Restoration of ecosystem services through Indigenous fire management

A case study from northern Australia

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1 Restoration of ecosystem services through Indigenous fire management – A case study from northern Australia[1]

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Abstract

Indigenous land management in tropical savannas of northern Australia, covering 1.9 million km^2, presents a unique exemplar of the application of traditional knowledges and modern technologies. This study estimated the value of ecosystem services delivered from fine-scale, fire and land management practised by the Indigenous peoples on their lands covering an area of approximately 18 million ha, at about USD 7.29 billion per annum. Currently, the main ecosystem service valued and traded in the market, under the Australian Government's recognised abatement scheme – 'Savanna Burning' methodology, is the mitigation of greenhouse gas emissions from wildfires. This practice has generated about USD 9 million to date, since the implementation of the methodology in 2012, for reducing greenhouse gas emissions from Indigenously managed land. This study demonstrates the importance of Indigenous land management practices, and encourages policy makers, locally and globally, to develop incentivised mechanisms for enabling Indigenous peoples to better manage their lands that can deliver a wide range of ecosystem services to the regional and global populations.

Key words: Ecosystem services, Indigenous land management, Indigenous fire management, value of ecosystem services, tropical savannas.

1.1 Introduction

In Australia, ongoing Indigenous connections with the savanna landscape, covering an area of 1.9 million km^2 across three northern jurisdictions i.e. the Northern Territory, Western Australia, and North Queensland, offer special insights into the management of this vast region over millennia. Tropical savannas in northern Australia, cover almost a quarter of the Australian landmass, supporting a diverse range of vegetation types including open grasslands, shrublands, savanna woodlands, and tropical forests (Woinarski et al. 2007; Fig. 1). This vast landscape has traditionally been managed by Indigenous peoples over millennia through implementation of fine-scale mosaic burning, and protects diverse flora and fauna, and soil and water resources (Woinarski et al. 2009). As a result, Australia's northern savanna ecosystems support an array of services delivered to local, regional and global populations (Russell-Smith et al. 2019; Sangha et al. 2017a).

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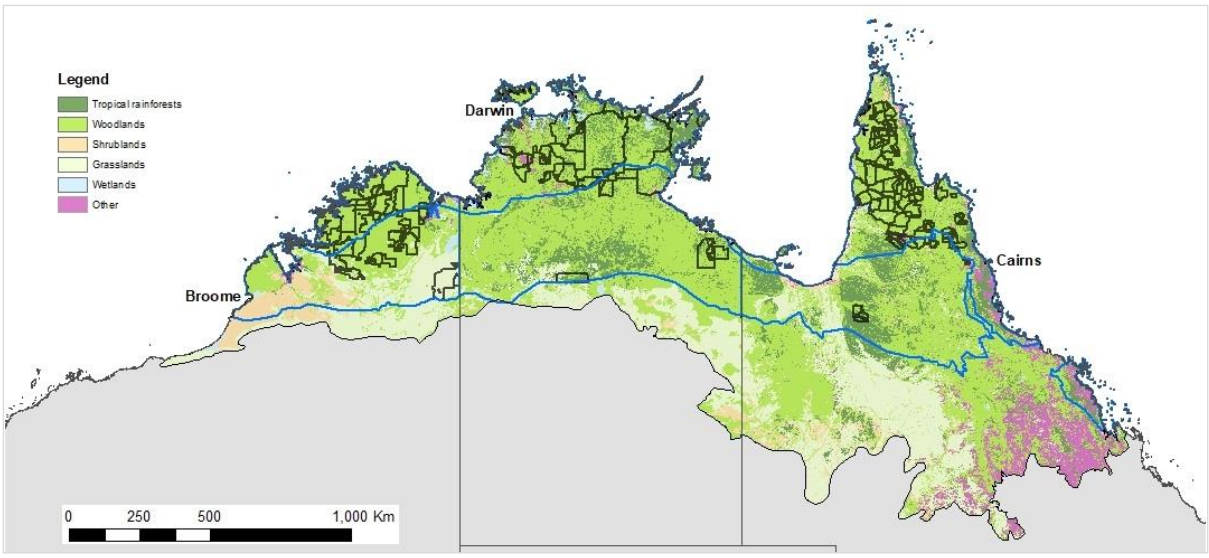

Fig. 1. Dominant vegetation types (following the Australian National Vegetation Information System dataset) across tropical savannas in northern Australia. The black outlined areas represent the carbon projects (land parcels) where Indigenous fire management is actively practised by the land managers (as per Australian Government Clean Energy Regulator; Source: Sangha et al. 2021a).

In the past, traditional burning practices in northern Australia - characterised by small, multi hectare-scale, patchy, cool fires (Fig. 2) - formed part of Indigenous people's lifestyles to afford their livelihoods and many other aspects of their lives. These practices were undertaken ritually when people traversed their estates for a variety of hunting, gathering, cultural, and spiritual purposes (Garde et al. 2009; Ritchie 2009). As a result, over time the savanna landscape has co-evolved with fire, including the influence of Indigenous management practised over millennia (Bird et al. 2005).

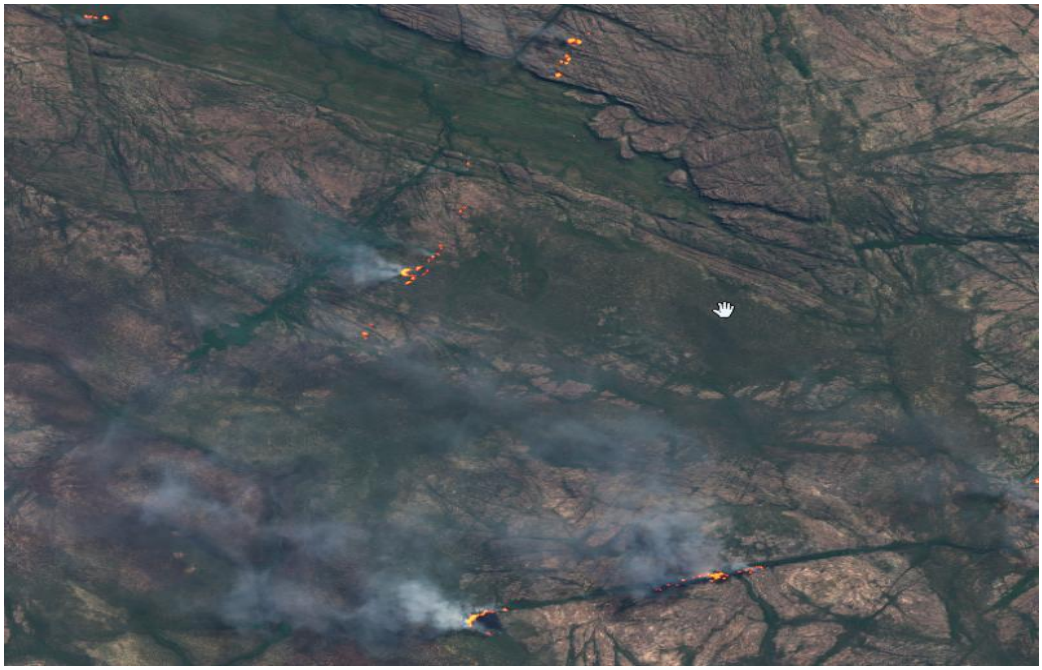

Fig. 2. A satellite view of traditional burning, showing small, patchy, mosaic fire scars across the landscape.

However, traditional fire management across northern Australia was markedly disrupted by European colonisation from the mid-1800s. It also affected traditional governance systems and relationships among and between different clan groups (Richie 2009; Fache and Moizo 2015). With the Commonwealth of Australia's Aboriginal Land Rights Act 1976 (ALRA) in the Northern Territory, and later in other northern jurisdictions under the Commonwealth of Australia's 1992 Native Title legislation, Aboriginal people were able to start reclaiming their traditional lands which enabled them to traditional knowledges and skills (Altman and Markham 2014; Dodson 1997).

With colonisation and subsequently the abandoning of traditional fire management, northern Australia started experiencing hot, destructive, wildfires, almost every year, that spread over vast areas covering thousands of square kilometres (Fig. 3; Sangha et al. 2019, 2021a&b). These fires are often lit by lightening, arsenals or by accidents as the vegetation dries up during the dry season, from April until August-September, with little to no rain. In August, with the onset of hot, dry weather, these fires once lit spread over large areas. Such a spread of wildfires further threatens the lives of many Indigenous peoples who reside across the northern landscape in >200 remote communities (Fig. 4). However, the government support to manage these wildfires was minimal until recently. Only, when the Australian Government ratified the Kyoto Protocol in 2008, and committed to reduce Australia's greenhouse gas (GHG) emissions, there was realisation that savanna wildfires in northern Australia contribute about 3-4% of the national GHG emissions inventory (Russell-Smith et al. 2013). The efforts then commenced to understand and value Indigenous practices of managing wildfires, to reduce GHG emissions.

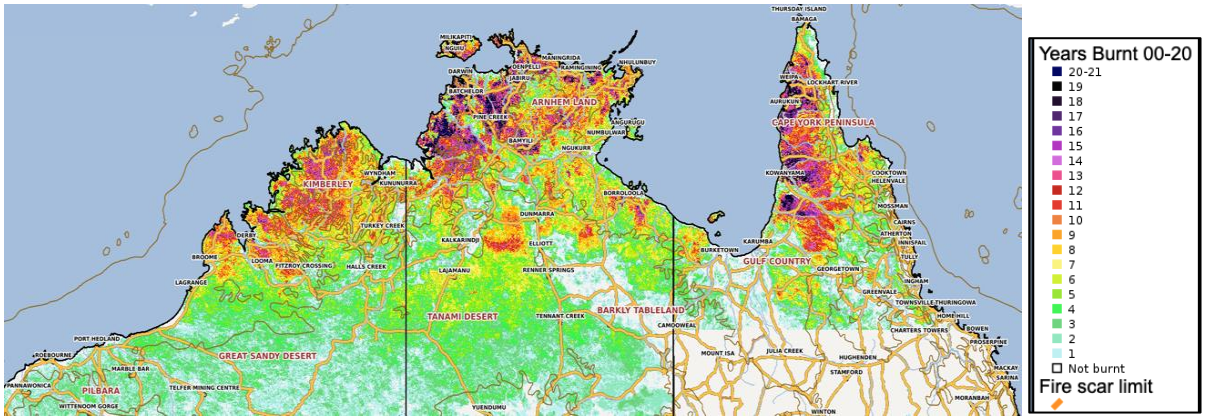

Fig. 3. Fire frequency from 2000-2020. Red and purple coloured areas are burnt almost every year and yellow coloured areas every second year (Source: North Australia Fire Information website).

Since 2000s, Indigenous customary fire management has evolved into a well-recognised fire management practice with wider scientific and political support, commonly referred to as 'prescribed burning' or 'savanna burning' (Russell-Smith et al. 2009, 2013). Prescribed burning may differ from traditional management approaches by focusing on strategic management of fuel loads, whereas traditional management approaches focus more generally on sustainable resource management on clan estates throughout the seasonal cycle (Yibarbuk et al. 2001). The contemporary fire management across the north involves application of traditional knowledge and use of modern technology such as incendiaries, satellite imagery, and updated fire information from the North Australia Fire Information website (https://firenorth.org.au/nafi3/).

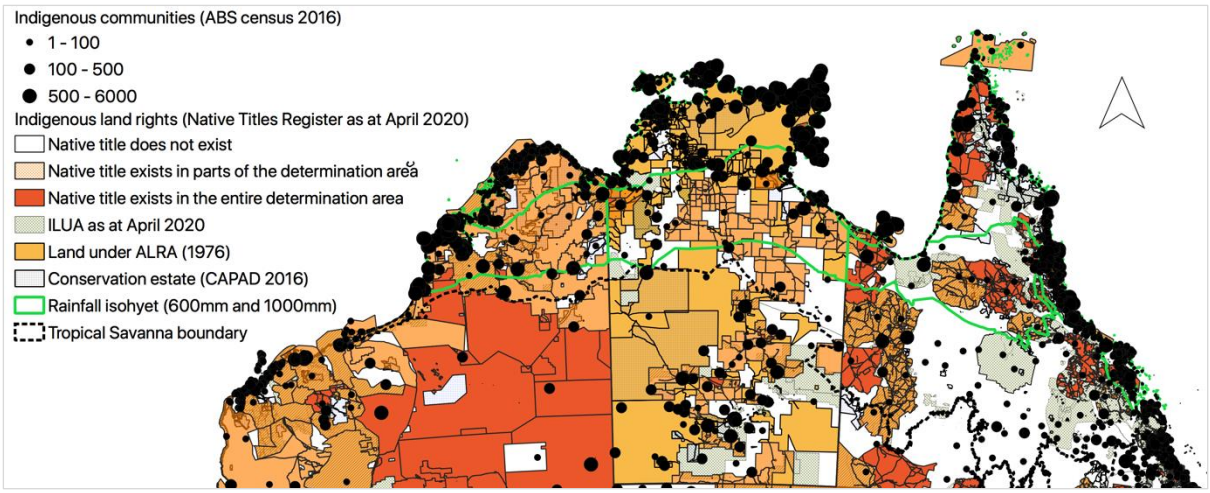

Fig. 4. Distribution of Indigenous communities (ABS census 2016), Indigenous land rights under Native title, Indigenous Land Use Agreement (ILUA), Aboriginal Land Rights Act (1976; ALRA), and conservation estate above the 600mm rainfall isohyet where 'savanna burning' methodology is currently applicable (Source: Sangha et al. 2021a).

This revival of Indigenous fire management practice has contributed significantly to the protection and management of savanna landscapes (Edwards et al. 2021), especially for reducing the impacts of extensive, severe late dry season wildfires ignited both by people and lightning. Strategic application of small, patchy burns as firebreaks, and more generally to reduce fuel loads, in the early dry season (March-July) mitigates the risk of extensive wildfires that can occur during August to December, which causes huge losses to various natural and man-made assets, and contribute to climate change (Sangha et al. 2019, 2021b).

In the Indigenous vernacular, prescribed burning is often described as 'cleaning-up country', by which people mean to clear the rank (senescent) grass and protect land and water resources. By doing so, savanna landscape delivers a number of ecosystem services (ES) that benefit the local Indigenous people and the broader Australian and global public.

1.2 Indigenous fire management and the delivery of ecosystem services

Managing the vast savanna landscape from wildfires, at a fine-scale, by applying traditional and modern land management practices provides ES such as GHG emission abatement, carbon sequestration, water regulation, biodiversity protection, in addition to enhancing social and cultural learning, and creating jobs for Indigenous peoples on country (Russell-Smith et al. 2013; Sangha et al. 2021a).

Since 2012 (after ratifying the Kyoto Protocol in 2008), the Australian Government, under the 'Savanna Burning' methodology i.e. applying fine-scale fire management, started supporting the abatement of GHG emissions from wildfires in the eligible savanna region that is above the 600 mm rainfall isohyet (i.e. 1.2 million km^2, area above the green line in Fig 1&4). The total area that is currently managed from wildfires by the Indigenous peoples alone in northern Australia (across all the three northern jurisdictions) is about 18 million ha (Table 1), which is registered as 27 different carbon projects (land parcels) under the government's 'savanna burning' methodology (see black outlined areas in Fig.1; details in Sangha et al. 2021a).

These formally recognised 27 carbon projects now abate more than five million tonnes of GHG emissions since the implementation of the methodology in 2012, from Indigenous lands alone (pastoral and conservation are the other main land use sectors that abate another two million tonnes of GHG emissions). The estimated value of GHG emissions abatement accounts is about USD 9 million per annum (applying the recent carbon price of USD 10.4 per tonne abatement of GHG emissions; Table 1).

To support the implementation of 'Savanna Burning' methodology and other GHG emissions abatement methodologies, the Australian Government established an Emissions Reduction Fund (ERF) in 2012 (of USD 2.55 billion) to purchase the lowest cost of abatement from a range of abatement sources (soils, cattle, farming, wildfires, industry, etc.; with >70 methods including 'Savanna Burning methodology') (https://www.industry.gov.au/policies-and-initiatives/emissions-reduction-fund). In 2019, this scheme was further extended with an additional investment of USD 2 billion, and rebadged as 'Climate Solutions Fund'. The only drawback of the ERF/Climate Solutions Fund is that it is public money, and the scheme fails to tax/penalise the agents/actors who are responsible for GHG emissions.

For many remote Indigenous communities, residing in remote areas, typically hundreds of kilometres away from urban areas, with little economic opportunities, 'Savanna Burning' methodology has created a new economy, popularly called 'carbon economy'. However, the total value of the other ES is far beyond the abatement of GHG emissions value (mentioned above) that Indigenous land managers currently obtain. Sangha et al. (2021a) recently assessed the total value of ES, as a bundle, that are delivered by fine-scale, fire management on Indigenous lands, at USD 7.29 billion per annum, applying local and standard valuation approaches (Table 2; details in Sangha et al. 2021a).

Table 1. Total area (ha) managed for fire and related carbon credits earned by the Indigenous peoples across northern Australia. Under the 'Savanna Burning' methodology, a land parcel is registered as a carbon project that through fire management, generates Australian Carbon Credit Units for each tonne of GHG emissions abatement.

	Northern Territory	Queensland	Western Australia	Total for three jurisdictions
Area (ha) under Indigenous fire management	10,326,370	3,304,735	4,300,534	17,931,639
Total number of projects registered under 'Savanna Burning' methodology	11	11	5	27
Number of Australian Carbon Credit Units (ACCUs) earned from fire management on Indigenous lands (1 tonne of GHG emissions abatement = 1 ACCU)	3,445,652	893,554	833,725	5,172,931
Average value (USD)/year (@USD10.4/ACCU)*	5,972,463	1,548,826	1,445,123	8,966,412
Jobs (number of people employed)	>400	>100	>100	>600

*values in USD, applying recent C price from government auction at AUD 16.14, and a conversion rate of 0.64 on 19 May 2020 i.e. @ USD 10.40/tonne of GHG abatement

Table 2. Annual value of ES from fire managed land area as registered under 27 Indigenously managed carbon projects in tropical savannas of Australia (as of May 2020).

			Northern Territory			Queensland			Western Australia		
Dominant land use	**Ecosystem type**	**ES value (USD values in 2020)/ ha/yr**	**Ecosystem area (ha)**	**Total value of ES (USD million)**	**Fire management-related ES values (1/4th of the total ES values) (USD million)**	**Ecosystem (area in ha)**	**Total value of ES (USD million)**	**Fire management-related ES values (1/4th of the total ES values) (USD million)**	**Ecosystem (area in ha)**	**Total value of ES (USD million)**	**Fire management-related ES values (1/4th of the total ES values) (USD million)**
Indigenous	Tropical rainforest	4158	3,722,094	15,476.47	3,869.12	223,864	930.83	232.71	57,113	237.48	59.37
	Woodlands	896	6,103,949	5,469.14	1,367.28	2,814,343	2,521.65	630.41	4,007,239	3,590.49	897.62
	Shrublands	448	137,537	61.62	15.40	44,837	20.09	5.02	0	0.00	0.00
	Grasslands	445	41,548	18.49	4.62	43,679	19.44	4.86	137,319	61.11	15.28
	Wetlands	2078	187,909	390.47	97.62	155,242	322.59	80.65	0	0.00	0.00
	Others	223	133,333	29.73	7.43	22,770	5.08	1.27	98,863	22.05	5.51
	Total		**10,326,370**	**21,445.92**	**5,361.48**	**3,304,735**	**3,819.67**	**954.92**	**4,300,534**	**3,911.12**	**977.78**

1.3 Challenges

The wide range of benefits derived from managing fires across the savanna landscape are well recognised now, yet largely under-valued for supporting further Indigenous land management. The work is required to consider a broader perspective of fire management for delivering not only GHG emissions abatement, but also many other vital ES such as biodiversity protection, water regulation, cultural learning, etc. (Russell-Smith et al. 2019; Ansell et al. 2019; Evans and Russell-Smith 2020; Edwards et al. 2021). Managing wildfires across the vast savanna landscape, with sparse human population, presents a singular challenge for land managers and for many organisations involved in land and emergency management related services across the north.

1.4 Discussion

The incentivised fire management, applying traditional burning practices, on Indigenous lands across the tropical savannas of northern Australia, is delivering a range of ES as well as socio-economic outcomes including income, employment, improved health, rebuilding relationships among clan groups, enhancing peoples' connection to country, relearning traditional ceremonies and practices in situ (Burgess et al. 2009; Sangha et al. 2017a&b, 2021a; Social Ventures Australia 2016). An Indigenous Elder recently commented:

> **"This fire management program has been successful on so many levels: culturally, economically and environmentally. Through reinstating traditional burning practices, new generations of landowners have been trained in traditional and western fire management, hundreds of thousands of tonnes of greenhouse gas have been abated, and the landscape is being managed in the right way."**

Dean Yibarbuk (Fire ecologist and Senior Traditional Owner, West Arnhem Land), Savanna Fire Forum, 9-11 Feb 2020, Charles Darwin University.

By highlighting the total value of ES delivered from fine-scale fire management, this study underlines the potential returns that could incur to the Australian Governments (including State/Territory Governments) if a wider Payments for Ecosystem Services (PES) mechanism approach is developed and supported by the government policies.

Implementation of incentivised fire management on 18 million ha of Indigenous lands (and additional 11 million ha of pastoral and conservation lands) across north Australian savannas has demonstrated that fire regimes are transformed across the north, resulting in at least 30% less GHG emissions, and better conservation and land management outcomes. Subsequently, better management of the savanna landscape (including lands managed by non-Indigenous people) will further deliver a diverse range of ES, total value estimated at USD 10.54 billion/yr (Sangha et al. 2021a). The need is to extend the current incentivised carbon program to a broader ES program so that land managers are able to manage natural resources in a holistic way, for considering ecological (such as biodiversity, water regulation) and socio-cultural outcomes.

This study demonstrates the importance of Indigenous fire management and encourages policy makers to appropriately invest in and incentivise Indigenous fire and land management programs, and build Indigenous and local capabilities and knowledges, not just in Australia but across the globe.

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