows an opening for the saplings to thrive once in the open spaces during the rainy season. It also reduces the competition for available resources, especially water and nutrients for stronger tree growth. In some cases, fires allow seeds to drop into the soil for germination. The trees that emerge after fire incidences, especially in the savanna areas, are largely fire-resistant and are adapted to survive and thrive in harsh conditions.

1.2 Global wildfire databases

There is limited information and data on wildfires and their impacts at global and national levels. One of the main reliable fire datasets is the Global Forest Watch which provides comprehensive fire reporting incidences at different scales. GFW is an online platform with multiple datasets related to forest management across the world. NASA Fire Information for Resource Management System (FIRMS) also provides near real-time active fire data from Moderate Resolution Imaging Spectroradiometer (MODIS) and Visible Infrared Imaging Radiometer Suite (VIIRS) satellites to map fire location, by detecting heat signatures of fire from the infrared spectral band and giving an 'alert' of the incidence. The Global Wildfire Information System – GWIS (gwis.jrs.ec.europa.eu) aims to bring together different fire-related information sources at different levels to give a detailed view of fire regimes and support local actions. GWIS is built on various information and observing systems and complements global wildfire monitoring systems. However, it's crucial to complement the global data with actual ground-truthing at the point of fire occurrence to establish the causes and extent of fires for a more informed decision-making process.

1.3 Global interventions to wildfires management

Wildfire management interventions vary with geographical settings, sociocultural dynamics of the surrounding communities, and technological advancement in a particular context. One of the major drivers remains climate variability and effects, which have accelerated the frequency and intensity of wildfires. Whereas there is no one approach to reducing climate change, restoration practices such as agroforestry, farm-level natural regeneration, and assisted regeneration, among others, could play a pivotal role in increasing vegetation cover and reducing fire intensity. In addition, wildfires are also accelerated by human factors inside and around the forest's ecosystems, including honey harvesting, charcoal burning, timber and firewood harvesting, and poaching, among other activities. Different interventions are in place already to manage wildfires at different levels, depending on the stage of the fire outbreak.

1.4 Fire behaviour

Fire behavior largely refers to the impact, intensity, and spread of fire in a given location. According to Tadesse & Seboko (2013), the three main factors that affect wildfire behaviors are fuel load, weather and climatic conditions, and topography.

The fuel types include grass, shrubs, timber, and non-timber litter, among others. Different types of fuels have varying moisture and load content depending on the size and shape of the fuel type. To illustrate, light fuels such as grass and shrubs have lesser fuel loads compared to logs and stumps which have heavier loads. Consequently, heavier fuel loads are harder to take off but spread at a lower speed, compared to lighter fuel loads such as grass which spread at a faster rate but are easier to take off. In a typical savannah grassland, there are more grass and shrubs hence the wildfire spreads fast, while the forest ecosystems have a combined undergrowth with litter and grass, low canopy, and high canopy trees thus a huge variance of fire spread depending on the context.

The wildfire also takes different spread behaviors, which either include horizontal arrangement (continuous fires over a geographical area or patchy spread in particular areas within an area), or vertical arrangement (where the fires spread on the ground, along the surface, or at the aerial level). Ground wildfires include combustions on the ground and beneath, including fire spreading underground along the roots or leaves and litter along the ground. The surface wildfires involve all the materials immediately above the ground, including fires on low-lying grass, stumps, and shrubs, among others. The aerial combustions affect both the green and dead materials at the upper canopies including the tree branches and crown.

Weather and climatic factors are also critical in wildfire behaviors. They include temperature, whereby high temperatures aggravate wildfire spread compared to low temperatures. Wind is also essential in shaping the behavior of the wildfires in various ways. These include increasing oxygen supply, pushing the speed and direction of the spread of wildfires into adjacent areas, and raising fuel moisture. Other critical weather-related factors include relative humidity and changing precipitation patterns. The topographical factors that influence wildfire behaviors include the direction of slope – either the leeward side which is drier with a lighter fuel load or the windward side which is moister with a heavier fuel load. The steepness of the slope is also critical, with steeper slopes causing a more rapid spread of wildfire compared to flat grounds. The position or location of the fire along the slope is equally important, with the fires near the bottom having a higher possibility of spreading to the top as opposed to fires at the top descending downwards.

CHAPTER TWO

CHARACTERIZATION OF WILDFIRES IN THE GAMBIA

CHAPTER TWO

CHARACTERIZATION OF WILDFIRES IN THE GAMBIA

2.1 Wildfire situation The Gambia

The Gambia has witnessed a rapid escalation of wildfires in the past couple of decades, which threatens life, properties, and ecosystems. Wildfires in The Gambia, have significant impacts on ecosystems (particularly forests), the economy as well as the safety of communities adjacent to the affected areas. According to the Global Forest Resources Assessment Report (FAO, 2020), the primary causes of bushfires include land clearing, hunting, wild honey harvesting, and smoking. ThinkHazard (2023) classifies The Gambia as a country with high wildfire hazard, meaning that there are over 50% chances of encountering wildfire based on the climatic and biophysical circumstances in the country (Figure 2). The modeled climate projections predict an increase in temperatures and greater variance in rainfall patterns, which are more likely to increase the intensity and duration of wildfires. The National Forests Assessment Report (USDA, 2010) indicated that 151,000 ha of forest cover was burned in the 2010 fire season, in addition to 55,000ha and 105,000ha of other wooded land and other land types, respectively. The highly prone regions were URR, CRR, and LRR according to the report. In agreement, Duguma et al. (2020) established that LRR and CRR have the highest community-reported fire incidences at 89.8% and 67.25%, respectively. Some of the aggravating factors include high forest, woodland, and grass cover with abundant fuel loads especially during the dry seasons, as well as climate variability and change effects.

This necessitates consideration of fire management in all phases of national and local planning since fire may pose a great threat to the development process. Further, this assessment necessitates more investment in understanding the local context in which fires are occurring and in developing measures to curb them before they spread. These include having a clear policy on human activities that can aggravate fire ignition.

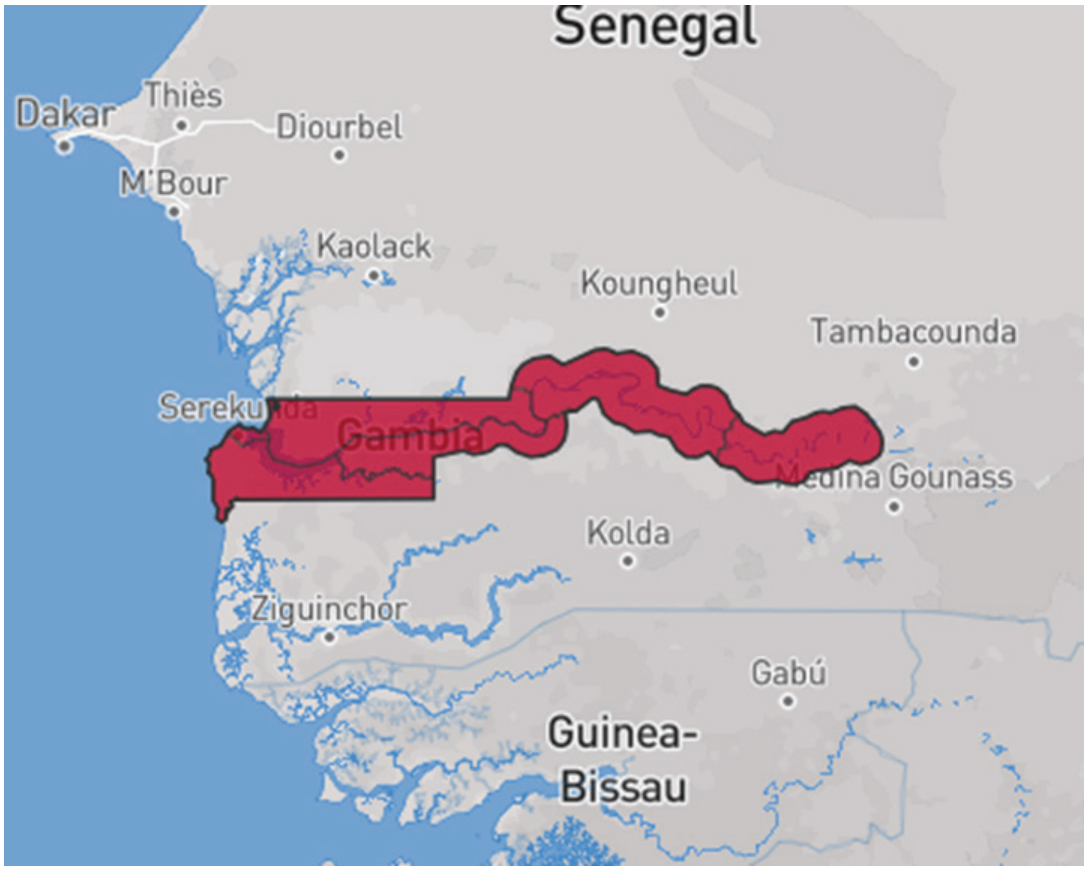

Figure 2 Wildfire hazard classification of the Gambia (Source: ThinkHazard, 2023)

2.2 Relationship between wildfires and precipitation patterns in the Gambia

In the Gambia, there is a positive relationship between wildfire incidences and precipitation patterns. In the months with the highest rainfall, there are generally minimal or no fire incidences, while in the dry months, fire incidences are highly reported. To establish this relationship between wildfires and precipitation, the authors analyzed the fire data downloaded from the Visible Infrared Imaging Radiometer Suite (VIIRS). The VIIRS sensors flag active fires using a spatial resolution of 375-meter pixels at different confidence levels. The platform provides cutting-edge technology that allows users to access near real-time information (as recent as 24 hours for fire alerts) on changes within the forestry sector globally (globalforestwatch.org). The VIIRS was launched in October 2011 and provides full global coverage of wildfires using infrared imagery data (Schroeder et al., 2014). In the Gambia, the VIIRS fire alert data suggested a general rise in the reported fire incidences in the last decade (2012-2022). The year 2023 alone witnessed 593 VIIRS high-confidence fire alerts, which is higher compared to most of the previous years, as summarized in Figure 3.

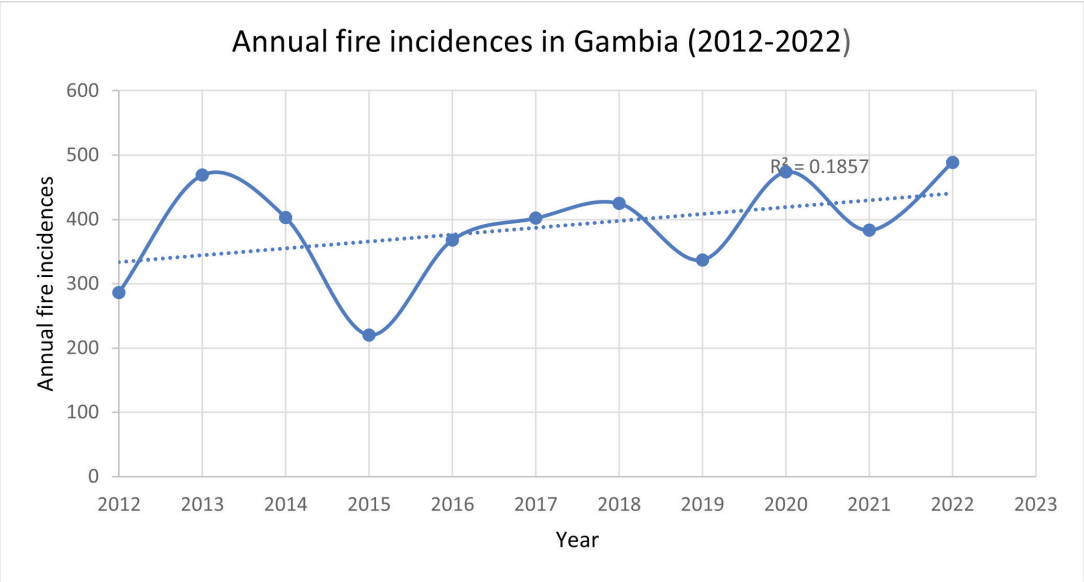

Figure 3 Annual fire incidences in the Gambia (2012-2022). (Source: Authors computation)

A closer analysis suggests that the fire incidences begin from early November and peak progressively peaking in February and then slowing down from March towards June where the most minimal incidences are reported (Figure 4). The months of July, August, September, and October have the minimum or no fire incidences. The precipitation pattern is one of the critical determinants of wildfire patterns. The Gambia experiences a Sahelian climate with two distinct seasons. The long and dry season lasts between November to June, a period which also experiences wildfire incidences, while the short-wet season lasts between July and October, a period with minimal fire incidences. Notably, there is minimal variation in average annual temperatures ranging from 27°C to 31°C as summarized in Figures 4 and 5.

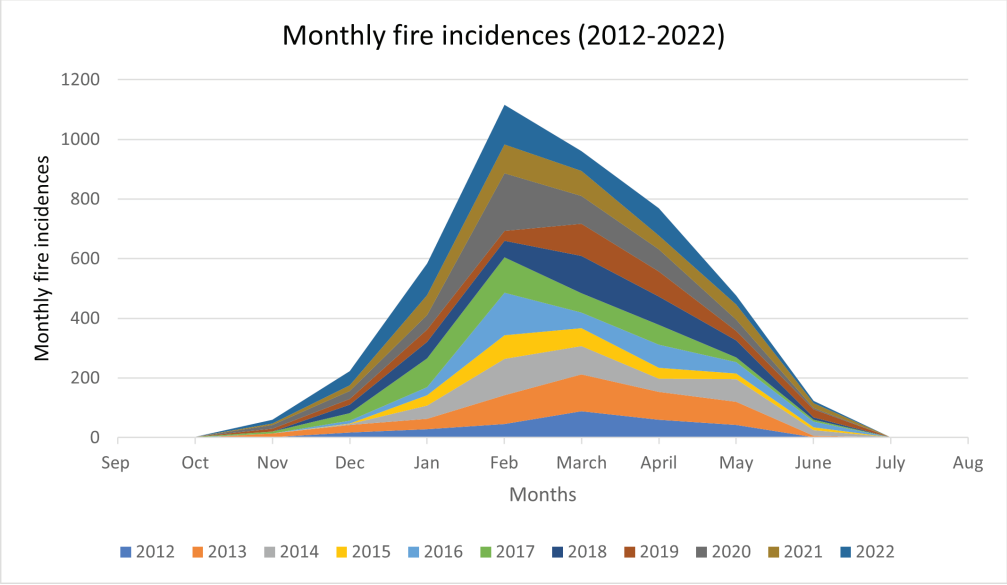

Figure 4 Monthly fire incidences (2012-2022) (Source: Authors computation)

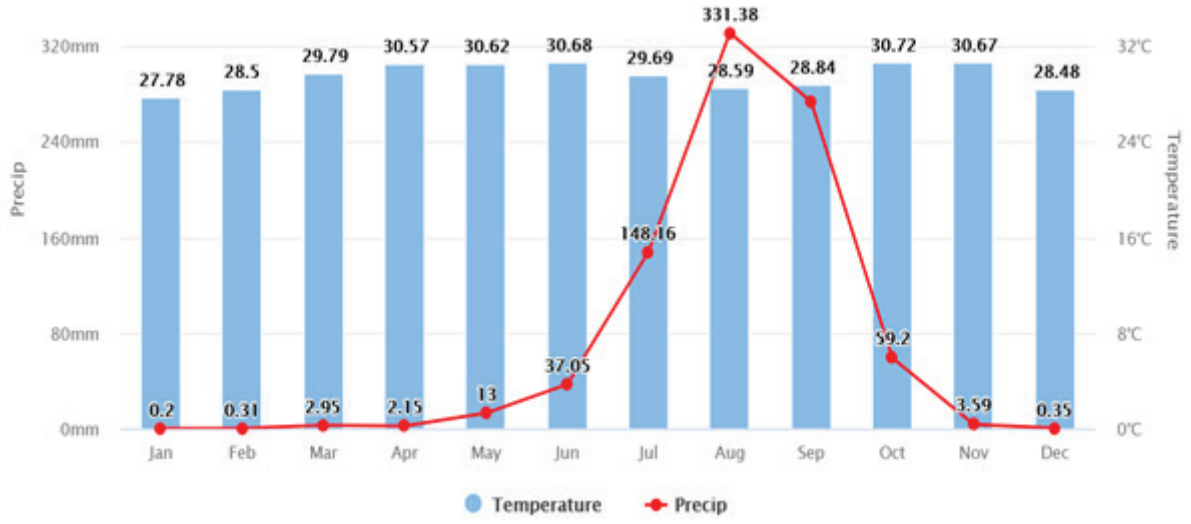

Figure 5 Monthly precipitation and temperature changes (Source (https://weatherandclimate.com/the-gambia)

Both climatic and human factors are attributed to the positive relationship between precipitation patterns and wildfires. Notably, the rains directly suppress any possible occurrence of wildfires in both agricultural and forest lands, consequently reducing fire incidences. Further, the fuel load is reduced during the rainy season since most of the vegetation is largely green. Non-climatic factors such as socioeconomic systems are also contributors to low wildfires during the rainy seasons. Most rural communities practice agriculture and usually concentrate on farm work during the rainy season, especially in growing and tending to the annual crops. This reduces activities in the forested lands that aggravate wildfires. In contrast, the prolonged dry periods attract wildfires in several ways. Notably, the dry seasons lead to the drying of the forest vegetation, including trees, shrubs, grass, and underground which increases the fuel load in the landscapes. Consequently, the slight emergence of fire spreads fast within the forests. In addition, forest-related activities such as charcoal burning, fuel wood fetching, honey harvesting, hunting, transhumance and increase during the dry period. In addition, most of the farm clearing activities take place during the dry period, including farmland clearing using fires.

2.3 Wildfires and transhumance activities in The Gambia

Transhumance and free-range animals (both domestic and foreign) also take an almost similar trajectory with wildfires and precipitation patterns in the country. The animal movements start from December all through to June during the dry seasons which are also characterized by high incidences of wildfires (Figure 6). However, whereas domestic transhumance and animal movement happen across the year, over 90% of the cross-border transhumance largely from Senegal to the Gambia occurs between January and June when it is very dry. Transhumance activities are associated with tree-cutting, overgrazing, and fire incidences as the herders move to different places in search of water and pastures in both forests and farmlands (Bah et al., 2021). Further, host communities also burn their fields after the fire incidences to destroy pests

and diseases emerging from transhumant animals to allow the regeneration of fresh grass. Therefore, addressing transhumance activities is critical in minimizing wildfires during the dry seasons.

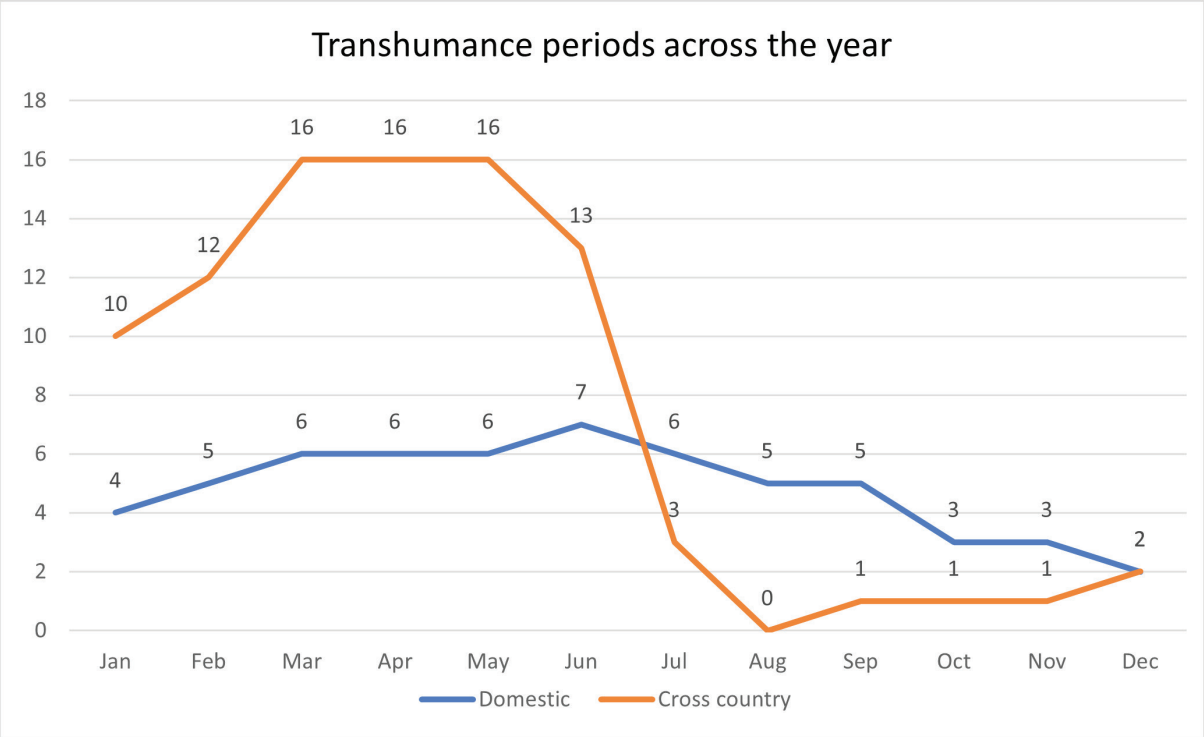

Figure 6 Transhumance in The Gambia (Source Bah et al., 2021)

2.4 Regional analysis of fire incidence in the Gambia

There is a wide variance of fire occurrence in different regions of the Gambia. Generally, most fire-prone months of the year in the Gambia are from November to June, while July to September which are wet months have the least recorded fire incidences. A regional-level analysis is critical in guiding regional and district committees in establishing the right mechanisms to put in place monthly. Months with high fire intensity could focus on more reactive measures with some level of engagement in proactive measures. The emphasis on low fire intensity months should be mainly on a proactive measure to reduce the likelihood of fire damage in the following high fire intensity months. Notably, all regions in the Gambia are prone to wildfires, though the country risk profiles prioritize fire incidences differently. To illustrate, LRR sets it at priority 1, URR priority 2, CRR priority 3, and WBR and NBR regions set it at priority 4, as summarized in Table 1.

Table 1 Risk profiles of different regions in the Gambia (Source: Duguma et al., 2020).

Region	Priority 1	Priority 2	Priority 3	Priority 4	Climate change related risks
URR	Flood	Fire	Windstorm	Drought	All
LRR	Bush fire	Deforestation	Flood	Disease outbreak	All
CRR	Drought	Hippo and pest invasion	Bush fire	Flood	All
WR	Poor wast management Deforestation	Flood Poor waste management	Accidents (Traffic) Misuse of pesticides & antibiotics	Fire Bush fire	Two of the top four are directly linked to climate change Only one is directly linked to is directly linked to climate change

2.5 Main fire drivers in the Gambia

Wild honey collection: Honey collection in the forests is one of the main causes of wildfires. People collecting wild honey can cause fires accidentally by using crude methods with lit fires to drive the bees away.

Smoking activities: Smoking activities are also a major cause of fires and have affected many forest and farm areas during the dry period. This results from the poor dumping of cigarette butts when it still has traces of ash that trigger a fire.

Crop protection and pest control: Fire is used to keep animals, namely bush pigs and monkeys, away from field crops in the rainy season, especially during the night. Farms are also burnt during the dry season to destroy smaller pests such as locusts and grasshoppers, which farmers believe lay their eggs in the surrounding forests.

Fuelwood and charcoal production: In the public forests, fuelwood and charcoal production contributes to wildfires. Fuelwood producers sometimes engage in illegal businesses such as setting the forest on fire to kill more trees to promote their businesses. Charcoal production is among the booming businesses in regions such as WCR, LRR, NBR, CRR, and URR especially during the dry periods as an alternative livelihood to earn additional income. The heat generated by the charcoal burning process aggravated by strong winds spreads quickly to the dry litter and can easily cause wildfires.

Litter and fuel loads in the forests - The Gambia has extensive dry savannas and dry forests that are dominated by tall grasses – some as tall as 2-3 meters. During the dry period, dry grass contributes to combustible fuel load both underground and spreads further to adjacent tree canopies due to the height of the grass. With the ranging winds, such wildfires spread quickly and may cause massive damage to the biodiversity and forests.

Figure 7 The tall savannah grasses (especially Andropogon grass) dominate the Kiang West National Park. During the dry period, the grass adds to the fuel load aggravating the spread of wildfires (Photo: ICRAF).

Forest and farmlands-related activities: Wildfires can also emerge from controlled early burning and firebreak preparation activities conducted by the communities and foresters. This affects both the forests and farmlands where these activities are conducted. A study by FAO (2003) notes that farming and herding are significant contributors to wildfires through uncontrolled fires resulting from burnings. This is more common when the farmers are preparing their farms for planting before the rains. This calls for proper coordination when conducting such activities with clear fire suppression mechanisms in case the fire becomes unmanageable.

Figure 8 Charcoal burning near dried grass that easily propels wildfire spread (Photo: ICRAF).

Sparks from faulty vehicles: Though not widely mentioned and researched, there is still some evidence that badly maintained combustion engines can throw sparks from their exhausts when being operated. As with cigarette butts, this can cause the grass cover along roads to catch fire.

Livestock grazing and transhumance activities: animal movement especially during the dry season in search of water and pasture is characterized by the cutting of tree branches to feed the livestock, which contributes to underground litter and fuel load. The damaged trees are also exposed to drying further increasing the fuel load. Cattle herders also practice burning dry grass towards the beginning of the rainy season to allow for grass regeneration.

Cross-border fires - some wildfires come from the Senegal border and largely affect the bordering regions and districts. It is hard to control such fires unless there are concerted efforts from both sides.

FAO (2003) attempted to rank the percentage contribution of different activities to wildfires and established that clearing farms for weeds and clearing harvest leftovers were among the main causes as summarized in the table below.

Table 2 Leading causes of wildfires in The Gambia (Source: FAO, 2003)

Activity category	Total observation	Percentage
Clearing of harvest leftovers	78	69
Clearing of weeds	66	58.4
Control of wild animals	40	35.4
Insect and pests' control	18	15.9
Cooking/roasting	18	15.9
Insect and pests' control	18	15.9
Clearing in general	17	15
Fertilization	12	10.6
Preparation for planting	10	8.8
Processing of oysters	1	0.9

2.6 Learnings from previous fire management experiences

The strategy draws from interesting experiences in The Gambia, Africa, and globally. We particularly draw from the insurance programs in The French Meadows Project and carbon projects in California, community forests and co-management approaches from The Gambia, Vietnam, and Ghana, and carbon additionality projects in Australia and British Columbia.

Wildfire resilience insurances are designed to pay certain aspects (parameters) of wildfires if they are met or exceeded. An example, the insurance can pay the insured parties a certain amount of money if a given threshold of burning (for example acres burned or livelihoods lost) and the right precautions had been observed to prevent the fires. This cushions both the insurance company and the insured parties to a given predetermined extent. The approach was adopted in the French Meadows Project (California) to insure wildfire risks and quantify the insurance benefits of ecological forestry. One of the major lessons from this model is the need for contextualized insurance schemes to insure 'parts' or 'whole' of the damage resulting from wildfires. The approach can also reduce risks of damages related to wildfires, promote ecological and livelihood benefits, and foster private-public partnerships in wildfire management. Through contextualized insurance schemes in The French Meadows Project, the wildfire-related losses were reduced by 44% (a total of $22.7 million of value at risk) (The Nature Conservancy, nd). Such an approach can be modeled in the Gambia to enhance public-private partnerships in wildfire risk management.

Community-based wildfire management approaches and co-management of community forests have played a significant role in wildfire management in countries such as Ghana, Vietnam, and California State, USA. The co-management plans establish fire committees and by-laws for the use and management of local forests. Some of the key successes of this approach include increased user rights and co-ownership of the community forests to promote their sustainable use. To illustrate, some communities in fire-prone areas have established fire breaks, early burning, fire patrols, and other mechanisms to manage wildfires. FAO and FILAC (2021) report

that co-management approaches improved the relationship between government agencies and indigenous communities, in addition to reducing wildfire risk by between 40% and 57% in fire-prone areas in Latin America and the Caribbean. Co-management needs to be scaled and integrated with more modern technologies for effective wildfire management. It's also notable that most wildfire management approaches are short-term in nature, calling for more proactive and long-term strategies.

Wildfires are associated with the emission of greenhouse gases, especially carbon. Carbon financing can play a crucial role in financing the restoration of burnt areas and cushioning investments around forests. In Northern California, carbon financing led to the reforestation of over 2 million trees, spread across over 10,000 acres through financing generated from carbon credits[1] (Wildish, 2023). The avoided wildfire emissions method allows forest owners to receive carbon credits for forest management and restoration in ways that reduce or avoid wildfires. In Australia, the savanna fire management methods use strategic fire management to cut down emissions and in the process earn carbon credits units (Nikolakis et al., 2022). Some of the conditionalities for a successful program include the development of a national compliance market (legislation), government support in carbon farming, and strong carbon markets with competitive prices. Over 130 projects are already registered with the Australian Government with the potential to abate over 13.8 MtCO2e over some time (Nikolakis et al., 2022). The additional benefits from the carbon initiatives include employment creation, livelihood support, strengthened local governance structures, and improved food security, among others. As such, carbon projects can aim for total benefits with minimal trade-offs. In British Columbia, grassland burning projects have the potential to abate several thousands of metric tonnes of carbon annually. Through verified carbon standards such as avoiding forest degradation through fire management, such projects can earn the communities and government money through the sale of carbon credits. Carbon credits can be explored as an incentive for forest protection from the wildfires in The Gambia in line with the existing international standards, with emphasis on additionalities that come with such interventions.

1 https://us.1t.org/stories/carbon-credits-and-wildfire/

CHAPTER THREE

VISION AND MISSION OF THE STRATEGY

CHAPTER THREE

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3.1 Vision and mission

The strategy envisions reduced wildfire incidences with resulting thriving forested and agricultural ecosystems that provide multiple goods and services for social, economic, and ecological benefits to the Gambia and the larger West Africa region.

The mission is to integrate all aspects of wildfire management to provide human safety, support emergency response, protect forests, biodiversity, natural resources, grasslands and other assets, using innovative and effective fire management strategies.

3.2 Goal

The broad goal of the national fire management strategy is to safeguard forest and agricultural resources as well as lives and livelihoods from the adverse effects of wildfires. This is in line with the Department of Forestry's strategy of achieving a healthy and functioning forestry sector. Achieving this goal calls for the engagement of all stakeholders (including the government and its agents, local communities, local authorities, farmers, and farmer groups) who are affected directly or indirectly by wildfires to take active roles in the management of wildfires. The goal is anchored on four main principles that are in line with the Gambia National Forestry Strategy, which includes:

- **Governance of forest resources** – establishing and strengthening the national and local governance systems and capacity, including early warning systems and enhanced fire management strategies is essential in achieving the desired goal.
- **Promoting inclusivity and integrated approaches in wildfire management** – multistakeholder and multisectoral approaches are essential in realizing the strategy's goal. Inclusivity entails bringing diverse stakeholders and interest groups together towards a common goal of fire management, while integrated approaches involve bringing together traditional and modern knowledge and mechanisms of firefighting.
- **Enhancing participatory forestry co-management and community forestry** – strengthening communities in co-management models is critical in addressing wildfires. Communities are key stakeholders in the management of their immediate resources, and strengthening their capacity to implement their agreed bylaws and policies through their local structures can reduce wildfires.
- **Research and development** – bridging the science-policy-practice nexus in wildfire management is essential. This entails combining mainstream and community science to bring together new and existing (traditional) knowledge in managing wildfires in the country. Investment in research in policy and decision-making is key and requires investment in capacity building of relevant institutions such as the forestry department in managing forestry resources and the meteorology department in providing weather and climatic information to inform decisions.

3.3 Key wildfire management approaches

Three broad wildfire management approaches are established in this strategy, including wildfire prevention and preparedness,

- **Wildfire prevention and preparedness approaches** – there are a wide range of interventions that are put in place to prevent the occurrence of wildfires. These include controlled early burning, the establishment of water points, the establishment of fire breaks around and within the main parks and forests, awareness creation, the development of early warning systems, the management of fuel load, continuous surveillance, education, enforcement and establishing community-level response mechanism
- **Wildfire response approaches** – these are broad activities and approaches that are used to suppress fire when it occurs, including timely reporting and communications, and fire suppression using different mechanisms – mostly traditional such as using soils, water, fire beating, and other traditional approaches, and evacuation of affected communities. There is a need for more investment in modern technologies such as modern firefighting equipment, proactive surveillance technologies to establish the extent of the fire, and the creation of active barriers to slow down the raging fires. Responses should also include relief and humanitarian activities for the affected population to save lives, protect livelihoods, provision of food and basic amenities such as food and shelter, and insurance for agroforestry and orchard farmers.
- **Wildfire recovery and restoration strategies** – after the fire occurrence and suppression, recovery and restoration strategies are put in place to restore the damaged ecosystems. These include surveillance to assess and communicate the damage, restoring damaged areas, resettlement of evacuated populations back to their lands, facilitating recovery of the lost vegetation, and reconstruction and restoration of the damaged infrastructure.

3.4 Key gaps in managing wildfire in the Gambia

There are several efforts already in place to address the wildfire occurrence in the Gambia at national, regional, and local levels. However, there remain some gaps that have frustrated adequate planning and management of wildfires in the country. Some of them are highlighted below.

a) ***Inadequate wildfire information management systems***

The country has no centralized platform or portal where different interest groups can access adequate and updated information on fire occurrence for effective planning. Further, there is no standard mechanism for recording, verifying, and disseminating information and data related to wildfires. Notably, most of the wildfire cases are not clearly documented and shared for future management lessons. This gap necessitates the centralization of wildfire information and data that users can easily access and use for future planning.

a) ***Inadequate coordination***

The role of wildfire management is not anchored in any particular institution or policy. To illustrate, different departments have a particular role to play in different landscapes. For example, the Forestry Department has a role to play in fire management in forests, the Agriculture Department in the farms, and the National Disaster Management Agency (NDMA) have a national and cross-cutting role in managing different types of risks and disasters. As such, there is a need to anchor the coordination role within a particular institution as the establishment of a policy towards wildfire management. In addition, there is a need for proper capacity development for both the personnel in the form of training and institutions in terms of providing the right resources and equipment for effective playing of the related role.

b) ***Inadequate awareness***

There is a form of awareness of wildfires in the Gambia even at the community level. For example, communities have a traditional system that they use to establish when to conduct controlled early burning and development of firebreaks. However, this needs to be complemented by technologically advanced approaches that can collect, analyze and disseminate the right information and data to enhance awareness. To illustrate, there is global data such as VIIRS (discussed in the previous sections) which provides real-time data on fire signals. However, this can be scaled down to national and regional levels to enhance awareness and evidence-based decision-making about wildfire management.

c) ***Inadequate incentives and dis-incentives***

There are no adequate mechanisms to incentivize preventive wildfire management. for example, there is no motivation for farmers who have established early fire burning to protect their plots and communities establishing fire breaks in their community forests. Incentives have been proven to work well in managing wildfires. To illustrate, the large-scale ecosystem-based adaptation project engaged the local communities in establishing firebreaks around Kiang West National Park, which played a crucial role in reducing fire intensity within the park. The firebreaks also played an important social role in opening and connecting different communities such as Kwinella, Tendaba, and Batelling. Other forms of incentives may include training and developing enterprises around Andropogon grass which is a major causative agent of wildfires in the country. Such incentives are important in encouraging participation in wildfire management.

d) ***Unclear zonation of wildfire***

Wildfires affect different regions and zones differently. However, there remains a gap in mapping the wildfire hotspots from where they spread to other regions. Wildfire zonation is important in establishing where to concentrate the efforts for fire management and conducting regular monitoring. This is also important for learning and documentation of triggers of wildfires in the country and possible long-term measures to address them. In addition, there is insufficient information and data related to regional assessment of wildfires and well-developed regional-level plans for wildfire management. The large-scale ecosystem-based adaptation project has made the first attempt to develop regional-level wildfire management plans which should be scaled to cover the entire country, with mechanisms to implement them.

CHAPTER FOUR

POLICY AND INSTITUTIONAL CONTEXT IN THE GAMBIA

CHAPTER FOUR

POLICY AND INSTITUTIONAL CONTEXT IN THE GAMBIA

4.1 National policies relating to wildfire management.

There have been attempts to address wildfires in the Gambia through local, regional and national policy interventions. It is notable that foresters, farmers, and pastoralists all comprehend forest fires differently, and often in very divergent ways. As the frequency of forest fires increased and the Forestry Department was unable to cope, people were invited to organize fire committees to raise awareness of and coordinate forest fire issues at the village level. Most villages had fire committees by the second half of the 1980s, but due to a lack of resources, they were unable to execute their intended duty, and most of them ceased to exist.

a) ***Constitution of The Republic of The Gambia***

The constitution entered into force in 1997 and has undergone several amendments. It is the supreme law of the land and every other Act and Policy must be consistent with the constitution

b) ***The Gambia Fire Services Act (Act No. 4 of 1964)***

This Act provided for the establishment of The Gambia Fire Service which is responsible for extinguishing fire and protecting lives and properties in the Country. It further provided for the roles of this department and protocols to adopt before, during, and after fire incidences.

c) ***Forest Policy, 1995-2005; 2010-2019; 2023-2032***

The Forest Policies in The Gambia aimed to improve conservation, sustainable management, and expansion of the forests, with the current (2023-2032) policy aiming to achieve at least 30% of forest cover in the country. They established that forest fires are among the major threats to forest conservation and development in the country, and established the critical role played by different actors, such as District authorities and Forestry Departments in wildfire management. Further, barriers such as inadequate resources and human capacity to manage forest fires are highlighted in these policies. The policy recognized that unless everyone becomes a stakeholder, sustainable forest management will always be an impossible goal. It provided opportunities for both private and community forestry management.

d) ***The Gambia Forest Management Concept (GFMC)***

This concept was developed by the Forestry Department borrowing from its vast experience in forest management. It was developed in 1995 and revised in 2001 and provided the frame for the Forest Policy and Forest Act. It envisions at least 30% of gazette forest cover managed under forest parks, community forests, private forests, and protected areas. The nucleus concept of the GFMC concept is that forests are unevenly distributed, fulfill different ecological and economic roles, grow in different niches and terrains, and are used by different people for different uses, hence the need for different management approaches. The concept acknowledges the

challenges related to fires and introduces the concept of forest fire management plans and mapping.

e) ***Forest Act, 2018***

The new Forest Act (PART X – Management of Forests, Section 79) requires that "Every Regional Office Forest shall keep and progressive update an assessment of forest fires which have occurred, including;

a. a map showing the forest sites for each year; and

b. the extent of every fire, its possible causes, date, duration, and information on how it has been extinguished.

Section 80 of the Act buttressed the need to develop Fire Management Plans, including identifying designated zones for high-priority protection, designating zones for early controlled burning, map of natural and artificial fire breaks and attack lines, setting out an incident command system, providing a list of firefighting equipment, list of villages and people to be contacted, setting out periods and areas for burning to be permitted, promoting sensitization and extension programs and providing details for fighting fires within zones.

The procedure for adopting the Fire Management Plans requires the Regional Forest Office to consult the regional office responsible for the environment, the fire department, concerned communities, and all other stakeholders within the region.

The Forestry Legislation and Regulations (1998, Part IV Section 19) hold district, town, village, and community leaders accountable for maintaining the territories under their authority from the ravages of forest and bushfires. If they are proven to be negligent in their duties about such fires, they may face the penalty for violation. If the fire erupts between two villages and the perpetrator cannot be identified, the heads of the two communities are held accountable. Part IV Section 17 also charges the forest committees with the task of safeguarding their community forests and any other piece of public forest within the area against fires. They must develop sufficient protocols to ensure the safety of their forests from fire. Laws mandating public engagement in forest fire suppression are viewed as punitive by local communities and authorities. The village leaders, in particular, claim that the law holds them liable for fires over which they have no control. They also claim that their adversaries, both inside and outside the group, can ignite fires to cause them problems. Promulgation, as with any other act, is significantly easier than execution. For fear of losing favor, district chiefs are frequently hesitant to move against their constituents. Forest offenses, including forest fires, have been sanctioned with fines and prison terms. According to the Forest Act (Schedule), forest fire offenses carry the highest fines and prison terms.

4.2 Summary of different types of institutions relevant to the strategy and their potential roles

4.2.1 Government ministries and their relevance to the wildfire strategy

Different government ministries in The Gambia have different roles that they can play in the effective execution of this strategy. Some of these institutions and their roles are summarised in Table 3.

Table 3. Ministerial framework relevant to the wildfire strategy

Name of the ministry	Roles	Relevance to the wildfire strategy
1. Ministry of Agriculture	MoA is responsible for providing the overall supervisory, regulatory, policy guidance, coordination and monitoring and evaluation role for the public sector in agriculture.	→ The Ministry is responsible for developing and enforcing policies and guidelines related to agricultural land use, agricultural practices, and forestry that impact fire management. → They conduct awareness campaigns and educational programs to inform farmers, communities, and stakeholders about fire prevention methods, safe agricultural practices, and responsible land management to prevent wildfires. → The Ministry is involved in land use planning and zoning regulations. Proper planning helps in creating buffers and appropriate boundaries between agricultural lands and forests, reducing the risk of accidental fires. → The Ministry collaborates with various agencies, including the Department of Forestry, local government bodies, NGOs, and international organizations, to coordinate efforts in fire prevention, early detection, and fire suppression. This collaboration ensures a unified approach to managing fires effectively
2. Ministry of Environment, Climate Change, and Natural Resources	MECCNAR is responsible for overseeing and coordinating the development and implementation of policies and programs relevant to the environment, climate change, and natural resources management.	→ Formulation and enforcement of policies and regulations related to environmental conservation, forest management, and climate change adaptation that directly or indirectly impact fire management strategies. → Conducting awareness campaigns and educational programs to inform the public, communities, and stakeholders about fire prevention methods. → Integration of fire management strategies into broader climate change adaptation plans, focusing on mitigating risks and building resilience.
3. Ministry of Lands, Regional Government and Religious Affairs	The ministry is responsible for effective land resource management and local governance	→ The Ministry plays a role in land use planning, zoning regulations, and overseeing regional governance → Advocating for policies and regulations that support fire management initiatives, especially regarding land use planning, sustainable practices, and disaster management at the regional level

4. Ministry of Gender, Children and Social Welfare	The ministry aims to create a harmonious and inclusive society	→ Offer support to affected families especially women and children displaced during a fire. → Providing counseling and psycho-social support to individuals and families affected by fire incidents, as they might experience trauma and emotional distress. → Collaborating with communities to raise awareness about fire prevention, safety measures, and emergency response protocols. → Advocating for policies and measures that consider the needs of vulnerable groups in disaster management plans, including fire incidents, to ensure their protection and well-being.
5. Ministry of Fisheries and Water Resources	The ministry aims to promote the sustainable development of fisheries, climate, and water sectors	→ The ministry's focus on preserving water bodies, wetlands, and aquatic ecosystems contributes to overall environmental health. Healthy ecosystems can serve as natural buffers against wildfires by maintaining moisture levels in the surrounding areas. → In the aftermath of fires, especially those that affect water bodies or aquatic ecosystems, the Ministry can be involved in rehabilitation efforts aimed at restoring affected water resources and ecosystems.
6. Ministry of Finance and Economic Affairs	The ministry is responsible for financial and economic policies in the Gambia through different departments	→ Allocating funds for firefighting equipment, training, and resources required by other ministries or agencies directly involved in fire management. → The Ministry can be involved in mobilizing resources, including seeking financial assistance or grants from international organizations, donors, or aid agencies to support fire management programs and initiatives. → Allocating funds for the development of infrastructure that aids fire management, such as establishing firebreaks, improving access roads for firefighting vehicles, or investing in technology for early detection and monitoring of fires → Exploring options for insuring public or private assets against fire-related risks. Engaging in risk assessment and management strategies to minimize financial losses due to fires. → Assessing the economic impact of wildfires on agriculture, forestry, and other sectors can be within their purview. Understanding these impacts can inform budgetary decisions and strategies for mitigating losses. → Allocating funds for capacity-building programs, training, and skill development related to fire management for relevant government agencies and communities.

4.2.2 Government departments and their relevance to the wildfire strategy

The Gambia has numerous government departments that could play a pivotal role in pushing the implementation of the national wildfire strategy for sustainable landscapes and livelihoods as summarized in Table 4.

Table 4 Government departments relevant to the wildfire strategy

Institution	Mandate	Relevance to the strategy
1. Department of Forestry (DoF)	The Department of Forestry is responsible for the sustainable management of the forest resources and coordinating the implementation of the forest policy which aimed to transform the sector into a medium and long-term development framework.	→ The department is involved in the Development/updating of early warning systems for forest fires. → Involved in risk assessment and fire risk mapping. → Enforces laws and regulations relevant to the prevention of forest fires. → Conduct a rapid assessment immediately after a fire incident is reported. → Involved in the rehabilitation of fallow land through planting of trees. → Involved in the creation of buffer zones in forest-fire-prone areas using exotic tree species. → Updates the contact list of forest rangers and links them to the Regional Disaster Management Committees (RDMC). → Creates and maps out access routes to forest areas, nature reserves, and national parks. → Carries out sensitization campaigns on forest laws, enforcement, fire prevention, control, and management. → Provides equipment for fighting forest fires. → Conducts training of rangers, forest guards, and communities in fire-fighting skills and techniques
2. Department of Community Development (DoCD)	The Department is mandated to enhance and promote the empowerment of communities in charting their destiny through participatory development processes.	→ Providing training and capacity-building initiatives for community members on fire prevention, early detection, and basic firefighting techniques → Focusing on the needs of vulnerable groups within communities, such as women, children, and the elderly, in fire preparedness and response plans → Supporting or facilitating community-led initiatives for fire prevention, such as establishing firebreaks, organizing fire patrols, and implementing controlled burning practices.
3. Department of Agriculture (DoA)	The department is responsible for agricultural activities in The Gambia.	→ Implementing programs focused on fire prevention in agricultural areas adjacent to forests or in areas where agricultural practices might pose a fire risk. This can include educating farmers on responsible land clearing and burning practices. → Engaging with farmers to encourage the adoption of practices that reduce fire hazards, such as creating firebreaks, using controlled burning for land management, and promoting alternatives to burning for waste disposal. → Collaborating with relevant agencies to establish or support early warning systems for detecting and reporting fire incidents in agricultural areas. → Monitoring fire risks in agricultural areas and reporting potential fire hazards or incidents to relevant authorities for prompt action
4. Department of Parks and Wildlife Management (DPWM)	DPWM is responsible for the community protection of parks and wildlife, and implementation of related policies.	Working with relevant department to protect and conserve The Gambia's wild fauna from wildfire hazards, • create awareness on prudent use of wildlife resources and their protection

5. Department of Water Resources (DWR)	The DWR is mandated to regulate and manage the sustainable utilization of water resources.	→ Ensuring availability and access to water resources for firefighting purposes. Water sources can be crucial for firefighting efforts, especially in remote forested areas where water access might be limited. → Contributing to the development of infrastructure that aids in fire management, such as ensuring water availability for fire trucks, establishing water reservoirs, or maintaining hydrants in strategic locations for firefighting purposes → Working in collaboration with relevant agencies during fire incidents to provide necessary water resources for firefighting operations. Coordinating efforts to ensure efficient utilization of available water sources for firefighting purposes. → Collaborating with other departments or agencies to integrate water resource management into land use planning strategies
6. Department of Livestock Services (DLS)	DLS is responsible for the management of the livestock sub-sector.	→ Demarcation of stock routes in consultation with DoF and affected communities. → Establishment of water points in strategic locations to aid in firefighting → Creation of buffer zones for livestock feeding grounds

4.2.3 National agencies and their relevance to the wildfire strategy

There are other groups such as national agencies, national community groups, science and academia, and other institutions drawn from the public, private, and community sectors that can play a crucial role in the wildfire strategy implementation in the Gambia. Some of them are summarized in Table 5.

Table 5 National agencies and their relevance to the wildfire strategy

Institution	Mandate	Relevance to the strategy
1. The National Assembly	The key roles of the National Assembly are lawmaking, representation, and oversight.	→ Formulation of the relevant laws and policies on wildfire management → Representation of communities affected by wildfire for relevant support and compensation
2. The Gambia Fire and Rescue Services	Saving and rescuing lives and properties during fire incidences	→ Provision of fire management and rescue services to save lives, livelihoods and ecosystems during the outbreak of fires
3. National Environment Agency	NEA is the main technical body responsible for ensuring that the environmental resources are judiciously used sustainably.	→ Enforces laws and regulations relevant to forest fires. → Ensuring an environmentally sustainable economy before, during and after fire incidences

4. National School of Forestry	Training of students in forestry at certificate and diploma levels.	→ Offering specialized training programs or courses focused on forest fire management. → Researching fire behavior, prevention methods, early detection technologies, and ecological impacts of forest fires. This research helps in developing effective fire management strategies and understanding the local fire ecology → Integrating forest fire management modules into the forestry curriculum to educate future foresters about fire prevention, suppression techniques, and the ecological role of fire in forest ecosystems. → Organizing field demonstrations, exercises, or simulations to provide hands-on experience for students in fire suppression techniques, fireline construction, controlled burning practices, and other firefighting methods. → Providing advice and guidance to government bodies, forestry departments, and other organizations on fire management policies, strategies, and practices based on research findings and expertise
5. National Coordinating Organization of Farmer Associations Gambia (NACOFAG)	NACOFAG is the farmer umbrella group in The Gambia.	→ NACOFAG can raise awareness among farming communities about the risks and impacts of forest fires. → Encouraging sustainable agricultural practices that reduce the risk of accidental fires, such as controlled burning for land preparation, creating firebreaks, and avoiding practices that increase fire hazards → Mobilizing farmers to participate in fire prevention efforts, including organizing community-led initiatives for fire prevention, preparedness, and response → Encouraging farmers to be vigilant and report any signs of fire outbreaks promptly
6. Soil and Water Management Services (SWMS)	The SWMS oversees developing policies on soil and water management, and land capability zoning.	→ Contributing to land use planning strategies that consider fire management aspects, such as creating firebreaks, zoning regulations, or implementing land management practices that reduce fire risks → Researching soil-water-fire interactions to better understand the relationship between soil and water management practices and their impact on fire susceptibility
7. National Agricultural Research Institute (NARI)	NARI is the main national body undertaking research for sustainably improving the agricultural sector.	→ Identifying and promoting fire-resistant plant species → Conducting studies and assessments to understand the factors contributing to fire risk in agricultural landscapes → Providing training and technical assistance to farmers, agricultural extension workers, and relevant stakeholders on fire prevention, early detection, and fire management practices tailored to agricultural settings
8. National Disaster Management Agency (NDMA)	The NDMA has the authority to engage in planning, coordination, and implementation activities related to disaster risk reduction at both the national and local levels.	→ Provides vulnerability-based basic needs to displaced community members (food, shelter, medical services) → The department is involved in the development/updating of early warning systems for forest fires → Involved in risk assessment and fire risk mapping → Conducts training of Rangers, Forest guards and communities in firefighting skills and techniques → Provides equipment for fighting forest fires → Provides fire treatment kits in health centers

9. Renewable Energy Association of The Gambia (REAGAM)	REAGAM is active in the promotion of the renewable energy sector in The Gambia.	→ Encouraging the use of clean and sustainable energy sources as alternatives to traditional biomass fuels. This can indirectly reduce the risk of accidental fires caused by the use of open fires for cooking or heating. → Educating communities about the responsible use of renewable energy technologies to minimize fire hazards → Encouraging and supporting sustainable land management practices that integrate renewable energy solutions, such as promoting solar-powered irrigation systems or clean energy technologies in forestry-related activities, which indirectly contribute to reducing fire risks
10. University of The Gambia	The UTG through the School of Agriculture and Environmental Sciences is mandated to provide the human resource base required to sustainably manage and develop the country's agriculture and natural resources (e.g., land, marine, and aquatic).	→ Offering academic programs, courses, and research opportunities focused on forest ecology, environmental science, natural resource management, and related fields. → Providing training and workshops for forestry professionals, firefighters, community leaders, and relevant stakeholders on fire prevention, firefighting techniques, and ecosystem restoration following fire incidents → Contributing research and expertise to inform policy development related to forest fire management, advocating for regulations that support fire-resilient landscapes and sustainable land use practices → Researching to develop and refine fire management strategies, including early detection systems, fire risk assessment models, and sustainable fire prevention and suppression techniques
11. The Gambia National Youth Council (NYC)	To mobilize, coordinate, and supervise youth organizations, implement national youth programs, and advise the government on youth matters	→ Mobilizing young people within communities to participate in fire prevention initiatives → Advocating for policies that prioritize forest conservation and fire management → Organizing community events, forums, or discussions that involve youth in dialogues about fire prevention and the protection of natural resources. Encouraging youth to be active stakeholders in fire management efforts → Organizing volunteer groups or community service projects that focus on fire prevention and environmental conservation
12. The Gambia Federation of the Disabled (GFD)	The umbrella organization that represents the disability sector and brings together all Disabled Peoples Organisations (DPOs) and People With Disabilities (PWDs) in The Gambia.	→ Ensuring that fire safety information and awareness campaigns are accessible to people with disabilities. This involves providing information in various formats, such as braille, audio, or sign language → Conducting training sessions or workshops tailored to people with disabilities on fire prevention, safety measures, and evacuation procedures during fire incidents. → Advocating for inclusive fire safety policies and practices that consider the needs of people with disabilities in emergency planning and evacuation procedures → Providing support and guidance to individuals with disabilities and their families during fire incidents, ensuring their safe evacuation and access to emergency services.
13. Gambian Women Bureau	The bureau gives policy guidance and proposals to the Gambia Government on issues affecting women	→ Mobilizing women within communities to participate in fire prevention and management initiatives. They can encourage women's groups to be proactive in activities like creating firebreaks, monitoring forested areas, and promoting responsible land use practices → Providing training and workshops for women and community members on fire prevention, early detection, and basic firefighting techniques. Equipping women with knowledge and skills can empower them to take an active role in preventing and containing fires → Advocating for inclusive fire management policies that consider the role of women in forest conservation and fire prevention

4.3 Summary of relevant policies, strategies, and plans

4.3.1 Global and regional outlook of the policies and strategies

Policies and strategies of fire management have evolved significantly in recent years as the world grapples with the increasing frequency and intensity of wildfires. One key aspect of evolution is the recognition of the interconnected nature of wildfires and climate change. Rising temperatures, changing precipitation patterns, and prolonged periods of drought contribute to the conditions conducive to wildfires. Consequently, fire management strategies are increasingly being integrated into broader climate change mitigation and adaptation plans. Countries have improved and adjusted their wildfire management procedures in response to the increasing frequency of intense wildfires. While doing this, enhancing emergency preparedness and response capabilities has received a great deal of attention (Rodrigues et al., 2023). Additionally, they have enhanced their fire monitoring capabilities in an endeavor to identify wildfires at an early stage. Systems for early warning and evacuation have been strengthened in response to the vulnerabilities found during severe wildfires.

ECOWAS community has also recognized wildfires as a major disaster in the region. To that effect, it has developed various initiatives such as ECOWAS Environmental Policy (2008), ECOWAS Humanitarian Policy, (2012), and ECOWAS Policy for Disaster Risk Reduction (2006). Governments in the region are acknowledging the need for comprehensive, cross-sectoral approaches that not only address the immediate threats posed by wildfires but also work towards long-term resilience in the face of a changing climate. To facilitate and include the implementation of policies and strategies on fire management into more comprehensive programs, several governments have partnered with local and indigenous groups. Additionally, nations have established initiatives to support the inclusion of indigenous and customary knowledge in policy-making processes (OECD, 2021). There are still significant policy gaps in the restoration of natural fire activity, which is a crucial component of ecosystem restoration in some places. The lack of natural fire activity in ecosystems that are adapted to fire is sometimes attributed to a lack of technical expertise and a distorted perception of risk. This can have long-term effects on the health of the ecosystem and its ability to withstand future wildfire risks (UNEP, 2022).

Fire management is characterized by a holistic and adaptive approach that recognizes the complex interactions between wildfires, climate change, and human activities. By integrating policies and strategies that address both immediate and long-term challenges, fostering international collaboration, empowering local communities, and harnessing technological innovations, the world is working towards a more resilient and sustainable approach to fire management in the face of an increasingly fire-prone environment.

4.3.2 National and regional policy context of wildfire management

Table 6 National and regional policy context of wildfire management

Policy/strategy/ plan	Lead institution	Link to wildfire strategy
National Forest Action Plan (NFAP) 2019 – 2028	The Department of Forestry (DoF) - Ministry of Environment, Climate Change, and Natural Resources	→ **Integrated Forest Fire Management (IFFM):** Adopting a comprehensive approach that combines prevention, preparedness, response, and recovery measures. IFFM recognizes the interconnection of ecological, social, and economic aspects of fire management. → **Joint forest park management (JFPM):** this provided adjacent local forest communities greater opportunities such as taking over more responsibilities (control 3 and patrolling, fire prevention and fighting, planting of trees → **Community-Based Fire Management:** Empowering local communities to actively participate in fire prevention and response. This includes education, training, and the establishment of community fire management organizations.
National Forestry Strategy 2019-2028	The Department of Forestry (DoF) - Ministry of Environment, Climate Change, and Natural Resources	→ Sets the national forestry aspirations, vision, and guidance principles toward achieving the national forestry goals and highlights the challenges → Lays a foundation for wildfire strategy achievements
National Development Plan (NDP) 2018-2021 (GoTG, 2017).	Office of the President	→ Increase the level of participation in bush fires management and control through mechanisms such as early control burning
Second Nationally Determined Contribution (NDC) of The Gambia	Climate Change Secretariat - Ministry of Environment, Climate Change, and Natural Resources	→ **Re-greening degraded landscapes** (including protected forests) - Mitigation of approximately 373 GgCO2e in 2030 through fire prevention and control
National Forestry Policy	Government of Gambia - Department of Forestry	→ **Integrated resource management programming** - To engage local communities and their forest committees on bush fire prevention and mitigation programs through extension activities → Engage partners to develop new strategies for the prevention and control of bushfires as the most important agent of forest and range land destruction
National Climate Change Policy (GoTG/EU, 2016)	Ministry of Environment, Climate Change, and Natural Resources.	Capacity development for fire and rescue services
National Disaster Risk Reduction and Management Policy (GoTG, 2007)	National Disaster Management Agency (NDMA)	→ **Disaster Prevention and Preparedness** - Creation of fire belts

Agriculture and Natural Resources Policy, 2017-2026. (GoTG/WB, 2016)	Ministry of Agriculture (MOA)	→ **Forestry policy** - improving and maintaining forest resources through greater involvement of the local communities. The ministry will equip each of the participating communities/villages with patrol and bush-firefighting equipment.
The National Adaptation Plans (NAPs) Roadmap (UNDP, 2015)	Department of Water, Ministry of Fisheries and Water Resources	→ **National Forest Assessment (NFA)** recommended measures include protection and afforestation through participatory forest management; fire management; grazing management, promotion of alternative energy sources for fuel wood and charcoal
Strategic Programme for Climate Resilience (SPCR) (Agrer, 2017)	Ministry of Environment, Climate Change and Natural Resources	→ Establish an operational mobile **innovative system** using drone-based GIS technology to undertake detailed mobile mapping for real-time monitoring purposes, which can significantly lower costs reduce worker safety risk and assure repetition in time – this is applicable in forest fire risk and vulnerability assessment. → **Training and capacity building** of National Forest Guards in each of the regions for monitoring/ enforcement of all forest management guidelines regarding encroachment, fire, logging, etc → Promoting strategically placed drinking points/ponds deep in forest-protected areas for offsetting the disappearance of the natural habitats and indigenous traditional flora and wildlife species due to frequent bushfires and drying of streams → Encouragement of **community forest management** to restore the ecosystem through afforestation and minimize the cutting of trees and bushfires → Raise **awareness** of the harmful effects of bushfires and deforestation → Regional consultations - Creation of a **bushfire control committee** (early burning control, prosecute offenders), creation of **fire belts** to control bushfires

CHAPTER FIVE

RECOMMENDED STRATEGIES AND POLICY ACTIONS

CHAPTER FIVE

RECOMMENDED STRATEGIES AND POLICY ACTIONS

5.1 Strategic objectives and action plans for mainstreaming wildfire management

Fires are the greatest drivers of forest degradation in The Gambia, with disastrous impacts on ecosystems, properties, livelihoods, and biodiversity. Therefore, combating forest fires is the single most important strategy to protect and restore the vegetation cover. In the Gambia, in response to the increasing occurrence of forest fires across regions, there is a need to adapt and improve management practices. In doing so, an overwhelming focus must be directed towards improving mitigation measures, and strengthening emergency preparedness and response capacities as practiced in several countries (Rodrigues et al., 2023). Integrating these actions can enhance the effectiveness of wildfire prevention, detection, and monitoring systems, leading to more efficient fire management and mitigation efforts.

Incidences of forest fires continue to escalate in The Gambia, leading to negative ecological, social, and economic impacts. The impacts on food security, agricultural sustainability, forest cover, biodiversity, and livelihoods are huge. It is also associated with the increased vulnerability of vulnerable communities, particularly the poor. The Gambia's strides to achieving the Sustainable Development Goals could be affected due to significant loss of vegetation, infrastructure, and asset damage as a result of forest fires.

Key forest fire management strategies should entail:

- Intensifying forest fire campaigns at the national, regional and local levels through various media (mobile, radio, social media, televisions, community sensitization, etc).
- Harmonize forest-related monitoring, assessment, and reporting systems at the national, regional, and local levels to contribute directly to providing holistic guidance for sustainable forest management (SFM) regimes in the country.
- Revive and strengthen fire management committees in rural areas to assist with sensitization and control of forest fires.
- Develop and implement regional fire management plans and frameworks with communities and other non-state actors.
- Provide financial support for fire protection works such as fire line establishment around forest parks.
- Equip the Department of Forestry with sustained supplies of firefighting equipment and tools that could be used by communities to fight fires.

- Sensitize communities about forest fire prevention and management, and implement as appropriate, early control burning programs at the regional level.
- Undertake country-wide national forest fire prevention campaigns, in collaboration with the DPWM, DLS, and DoA, involving politicians such as Parliamentarians and Ministers and civil society organizations (CSOs) as appropriate.
- Enable communities, local agencies, and national organizations to implement effective, efficient, and appropriate fire management programs.
- Accessing clear, soundly based descriptions of fire management requirements and applying the approach of Review and analysis, Risk Reduction, Readiness, Response, and Recovery (the 5Rs); through access to data, analytical tools, successful examples of policies, plans, and processes that constitute good integrated fire management practice.

5.2 Aims of the strategic objectives.

Effective implementation of the Wildfire Management Strategy is guided by six strategic objectives. These include:

a. **Effective wildfire communication enhanced in The Gambia** – this objective aims to improve accessibility and use of wildfire-related information and data for an evidence-based decision-making process.

b. **Development and implementation of regional and local level frameworks for wildfire monitoring and reporting –** this aims to localize wildfire management at the regional and local levels to feed into the national wildfire strategy.

c. **Mechanisms for fuel load management developed and implemented –** fuel load remains the major aggravator for wildfires in the Gambia. The objective explores how an enterprise can be created from fuel load as an incentive for wildfire management.

d. **Integrated fire management approaches developed and rolled out –** the objective aims to establish mechanisms through which traditional and modern approaches can be put together for effective wildfire management.

e. **Multistakeholder collaborations on wildfire management promoted** – this objective aims to ensure that different stakeholders and interest groups are brought together in a forum to ensure that they exchange knowledge, ideas, and practices that can be scaled to manage wildfires in the country. The forum is also crucial to promote integration of efforts and reduce duplication of efforts.

f. **Enhanced restoration and recovery after fire incidences –** this objective aims to ensure that a clear protocol is developed to ensure that livelihoods and ecosystems are restored after fire incidences. The protocol should also be part of the national and regional frameworks.

The detailed assessment of these objectives in terms of the desired outcome, outputs, baseline situation, indicator for assessment, and responsible organization is presented in the Tables below.

5.3 Strategic objective statements and plans

Strategic objective 1: Effective wildfire communication enhanced in The Gambia

Outcome	Output (s)	Baseline	Indicator	Responsible
1.1 Decision-making on wildfire management process improved	1.1.1 Information and data related to wildfires in The Gambia improved	Inadequate systems and mechanisms on wildfire information for decision-making	Systems and mechanisms in place on wildfires for decision-making	MECCNAR (DoF)
	1.1.2 A dedicated national system for wildfire data collection and analysis developed	No central system for wildfire data collection and analysis	Wildfire information system established and operational	MECCNAR (DoF)
	1.1.3 A national mechanism for wildfire data dissemination established	Inadequate mechanism for wildfire information and data sharing among different users	Mechanisms established and functional	DoF, MECCNAR, NDMA
	1.1.4 A national fire surveillance mechanism developed	Weak / Non-existence of a national wildfire surveillance mechanism	National surveillance mechanisms established/ strengthened	DoF
	1.1.5 Continuous wildfire data collection, analysis and communication	Minimal/no mechanism for data collection and sharing	Data collected periodically and communicated	DOF, MECCNAR, NDMA

Strategic objective 2: Regional and local level frameworks for wildfire monitoring and reporting developed and strengthened.

Outcome	Output (s)	Baseline	Indicator	Responsible
2.1 Regional and district systems and frameworks for wildfire monitoring and reporting established	2.1.1 Systems for monitoring and reporting wildfire incidences developed at regional and local levels	No existing regional and local systems and frameworks for wildfire reporting	System developed and operationalized	NDMA, DoF
	2.1.2 Wildfire hotspot areas mapped at regional and local level (clear zonation)	Inadequate mapping of the wildfire hotspot area to guide in installation of preventive measures	Wildfire hotspot mapping frameworks and systems available/developed	NDMA, DoF, DPWM, GFRS
	2.1.3 Regional fire management plans developed/strengthened and rolled out	Regional fire management plans established in some regions (yet to be rolled out)	Strategies piloted in hotspot areas	Regional Forestry Committee and DOF
	2.1.4 Sensitization and awareness of forest fires at regional and district levels enhanced	Inadequate multistakeholder platforms at regional and district levels with clearly timed activities	Training and awareness schedules available Well-designed training modules developed	DoF, DPWM, RDMC, Regional Disaster Management Committees (RDMC), ANR/ URCOFA
	2.1.5 Enhanced regional and district patrols	Local patrols exist but need to be enhanced and integrated at the regional and national levels	Patrols plan designed and implemented	DoF, Livestock Dealers Association (NALWA)
2.2 Regional and District levels wildfire management capacity developed	2.2.1 Regional and district fire management committees established and strengthened	Inadequate capacity and structure for effective fire management at district and regional levels	Strong fire management committees developed	DoF, Fire management representatives, and committees, DoCD, DPWM
	2.2.2 Committees equipped with the right skills and tools to manage wildfire, e.g. signage posts,	Lack of adequate awareness among the communities on the impact of forest fires Lack of appropriate tools and equipment for effective fire management	Well-equipped committees with skills and tools to manage wildfires established and functional	DoF, DCD, DPWM, RDMC, NDMA, GFRS
	2.2.3 Committees facilitated with the right resources for regular meetings and reporting on fire incidences	Inadequate resources for effective meeting and reporting on fire incidences and control measures	Regular fire incident reports and control	DOF, DPWM, regional and District fire management committees

Strategic objective 3: Mechanisms for fuel load management developed and implemented.

Outcome	Output (s)	Baseline	Indicator	Responsible
3.1 Fuel load management mechanisms developed and rolled out at different localities	3.1.1 Mechanism for fuel load management, established and popularized	Andropogon grass enterprise piloted at KWNP but needs to be scaled to other CF/CPA/ NP	Andropogon grass business module developed. A value map and chain for Andropogon gras established and scaled	DoF, DPWM, DLS
	3.1.2 Fire breaks and fire belts established in the fire hotspot areas	Traditional firebreaks established in some pilot sites, thus the need for scaling	Modern firebreaks and fire belts established in hot spot areas	DPWM, RDMC, DOF, RADs
	3.1.3 Early controlled burning in the farmlands enhanced	Communities have knowledge of early controlled burning systems, but this needs enhancement and scaling up for effectiveness	A well-defined Early controlled burning framework developed	DOF, DPWM, Forest Guards, Forest Rangers, Regional fire management committees

Strategic objective 4: Integrated fire management approaches developed and implemented

Outcome	Output (s)	Baseline	Indicator	Responsible
4.1 Fire management systems that integrate traditional and contemporary technologies developed	4.1.1 An integrative framework for traditional and modern wildfire management designed and operationalized	There is minimal integration of traditional and modern fire management interventions	Frameworks developed	DoF, NACOFAG, National School of Forestry
	4.1.2 Integrated fire management systems rolled out	Fire management approaches are developed in silos and largely along thematic areas	Piloting and scaling models developed. Records of implementation	DoF, Ministry of Agriculture, DPWM, DLS, Department of Water Resources, NDMA, NEA, National School of Forestry, Regional fire management committees

Strategic objective 5: Multistakeholder collaboration on wildfire management promoted.

Outcome	Output (s)	Baseline	Indicator	Responsible
5.1 A forum for wildfire policy and institutional integration established	5.1.1 A policy brief with a clear framework for wildfire management integration developed.	Weak fire management policies and strategies	A policy brief developed.	ICRAF, DoF, and other partners
	5.1.2 Annual multi-stakeholder and multi-institutional national wildfire management congress held with clear policy outcome	No multistakeholder engagement congress exists	National wildfires management congress held annually	DoF, DPWM, Ministry of Agriculture, MECCNAR, NEA, NDMA, NACAFAG, MECCNAR

Strategic objective 6: Restoration and recovery after fire incidences enhanced.

Outcome	Output (s)	Baseline	Indicator	Responsible
6.1 Wildfire restoration and recovery protocol developed and rolled out	6.1.1 After-fire livelihood recovery protocol and strategies developed	Livelihood restoration and recovery protocol nonexistent	Copy of the protocol developed. Record of the protocol roll-out	DoF, DPWM, Department of Agriculture, NEA, RDMCs
	6.1.2 Ecosystem recovery protocol including natural regeneration, assisted natural regeneration, and enrichment planting developed and shared at regional and local levels	Ecosystem restoration and recovery protocol nonexistent	Restoration protocol towards restoration and recovery developed	DoF, DPWM, Department of Agriculture, NEA, RDMCs
	6.1.3 Insurance schemes that could cover losses and damages emanating from wildfires negotiated	No insurance product covers the loss and damages related to wildfire, thus exposing the communities further to these hazards	Insurance mechanisms negotiated and available	Ministry of Finance, Insurance Providers, Banks
	6.1.4 Development of bankable carbon credit project to avoid wildfire and incentivize conservation	Inadequate carbon credit project to incentive wildfire avoidance and forest restoration	Wildfire management related projects developed	Private sector, government agencies

CHAPTER SIX
MONITORING, EVALUATION, AND REPORTING

CHAPTER SIX

MONITORING, EVALUATION, AND REPORTING

This section describes the role and importance of a monitoring system for forest fires development in The Gambia.

6.1 Monitoring, evaluation and reporting requirements

Wildfire management in The Gambia requires an integrated approach, including effective planning, implementation, monitoring, evaluation, and reporting. This calls for the use of robust monitoring, evaluation and reporting tools that are crucial to inform programming and implementation, using the best available evidence. This section describes the monitoring, evaluation, and reporting requirements, as well as the monitoring tools and framework needed to ensure an effective wildfire management system. The monitoring and evaluation aim to ensure an adaptive wildfire management process to help the country effectively respond to recurrent wildfire incidences.

Monitoring, Evaluation, and Reporting (MER) allows the Department of Forestry and other stakeholders to quantify the success of their wildfire management strategies and actions for achieving the desired objectives. This, in turn, supports transparent reporting to the government and the community on the outcomes of wildfire management.

MER should be a fundamental component of adaptative management, and a more outcomes-focused approach should be adopted for forest fire management. This approach should be a fundamental framework for targeted forest fire monitoring and evaluation. The new knowledge generated and experience gathered are then communicated through reporting to help inform future decision-making concerning forest fire management at the national, regional, and communal levels.

Effective wildfire monitoring and evaluation systems require fundamental considerations to:

- Ensure that human life and welfare will be accorded priority over all other considerations.
- Ensure the minimal impact of wildfires on human life, ecosystems, communities, infra-structure, livelihoods, and the environment.
- Maintain or improve the resilience of natural ecosystems and their ability to deliver goods and services such as water, carbon sequestration, biodiversity, and forest products.

6.2 Monitoring and Evaluation Goals

6.2.1 Wildfire data and information needs by different sectors

The are different types of information and data related to wildfires that are essential to a wide audience and users. Various data sources provide global, regional, and national information

that is useful for decision-making. However, much of the available data is global, hence the need to build and strengthen national systems in the long run to validate the global data. Table 7 provides an overview of potential data and information that can be used in monitoring wildfires in The Gambia.

Table 7 Data and information needed for monitoring wildfires in The Gambia

Type of data	Potential sources	Potential forms
Wildfire sources and impacts on the farmlands	Department of Agriculture; Ministry of Agriculture; National Disaster Management Authority (NDMA), etc	Reports; studies; demographics data; vegetation change data
Wildfire sources and impacts on the forests	Department of Forestry; Ministry of Environment; National Disaster Management Authority (NDMA), etc	Reports; studies; spatial maps; demographics data; vegetation change data
Climate change and variability data	Meteorological department; world bank climate data;	Climate-related raw and analyzed databases
Global wildfire databases	Global Forest Watch (GFW); Think Hazard; Satellite remote sensing; Visible Infrared Imaging Radiometer Suite (VIIRS); The Global Wildfire Information System – (GWIS), Moderate Resolution Imaging Spectroradiometer (MODIS); Landsat series	Global and national level data over time; dashboards
Financial models and projections of wildfire risks	National Disaster Management Authority (NDMA); Worldbank Data; IMF data; FAO data; Treasury and Ministry of Finance; private sector e.g. banks, insurance	Financial reports and records; short-mid and long-term fire projection;
Scientific research at local, national, and global levels	Academia sources; journal articles; book chapters, etc	Peer-reviewed and grey literature sources; geospatial data
Local and regional wildfire incidences	Community level records; regional level governments	Community records

Effective data and information collection, processing, and dissemination requires a well-functioning platform(s), with either integrated or single functionalities. The process requires setting out clear key performance indicators (KPIs) related to wildfire management which can be tracked and quantified. Raw and analyzed data of different types can then be collected in different forms from different sources (Table 7) and fed into the platform for aggregation and analysis to provide useful information for decision-making and actions. For example, data from different regions can be fed into the platform and aggregated to provide national data, including the total aggregate land affected by wildfires, spatial maps on the extent of coverage, numbers of the communities affected, and computed financial losses. With such data, the development

sector can work with the government to design restoration projects, the private sector can use the data to assess the potential risks in designing insurance schemes and carbon projects, communities can use the data and establish proactive measures for wildfire management in priority zones at the right time, among other users. Monitoring and evaluation should also form part of this framework. A schematic presentation of data infrastructure and processing is presented in Figure 9.

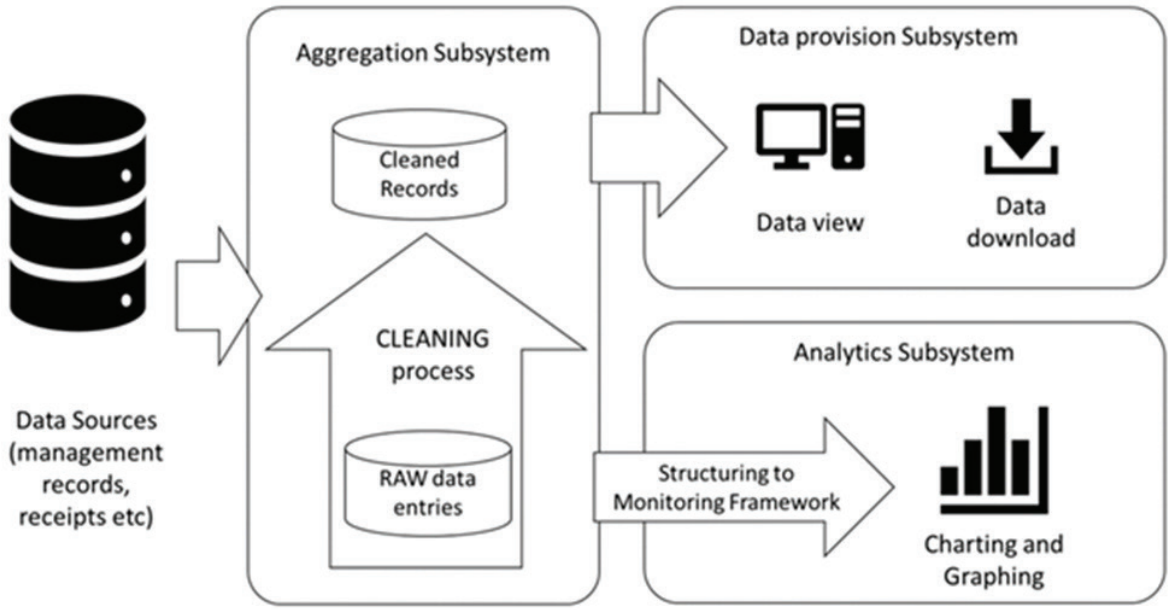

Figure 9 Data aggregation framework for decision-making (Source: Gilruth et al., 2021).

6.2.2 Priority areas towards the achievement of the strategy

Achievement of the strategic objectives under this strategy requires setting short and mid-term goals and long-term goals. These should be accompanied by clear means of verification to ensure that the progress is tracked over time. Table 8 highlights some of the priority areas for the achievement of the strategy under different objectives.

Table 8 Priority areas for the achievement of the strategy

Strategic objectives	Short to mid-term goal	Long-term goal	Means of Verification
1. Effective wildfire management awareness and communication enhanced in The Gambia	Wildfire data from global sources analyzed and disseminated to various stakeholders for decision making; training and capacity building of different stakeholders on wildfire management; equipping of national bodies	Development of long-term national infrastructure and systems to collect, process, and disseminate wildfire data for decision-making; continuous training and capacity building of different stakeholders and institutions	Link to the systems, guidance document developed; training modules developed; training conducted
2. Regional and local level frameworks for wildfire monitoring and reporting developed and strengthened	Community and regional wildfire management plans validated and rolled out; community and regional wildfire management monitoring systems developed; wildfire hotspots zoned	Community and regional wildlife management monitoring systems integrated into national monitoring systems, national hotspots zoned	Validated regional wildfire plans, roll-out plans developed; national wildfire hotspots map
	Community and regional wildfire committees established, strengthened, and equipped; Wildfire patrols enhanced	Community and regional wildfire committees well enshrined into national policies with resource allocation plans	Names of wildfire committee members; committee's terms of reference
3. Mechanisms for fuel load management developed and implemented.	Wildfire management plans at community and regional levels	Community and regional wildfire management plans mainstreamed into national policies	Copy of wildfire management plan
4. Integrated fire management approaches developed and rolled out	Wildfire management integrated framework developed at local and regional levels with contextualized approaches; modern wildfire management technologies piloted	National wildfire framework developed; modern technologies upscaled in different regions	Copy of the integrated wildfire management framework developed with clear technological priorities
5. Multistakeholder collaboration on wildfire management promoted.	Annual wildfire stakeholders forum held; policy brief developed	National wildfire management policy enacted; annual wildfire congress	Wildfire congress reports; list of engaged stakeholders; policy outcomes from the congress
6. Restoration and recovery after fire incidents enhanced	Post-wildfire management protocol developed; protocol piloted in different regions	Carbon project developed; insurance schemes negotiated; restoration and livelihood restoration plans rolled out	Reports on restoration plans; list of insurance schemes; list of carbon projects

6.2.3 Monitoring and Evaluation Framework

Forest fire prevention and management requires an understanding of the changing climatological, ecological, and social conditions. These parameter data are critical for monitoring fires and their impacts at the local level. To achieve an effective forest fire management process, a whole-system M&E framework that identifies and synthesizes fire monitoring needs to be planned and implemented. The main stages of fire monitoring should include the following:

a. Pre-fire vegetation inventories

b. Active-fire monitoring

c. Post-fire assessment

To enable timely action, the Department of Forestry should initiate early planning, detection, and rapid response systems that are crucial in forest fire prevention, monitoring and surveillance. Table 9 summarizes some of the approaches, management options, responsible Parties, and their particular roles.

Table 9 Forest fire management implementation framework

Forest fire management approaches	Management options	Responsible	Role
Prevention measures	Establish National Forest fires and early warning monitoring system	Department of Forestry data management center	To provide real-time forest fire prediction and monitoring in all regions.
	Pre-suppression measures by fuel management (fuel reduction, fuel break construction)	Communities/Forest fires management committee, Department of Forestry Regional staff	To reduce fuel load to minimize the occurrence and impacts of forest fires.
	Identification and mapping of Fire sensitive areas	Department of Forestry, Communities	To identify and map fire hot spot areas.
	Setting up effective surveillance networks across communities	Department of Forestry, Forest Fire Committees	To help reduce fire occurrence by setting up local fire observations and detection centers around the hotspot zones.
	Public awareness campaigns, launch special awareness programs in communities where shifting cultivation and charcoal production is common on the economic impacts of forest fires.	Department of Forestry Regional staff	To sensitize the communities, smokers, hunters, honey collectors, farmers and the public. about fire prevention and management.
	Establishment of regional fire management plans and committees	Department of Forestry	To help define and plan actions and infrastructure required to fight fire. It helps to ensure coherent analysis of the natural environment and anthropogenic variables such as climate, vegetation, settlements, attitudes, land use, etc)

Fire suppression measures	Capacity building and sensitization of fire management	Department of Forestry	To train communities and forest fire management committees on wildfire management practices.
	Deployment of firefighting resources and infrastructure	Department of Forestry, Gambia Fire Services	To mobilize resources to quickly contain forest fires to minimize their large-scale impacts on ecosystems and livelihoods.
	Knowledge sharing	Department of Forestry, Gambia Fire Services	To establish communal, district and regional level cooperation and knowledge sharing to facilitate collaborative approaches to fire management, leveraging shared expertise and resources.
	Improve access networks in the forests	Department of Forestry	To help minimize fire impacts and allow the movement of fire engines.
	Establish water points/ protect inland and develop water valleys in forests	Department of Forestry	To create access to water reservoirs for use by fire engines.
Post-forest fire management and rehabilitation	Scientific analyses of post-fire impacts and experiences	Department of Forestry, communities	To provide feedback on experiences to help analyze and develop the means of fire prevention.
	Monitoring of spontaneous regeneration of forest vegetation	Department of Forestry	To understand the dynamics of vegetation regrowth in affected areas.

REFERENCES

Aragão, L.E.O.C., Anderson, L.O., Fonseca, M.G. *et al.* (2018). 21st Century drought-related fires counteract the decline of Amazon deforestation carbon emissions. *Nat Commun* 9, 536. https://doi.org/10.1038/s41467-017-02771-y

Bah A, Duguma L, Minang P, Muthee K, Duba D, Sanneh E, Jallow P. (2021). *Transhumance, Tree Growing and Ecosystem Resilience in The Gambia*. ICRAF Technical Brief No. 02/2021. World Agroforestry, Nairobi, Kenya

Baijanath-Rodino, J., Kumar, M., Rivera, M., Tran, K. D. and Banerjee, T. (2021). How Vulnerable Are American States to Wildfires? A Livelihood Vulnerability Assessment. *Fire*, *4*(3), 54. https://doi.org/10.3390/fire4030054

Datta, R. (2021). To extinguish or not to extinguish: The role of forest fire in nature and soil resilience. *Journal of King Saud University - Science*, *33*(6), 101539. https://doi.org/10.1016/j.jksus.2021.101539

Duguma LA, Borona P, Minang PA, Nzyoka J, Bah A, Gilruth P, Makui P, Carsan S, Kindt R, Foundjem D, Baldeh F, Ahmad M, Wanjara J, Mwangi SK. (2020). *Diagnostic Study for Implementing Ecosystem-based Adaptation in Rural Landscapes of The Gambia*. Nairobi: World Agroforestry.

FAO (2003). *Community-based fire management: case studies from China, The Gambia, Honduras, India, the Lao People's Democratic Republic, and Turkey. Food and Agriculture Organization of the United Nations Regional Office for Asia and the Pacific*. Bangkok, Thailand

FAO (2020). *Global Forest Resources Assessment Report*. FAO Publication, Rome, Italy

FAO and FILAC. (2021). *Forest Governance by Indigenous and Tribal People. An Opportunity for Climate Action in Latin America and the Caribbean*. Santiago.

https://doi.org/10.4060/cb2953en

Global Forest Watch (2023). "Fires in Gambia". Accessed on 31 October 2023 from

https://doi.org/10.3390/su131910959www.globalforestwatch.org.

Gilruth, P., Duguma, L.A., Minang, P.A., Bah, A., Jaiteh, M.S., Mwangi, S. and Ahmad, M. 2021. A Framework for Monitoring Ecosystems-Based Adaptation to Climate Change: Experience from The Gambia. *Sustainability* 13(19): 10959.

Igini, M. (2022). "Top 12 largest wildfires in history". Access on 15 November 2023 from

https://earth.org/largest-wildfires-in-history/

IMF (2024). "Frequency of Natural Disasters". Accessed on 16 February 2024 from https://climatedata.imf.org/pages/climatechange-data

KPMG (2021). Large-scale Ecosystem-Based Adaptation in the Gambia: Developing a climate-resilient, natural resource-based economy. Volume 1: Environmental and

Social Impact Assessment. Accessed on 16 February 2024 from https://open.unep.org/docs/gcf/UNEP%20FP011%20Gambia%20Environmental%20and%20Social%20Impact%20Assessment.pdf

Leys, B. A., Marlon, J. R., Umbanhowar, C., & Vannière, B. (2018). Global fire history of grassland biomes. *Ecology and Evolution*, *8*(17), 8831-8852. https://doi.org/10.1002/ece3.4394

MacCarthy, J., Richter, J., Tyukavina, S., Weisse, M. and Harris, N. (2023). *The Latest Data Confirms: Forest Fires Are Getting Worse*. Accessed on 15 November 2023 from https://www.wri.org/insights/global-trends-forest-fires.

Mike, J. (2011). *Forest Fire Management and Control*. International Labor Organization,

Geneva, Switzerland

Nikolakis W, Welham C and Greene G. (2022). Diffusion of indigenous fire management and carbon-credit programs: Opportunities and challenges for "scaling-up" to temperate ecosystems. *Front. For. Glob. Change* 5:967653. doi: 10.3389/ffgc.2022.967653

Pausas, J. G., & Keeley, J. E. (2019). Wildfires as an ecosystem service. *Frontiers in Ecology and the Environment*, *17*(5), 289-295. https://doi.org/10.1002/fee.2044

Rodrigues, M., Cunill Camprubí, À., Balaguer-Romano, R., Coco Megía, C. J., Castañares, F., Ruffault, J., Fernandes, P. M., & Resco de Dios, V. (2023). Drivers and implications of the extreme 2022 wildfire season in Southwest Europe. *Science of The Total Environment*, *859*, 160320. https://doi.org/10.1016/j.scitotenv.2022.160320

Schroeder, W., Oliva, P., Giglio, L., & Csiszar, I. A. (2014). The New VIIRS 375 m active fire detection data product: Algorithm description and initial assessment. *Remote Sensing of Environment*, *143*, 85-96. https://doi.org/10.1016/j.rse.2013.12.008

Tadesse, E. and Seboko, B. (2013). *Training manual on forest/wildland fire prevention and control for sustainable forest management*. Ethiopia, Hawassa University, Wondo Genet College of Forestry and Natural Resources

The Global Historical Weather and Climate Data (2024). Weather and Climate. *The Gambia Climate: Climate Zone and Historical Climate Data*. Accessed on 15 February 2024 from https://weatherandclimate.com/the-gambia

The Government of the Gambia and FAO (2020). *National Forest Assessment 2008-2010 – The Gambia*. Accessed 10 November 2023 from https://www.fao.org/forestry/28636-042de4909ac624064c9c42f1fae43c57a.pdf.

The Nature Conservancy (nd). "Wildfire Resilience Insurance: Quantifying the Risk Reduction of Ecological Forestry with Insurance. Summary of Insights". Accessed on 15 February 2024 from https://www.nature.org/content/dam/tnc/nature/en/documents/FINALwildfireresilienceinsurancesummaryofinsights6.27.21PAGES.pdf

United Nations Environment Programme (2022). *Spreading like Wildfire – The Rising Threat of Extraordinary Landscape Fires*. A UNEP Rapid Response Assessment. Nairobi.

USDA. (2010). National Report on Sustainable Forests—2010. United States Department of Agriculture. Retrieved 7 February 2024. https://www.fs.usda.gov/research/docs/sustain/docs/national-reports/2010/2010-sustainability-report.pdf

Zubkova, M., Boschetti, L., Abatzoglou, J. T., & Giglio, L. (2019). Changes in Fire Activity in Africa from 2002 to 2016 and Their Potential Drivers. *Geophysical Research Letters*, *46*(13), 7643. https://doi.org/10.1029/2019gl083469

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