

## CASE STUDY:

# WEST ARNHEM FIRE MANAGEMENT AGREEMENT (WAFMA), AUSTRALIA

Prepared by Tropical Savannas CRC, Australia, for the report *“The Role of Environmental Management and Eco-Engineering in Disaster Risk Reduction and Climate Change Adaptation”* (ProAct Network 2008), available at [www.proactnetwork.org](http://www.proactnetwork.org)

## 1. BACKGROUND INFORMATION

This is a case study of an environmental management programme that seeks to avoid seasonally occurring disastrous wildfires in northern Australia. Improved fire management is implemented through a public-private- partnership. The programme also offsets some of the greenhouse gas emissions from the Liquefied Natural Gas plant located in the harbour of Darwin, Australia.

Fires in northern Australia behave differently depending on the weather conditions and the moisture status of fuel components (e.g. grass, leaves and wood) that are available to burn. Fuel and weather vary more or less predictably throughout the year:

- ★ Wet season, usually January – April: there is plenty of fuel around but the heavy rains and waterlogged conditions mean fires do not start or spread easily.
- ★ Early dry season, usually May – July/August: the grassy fuel is still moist following the wet season and the fires that do occur are usually patchy and often go out at night.
- ★ Late dry season, usually August– December: grass and litter become tinder-dry and it is typically hot, dry, and windy during the day. Fires can spread quickly, burn through the night and, under severe fire weather conditions, become intense and extensive wildfires. They can defoliate tree canopies and consume even solid woody debris.

The entire extent of northern Australia has been occupied for tens of thousands of years by indigenous people who used, and in various places still use fire as a tool for various customary and contemporary purposes. While the underlying climate-driven pattern of rain and growth of vegetation (usually January–April) and then the drying of vegetation followed by fire (usually May–December) remains, the long period of occupation by indigenous people has resulted in plant and animal populations that are adapted to a variety of different fire types at various times of year and with varying frequency. In the century or so since European settlement this situation has changed dramatically. The broad landscape is now sparsely populated with indigenous people living mostly in a few large regional settlements. Much of the land and its management is now in the hands of pastoral enterprises to the south and west of Arnhem land, adjoining National Parks, as well as emerging indigenous Ranger groups and the rural fire agencies — and all operate with relatively few people. But there are still plenty of places from which a fire can start (often through accidental ignition or from fires lit for other purposes that escape) such as from settlements and roads. If early season fire management isn't in place, such fires can burn over tens of thousands of km<sup>2</sup>.

Like many of the remote savanna regions, Arnhem Land has seen dramatic changes in recent decades in the number and distribution of people living there. Vast areas of country which were once inhabited are now almost empty and thus largely unmanaged. In particular, the western side of Arnhem Land, which backs onto Kakadu National Park, has very few residents. Notwithstanding the traditional land management practices of much of the area's Aboriginal population, many areas are now very rarely visited and suffer from the effects of a fire management vacuum. This has implications for the ecological health of these parts of Arnhem Land, but also for adjacent land managers. For example, Kakadu National Park regularly experiences wildfires which come in on very large fronts having originated in Western Arnhem Land. It should be noted that in those parts of Arnhem Land where Aboriginal people are living, such as in some of the coastal areas, traditional fire regimes are maintained. The incidence of wildfires in these parts of Arnhem Land is markedly less.

## PROJECT SCALE

The programme is implemented across 28,000 km<sup>2</sup> in Western Arnhem Land in the Northern Territory of Australia. The area is mainly Aboriginal land with approximately 9000 inhabitants.

## PLANNING INSTITUTION, EXECUTING INSTITUTION, SUPPORTING AGENCY

The West Arnhem Fire Management Agreement is a partnership between private and public institutions and the civil society.

- \* Darwin Liquefied Natural Gas Pty Ltd - private party of greenhouse gas offsetting agreement
- \* Northern Territory Government - public party of greenhouse gas offsetting agreement
- \* Aboriginal Traditional Owners and indigenous representative organisations – implementers of fire management practices
- \* The Northern Land Council – project developer and manager of the fire regimes together with the aboriginal ranger groups;
- \* The Northern Territory Bushfires Council - research and management
- \* Tropical Savannas CRC - monitoring and reporting on greenhouse gas emissions

All of these organisations employ participatory planning techniques to ensure that Aboriginal people are equal partners in the process.

## 2. PROJECT DESCRIPTION

### OBJECTIVE OF THE PROJECT

The project objective is to reduce the size and extent of unmanaged wildfires in Western Arnhem Land through traditional aboriginal fire management practices. The project also aims to reduce fire-related greenhouse gas emissions from Arnhem Land, producing a tradable carbon offset. At the same time, the project helps conserve environmental and cultural values in the project region.

### LOCATION AND CONDITIONS

The Arnhem Land Region is one of the five regions of the Northern Territory of Australia. It is located in the north-eastern corner of the territory and is around 500km from the territory capital Darwin.



Figure 1

Arnhem Aboriginal Land covers around 70,000 km<sup>2</sup> in the low-lying parts of Arnhem Land, east of the stony escarpment. The region is almost all Aboriginal land and has some areas leased for other purposes such as Gurig (Coburg) National Park and some mining operations. There is a small area of pastoral land in the south-west of the Central Arnhem biogeographic region. Because the region is Aboriginal land, together with the neighbouring Kakadu National Park, it forms the largest block of land not given over to cattle grazing in the tropical savannas.

This region's tropical climate, influenced by its proximity to the coast, is characterised by hot, wet, humid summers and mild, drier winters. The north-west monsoons deliver much of the 800-1600 mm of the area's annual median rainfall. The generally cloudy days of summer produce an average maximum temperature of around 33°C. During the dry winters minimum temperatures range between 15°C and 21°C in July.

Eucalypt open forests (typically Darwin stringybark (*Eucalyptus tetrodonta*) and Darwin woollybutt (*E. miniata*) dominate extensive areas of Arnhem Land. In addition over 10,000 rainforest patches are found within this dominant matrix. Other vegetation features include extensive mangrove forests, floodplain sedgelands and grasslands, swamp forests dominated by *Melaleuca* species, and heathlands in the sandstone plateau and sandsheets.

Aboriginal Land Trusts hold most of this region as inalienable tenure, and many parts of the ecoregion are managed in ways reflecting the more than 40,000 years of continuous occupation by these peoples. Over large areas, fire regimes have changed markedly over the last century, with increased incidence of destructive late dry season fires, in contrast to the intricate cooler burning regimes thought to have been used under traditional Aboriginal management. Approximately half of the region is burnt every year. The current regime is leading to degradation of the fire-sensitive elements within the landscape, most notably monsoon rainforest patches and sandstone heathland plants which reproduce through seed and largely require a fire-free interval.

Western Arnhem as well as central Arnhem Land are very isolated areas. Road access is limited, and the only way of reaching these areas is by walking or by helicopter.

### DESCRIPTION OF ECOSYSTEM MEASURES APPLIED

The project partners implement strategic fire management from early in the dry season to reduce the size and extent of unmanaged wildfires. Strategic early dry season burning involves a mix on on-ground patch-burning lit by people on the ground and larger scale fire breaks lit along tracks, rivers and creeks from helicopters. This breaks up the landscape and makes it more difficult for wildfires to spread across the fire breaks later in the year. With strategic breaks in place it becomes more feasible to burn later into the year if required. Limiting wildfires will in turn reduce the emission of greenhouse gases from that landscape.

### STARTING POINT OF THE PROJECT; MILESTONES

In August 2006, the operators of the Liquefied Natural Gas Plant consortium in Darwin entered into an agreement with the Northern Territory Government to offset some of the greenhouse gas emissions produced at the plant. Following assessment of other greenhouse offset opportunities elsewhere in the country (e.g. blue-gum and pine plantations), the company decided upon the West Arnhem Fire Management project option as being highly cost-effective, and politically relevant to the Northern Territory situation. Under the Western Arnhem Fire Management Agreement (WAFMA), the Northern Territory Government contracts the Northern Land Council and Traditional Owners to implement a fire management strategy.

Research coordinated by the TS-CRC and involving CSIRO, Bushfires NT, the Australian Greenhouse Office, NT's Department of Natural Resources Environment and the Arts, and Western Australia's Department of Land Information underpinned the feasibility of the agreement.

## 3. RESULTS

If the wildfires that burn across northern Australia can be changed so that there are less frequent intense wildfires in the late dry season, so that less grass, leaves and wood are burnt, then less smoke and greenhouse gases will be emitted. Reducing emissions in this way from the west Arnhem Plateau will offset greenhouse gas emissions from the Liquefied Natural Gas plant at Wickham Point. Limiting the frequency and extent of late dry season fires and introducing more patchy, diverse fire regimes also benefits biodiversity in northern Australia as evidence indicates that the frequent late dry season fires are degrading the habitat that many species depend upon (Woinarski and Fisher, 2003). Limiting wildfires stops the degradation of different plant communities and helps conserve environmental and cultural values of the Arnhem Land Plateau. These include numerous rock art sites and around 77,000 ha of rainforest which are being damaged by repeated wildfires.

Currently around 10% of the project area's landscapes are affected by early dry season fires and 30–60% are affected by late dry season wildfires in most years. Field studies and remote-sensing data have shown that early dry season fires emit less greenhouse gases (CO<sub>2</sub>, nitrous oxides and methane) per area affected than the more intense, late dry season fires. If the proportion of early dry season fires can be increased to around 15–20% to create fire breaks and patchy mosaics of burnt country and if this then reduces the extent of late dry season burning (more intense wildfires) to 15–20% of the landscape, then savings (abatement) of around 100,000 tonnes a year of CO<sub>2</sub>-equivalent in greenhouse gas emissions can be made. Many of the main benefits of the project are seen to be in better protecting the natural and cultural values of the plateau and in the social and economic stimulus it provides for Indigenous communities.

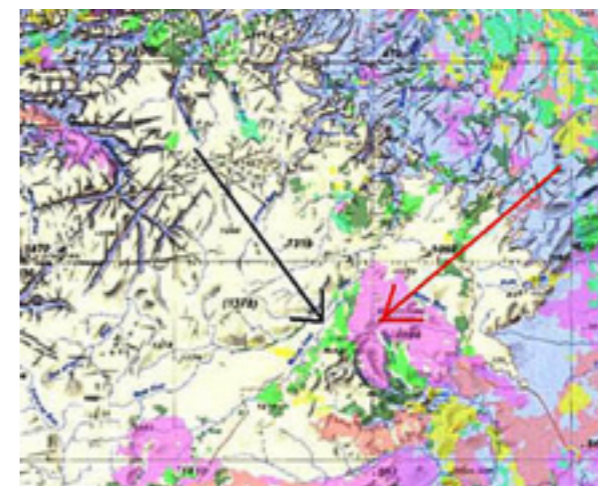


Figure 2: Fire breaks recorded by satellites (MODIS imagery) during the 2005 fire season on the Arnhem Land Plateau. Early dry season fire breaks shown in green (e.g. black arrow) were put in along rivers and tracks and succeeded in stopping the late dry season wildfires shown in pink (e.g. red arrow) that came in from the east.

What timeline is required to establish effective disaster risk reduction in the case study example? Is it a temporary or permanent solution?

Strategic fire management is a cyclic activity that needs to be repeated every year after the wet season and throughout the dry season.

## 4. SUSTAINABILITY

Aboriginal Land Trusts manage most of the lands in the area. Fire management in Arnhem Land is largely based on the traditional knowledge of the Aboriginal communities. Apart from providing long term jobs and other benefits for the aboriginal communities, the programme supports transfer of Indigenous knowledge between generations as elders work with young people, and as well as helping people to re-establish contact with traditional lands.

## 5. LIMITATIONS ON THE USE OF ECOSYSTEMS IN THIS PARTICULAR HAZARD

Fire management has been practiced in these areas for centuries in a sustainable way. The main challenge is related to the absence of communities in areas that have traditionally been inhabited. National authorities and an innovative partnership, such as the one described in this case study, can encourage and support the return of communities to their traditional grounds.

Given that prescribed and strategic approaches to fire management will be required to reduce wildfire threats in western Arnhem Land for the foreseeable future, the project is envisaged to function indefinitely as a greenhouse gas emissions abatement project. However, it is recognised that carbon assimilation into living biomass will, over a number of decades as a result of less frequent and less intense fires, eventually attain a new landscape 'equilibrium'. Currently, sequestration in native forest systems is not accountable for under Kyoto provisions. While this may change in the future, there are clear challenges ahead both for recognising and measuring changes in carbon stocks relative to pre-project baseline levels.

## 6. IMPLEMENTATION COSTS

As part of the arrangement, Darwin Liquefied Natural Gas will provide around US\$ 1 million every year for the next 17 years to Aboriginal Traditional Owners of Western Arnhem Land to implement a fire burning strategy and offsetting 100 000 tonnes of CO<sub>2</sub>- equivalent per year.

This project is not generating any income from carbon trading. Rather, it is a fee for service arrangement in which indigenous fire managers are being paid for fire management to produce greenhouse gas offsets. However, the process and accounting practices used to abate greenhouse emissions in this project would qualify for carbon trading if, for example, the market arose in the future. This approach has significant potential for application in other fire-prone regions of north Australia.

## ALTERNATIVE COSTS

Without strategic fire management destructive wildfires degrade Arnhem Land plateau year after year. Firefighting extensive wildfires in unmanaged lands is practically impossible and the costs would be very high.

## 7. CARBON BENEFITS

Savanna fires are the greatest source of greenhouse gas emissions for the Northern Territory. Based on estimates for 2004, burning of savannas contributes 41% of the Northern Territory's accountable emissions (CO<sub>2</sub> not included, see below).

When fire burns grass, leaves or wood, it emits smoke and gases which are produced by combustion. The main greenhouse gases produced by fire are CO<sub>2</sub>, methane and nitrous oxides. The CO<sub>2</sub> emitted is re-absorbed to a greater or lesser extent by the new plant growth that follows fire, particularly in the next rainy or growing season. If fire and plant growth after fire are in equilibrium, then the CO<sub>2</sub> emitted in the burning season — the dry season — will be balanced by that absorbed in the growing season — the wet season. There is emerging evidence, however, that for large areas of far north Australia such as Arnhem Land, the system is not in equilibrium and frequent late dry season fires are slowly reducing the tree biomass and releasing more CO<sub>2</sub> into the atmosphere that is not being re-absorbed (Cook et al, 2005).

Field studies and remote-sensing data have shown that early dry season fires emit less greenhouse gases (CO<sub>2</sub>, nitrous oxides and methane) per area affected than the more intense, late dry season fires (Russell-Smith et. al. 2004). This is mainly because the earlier fires:

- ★ Are not as intense and burn less of the grassy fuel than a more intense fire would — so plants that are burned are often only partially consumed by the fire, and the fire often leaves parts of the plant unburnt.
- ★ Do not burn the entire grass layer — often large patches of grass and litter fuels are unburnt by an early dry season fire.
- ★ Usually stay in the grass layer, whereas the intense fires typical of the late dry season can move into the upper canopy and can consequently consume the additional biomass of organic matter in tree trunks and branches.
- ★ Early dry season fires tend to be more easily stopped by roads, small creeks and rivers or dew cover and so tend to burn less country than a late dry season fire.
- ★ Furthermore, if early dry season fires are used to create fire breaks — or strips of already burnt country — in the landscape, this can limit the spread of late dry season wildfires.

If the types of fire that burn across northern Australia can be changed so that there are less frequent intense wildfires in the late dry season, so that less grass, leaves and wood are burnt, then less smoke and greenhouse gases will be emitted.

The WAFMA is designed to offset about 100,000 tonnes of greenhouse gas emissions per year. Currently around 10% of the project area's landscapes are affected by early dry season fires and 30–60% are affected by late dry season wildfires in most years. Field studies and remote-sensing data have shown that early dry season fires emit less greenhouse gases (CO<sub>2</sub>, nitrous oxides and methane) per area affected than the more intense, late dry season fires. If the proportion of early dry season fires can be increased to around 15–20% to create fire breaks and patchy mosaics of burnt country and if this then reduces the extent of late dry season burning (more intense wildfires) to 15–20% of the landscape, then savings (abatement) of around 100,000 tonnes a year of CO<sub>2</sub>-equivalent in greenhouse gas emissions can be made. Note that this is a relatively small fraction of the total emissions from the LNG plant - many of the main benefits of the project are seen to be in better protecting the natural and cultural values of the plateau and in the social and economic stimulus it provides for Indigenous communities.

The international guidelines on what constitutes valid greenhouse gas abatement stems from the Kyoto Protocol. To meet these requirements the abatement must firstly involve greenhouse emissions that are caused by people — i.e. are “anthropogenic”. Secondly, CO<sub>2</sub> emissions cannot be counted in the case of fire emissions because these are considered to be re-absorbed by new plant growth following fire (IPCC, 1996). Although there is a great deal of evidence (see above) that this is not the case for northern Australian wildfires, the West Arnhem Land project only counts the abatement of the non-CO<sub>2</sub> gases emitted by fire: methane and nitrous oxides. Even so, 41% of the Northern Territory's greenhouse emissions and around 2% of Australia's total greenhouse emissions are due to methane and nitrous oxides from savanna fires (Australian Greenhouse Office, 2006). Apart from methane and nitrous oxides, savanna fires are also a very significant source of the most common greenhouse gas — CO<sub>2</sub>. It has been estimated that the burning of savannas in northern Australia releases up to 218 million tonnes of CO<sub>2</sub> (Australian Greenhouse Office, 2006) which persist in the atmosphere for periods up to seven months of the year over the fire season. This amount is equivalent to 38.5% of Australia's total greenhouse gas emissions in 2004. Although there are considerable timing uncertainties concerning the degree to which this CO<sub>2</sub> contributes to climate forcing, it is clear that the gases produced by savanna fires are an important factor in Australia's greenhouse budget.

## 8. CONCLUSIONS AND LESSONS LEARNED

Strategic fire management in Northern Territory of Australia generates multiple benefits. Environmental benefits include reduction of greenhouse gas emissions and degradation of ecosystems, while economic benefits include increased employment and economic participation of aboriginal communities and the avoided economic costs of destructive wildfires and the associated loss of biomass and ecosystem services. Finally, social benefits include enhancement of traditional indigenous culture related to fire and increased participation of aboriginal communities.

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