Scientists develop improved fire management tools for Africa's savannas

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Scientists at the Nairobi-based World Agroforestry Centre (ICRAF) and partners have developed specialized graphs that map out fire behavior, known as nomographs, for landscape managers in Africa's savannas. The study, published in the February issue of the *Journal of Arid Environments*, pinpoints the optimal conditions for setting early-season prescribed fires—a process that when executed and timed properly, reduces the risk and impact of late dry season bushfires in increasingly fragile ecosystems, both of which are exacerbated by climate change.

Researchers say the findings signify an important step for Africa's Sudanian and Sahelian savannas, which have historically relied on less accurate methods to time early-dry-season controlled fires. The study finds it is necessary to use tools that consider both fuel characteristics and weather conditions, when planning these prescribed fires.

Fire has been battled by land managers for decades, but that doesn't make it a foe. In seasonally-dry savanna ecosystems – which dominate nearly half of Africa's surface area – naturally-occurring wildfires are critical to maintaining biodiversity and ecosystem function.

"The key to fighting fire with fire is robust science," said Cheikh Mbow, senior climate change scientist with the World Agroforestry Centre. "In the past, forest managers did not have the tools and methods needed to define what to burn, when to burn it, and to what extent. Our research is helping transform an age-old practice into a modern-day tool for managing fires and ecosystems in West Africa. This is a simple statistical tool that can be replicated most anywhere."

The scientists selected three areas representative of Senegalese savanna ecosystems, ranging from the open savanna of the Sahel to the more treed south-Sudanian savanna. They worked with Senegal's Forestry Service to torch 231 prescribed 10-by-10 meter plots (an area roughly the size of three football pitches) in Senegal at the end of the 2010 rainy season. They recorded data on air temperature, relative humidity, wind speeds, fuel load and cover, fuel moisture content and the amount of dry matter present.

Researchers found that the best time to ignite preemptive fires was when fuel moisture content – the amount of water a fuel holds, expressed as a percentage of its dry weight – was close to 120 percent and relative air humidity was between 12 and 79 percent. This was equivalent to between 12 days and one month after the last rain, depending on the site. They also found that the fires' rate of spread was greater when wind speeds were fast and fuel moisture content, relative humidity and fuel load were all low.

Their results showed that a fuel load of 94 grams per square meter is sufficient to support savanna fires in West Africa – less than half of what's required for savanna fires to propagate in South Africa. This is likely due to high grass cover and fast wind speeds.

"Fires have long been regarded as the enemies of the savanna, but since time immemorial, they have played a role in keeping these ecosystems functioning optimally, keeping the domination of some species over others in check," said Momadou Sow of the Environmental Sciences Institute of the Cheikh Anta Diop University in Dakar, Senegal. "Until now, we've lacked the accurate scientific knowledge to properly plan early season prescribed fires in West African savannas - our research is a step towards filling that gap."

Wildfires, like the hundreds that ravaged southeast Australia and Tasmania in early January, can cause widespread environmental devastation and destruction of property. Once the infernos gather strength, aided by wind and ample fuel supplies, they become uncontrollable and can travel large

distances, destroying infrastructure, wreaking havoc on ecosystems, releasing millions of tonnes of greenhouse gases into the atmosphere and costing billions of dollars in damage.

Wildfires also threaten biodiversity, including many unique plants and animals found only on the continent. Many animals that dwell in trees, bushes, deadfall or underground perish from the blazes or succumb later from lack of food and shelter or increased predation. In Australia for instance, the koala is especially vulnerable to wildfires that consume the tree canopy, as the animals are slow-moving and do not use hollows, in which they could shelter.

"In Senegal, the lack of equipment and qualified human resources for firefighting make late-season fires an especially large threat. But the outcomes of this study – especially the ability to reliably predict fire rate of spread and fuel consumption – should allow better planning of fires based on desired characteristics in the future," said Mbow.

Fast-moving savanna fires generally remain on the surface, inflicting only minimal damage on trees, barely heating the soil below and leaving roots, nutrients and microorganisms unharmed. These frequent, low-intensity fires are what forest managers attempt to mimic in order to limit dangerous fuel build-up.

Provided by World Agroforestry Centre (ICRAF)