THE CARBON FARMING INITIATIVE

Territory Natural Resource Management

CARING FOR OUR COUNTRY

Contents

What is the Carbon Farming Initiative?

With global greenhouse gas emissions rising year-on-year, the long term threats to both humankind and our planet's ecological balance are hot topics in the conservation arena. Carbon dioxide is a naturally occurring greenhouse gas but, at elevated levels, can cause extreme changes to Earth's climate. The last century has seen a dramatic increase in carbon dioxide (CO2) levels in our atmosphere, driven primarily by an increasing use and dependence on fossil fuels, and exacerbated by large scale habitat clearing. The consequences of increasing CO2 include rising oceans, a warming planet, species extinction and an increase in extreme weather events such as severe storms, droughts and widespread flooding.

In a bid to manage and potentially mitigate the worst of these expected outcomes, a number of global strategies have been proposed to reduce carbon output, such as the Kyoto Protocol and the REDD initiative. The Carbon Farming Initiative is the Australian Government's carbon offsets scheme designed to enable farmers and land managers to generate carbon credits (ACCUs) and so benefit through participation in carbon markets. The Government has committed to a $1.7 billion investment in this scheme over the next six years to improve productivity, sustainability and profitability – of which around $100 million has been allocated to directly support on-farm activities and $1 billion for biodiversity protection. The purpose of this booklet is to advise Territory land managers about the potential and suitability of this initiative for land management activities, and how the applicability of management strategies can vary across different land-use sectors as well as different regions.

ACCU's and the Kyoto Protocol

ACCUs are issued as either Kyoto ACCUs or non-Kyoto ACCUs.

K — Kyoto ACCUs are issued for eligible Kyoto projects and if the reporting period ends on or before the Kyoto abatement deadline.

NK — Non-Kyoto ACCUs are issued for eligible non-Kyoto projects, or if the reporting period ends after the Kyoto abatement deadline.

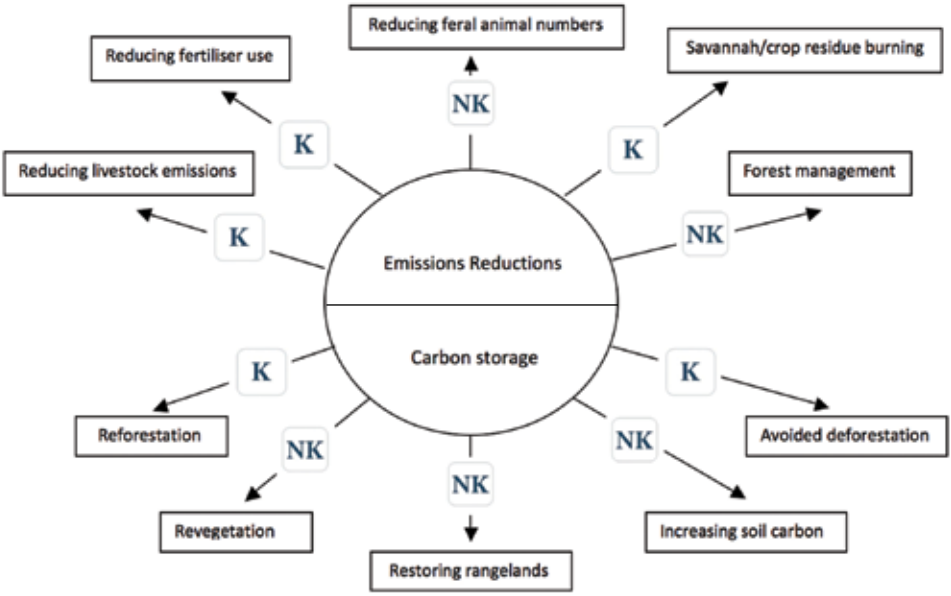
Symbol code

Indigenous stakeholders Pastoral stakeholders Cultivated lands

Slowing the pace of a growing carbon footprint

Australia's per-capita carbon emission rate is 4.5 times higher than the world average and, since the 1980s, Australian emissions have been rising at around twice the growth rate of the US and Japan and five times the growth rate of Europe. In 2009, 18% of Australia's greenhouse gas (GHG) emissions came from land use, agriculture and forestry - with livestock, crop agriculture and savanna fire all major contributors. Based on the type of industry prevalent in the Northern Territory, the main opportunities for greenhouse gas abatement within the land sector will be through emissions reductions or using biological processes to capture and store carbon (biosequestration)

Main CFI Activities and Accreditation Type



The Territory Context

Covering an area of about 1.365,000 km2, the NT is comprised of wet-dry tropics, savanna and desert environments. Features of the NT landscape include;

- High biodiversity
- Largely intact native vegetation
- Low rates of clearing
- Under threat from weeds, feral animals and destructive fire regimes.

The main GHG sources are;

- Fire in savanna woodlands (over 1/3 of all Territory emissions).
- Livestock (about 17% of emissions, especially methane).
- Feral ruminants including camels, horses and buffalos
- Fertiliser (nitrous oxide)

Agriculture and the land sector generate over half of all Territory emissions, a much higher proportion than nationally, and Territory agriculture accounts for around 1.3 % of all Australian GHG emissions. There are around 300 cattle stations across the Territory raising approximately 2 million cattle and most are managed as extensive, large-scale, low cost operations. Cattle exports constitute the NT's most important agricultural industry, both by value and by land use. Cropping and horticultural industries are primarily restricted to small areas of the Top End and around the Katherine-Daly and though limited in extent, these industries have grown rapidly in recent years.

Carbon Farming – Opportunities and Limitations

While the information presented here is intended as a general guide for landowners interested in taking part in an emissions reduction strategy, the extreme variation in the character of Territory landscapes (local climate, soil and vegetation types) means that CFI strategies are not a one size fits all approach. Opportunities for abatement and incentives for participation within the CFI differ between areas, with some better suited to achieve abatement than others. Depending on the location of and activities carried out on individual land areas, landowners may derive more benefit from alternative conservation initiatives.

Many Territory soils have relatively low carbon content and a limited potential for any increase. Soil carbon and carbon storage in vegetation and vegetal debris is generally highest in the northern Eucalyptus woodlands, monsoon forests, islands, coastal and riparian areas of the Top End. Lower levels of carbon are stored across the Gulf and Victoria River districts, while very little carbon is sequestered in the sandy soils and Spinifex grasslands of central Australia. In Top End tropical savannas, the largest proportion of this carbon is stored below ground in soil. Despite storing relatively small quantities of carbon per unit area, the vast extent of tropical savanna across the monsoon-influenced areas of the Territory have identified it as a significant carbon 'sink'.

As CFI strategies are a new field of research, the current methodologies for many of the following activity areas are still under development. As the application of on-ground actions is a relatively specialised field, it is likely that many land managers would need to employ the services of a project manager to implement a project in the context of the CFI, and would therefore need to factor this cost into planning decisions.

Savanna Fire Management

Tropical savannas extend across a 1.9 million km2 area of northern Australia and correlate with the region influenced by seasonal monsoon. They are complex systems influenced by the interactions of many factors including rainfall, grazing and fire. Woodland habitat with a grassy understory, their soils are highly weathered, leached and low-nutrient and are generally unsuited for broad-acre agriculture. They are mainly used for livestock grazing, although extensive areas of indigenous lands and conservation reserves means the landscape has remained largely intact.

Fire and GHGs

Low intensity fires are an integral part of the savanna nutrient cycle as well as the life cycle of many plants. Fire occurrence is related to seasonal accumulation of organic matter and can be brought about by human or natural causes. Changing land management practices over recent decades has led to increasingly severe fires that release levels of CO2, methane and nitrous oxide equal to approximately 3% of national GHG emissions, and over a third of Territory emissions. The proportion of emissions increases with fire intensity and is influenced by fuel type.

Required Actions

1. Develop detailed vegetation maps of proposed project areas, identifying vegetation types and distributions.
2. Calculate a 10-year emissions baseline from analysing historical satellite imagery of fire scars in combination with data on fuel loads and burning efficiency.

3. Begin fire management activities, whose resulting impacts are then calculated and compared with baseline emissions.
4. The difference between baseline emissions and those produced under the modified fire management regime constitute the carbon offsets achieved.
5. In practical terms, land managers seeking to use this method will need to consider some or all of the following strategies;

- implementing an early dry season fire regime to reduce fuel loads
- reducing the total area of land burnt
- establishing firebreaks or reinforcing natural barriers to contain the spread of severe fires.
- actively extinguishing fires (in some cases)

The specific detail of fire plans including the location, timing and logistics of burnings will need to be carefully designed, taking account of landscape attributes and vegetation types as well as local weather conditions. Reducing the area of land burnt annually, and implementing long term protection of some key sites from fire (patching the landscape with burnt and unburnt areas) probably constitutes the most ecologically benign management strategy.

International GHG accounting guidelines assume that CO2 produced by dry season savanna burning is re-absorbed by plant growth the following wet season therefore only nitrous oxide and methane emissions are accountable in GHG inventories. An approved savanna burning methodology has been produced and can be utilised to generate Kyoto compliant credits, accountable in national greenhouse gas inventories.

Benefits

Research has shown the potential to manage northern savanna fires to achieve significant emissions reductions, creating economic benefits through the production and sale of carbon credits as well as biodiversity and cultural benefits.
The restoration of managed fire regimes across sparsely populated regions will generate livelihood opportunities on traditional indigenous lands and assist in the economic revival of the outstations. Indigenous communities are well-placed to participate and benefit from savanna burning, notably through their ownership of lands, ecological knowledge and their demographic distribution across the Top End. Economic opportunities around fire management align well with indigenous cultural responsibilities to care for country, and will lead to an increasing valuation of traditional ecological knowledge and other aspects of culture.

Risks and Limitations

Although fire is an important tool in maintaining savanna health, adverse fire regimes can significantly damage savanna biodiversity. High burning frequencies can cause a change in the structure and composition of savanna vegetation, with consequential changes in fauna. Also, the current savanna burning methodology is only applicable to areas receiving over 1000mm annual precipitation.

Carbon Grazing on Semi-arid Rangelands

Territory rangelands are diverse and extend from the arid Central Australian ranges to the northern tropical savannas. More than half of the Territory land area is utilised primarily for grazing and in arid and semi-arid areas, the condition of rangeland vegetation varies according to environmental conditions, its palatability to livestock and land management history.

Grazing and GHGs

Many Territory rangelands have been degraded by overgrazing and require restoration. Evidence shows that improved rangeland management can increase carbon sequestration and storage in soil and vegetation while abating GHG emissions from other sources. While there may only be marginal capacity to sequester carbon in rangelands, the low opportunity costs (in some areas) and vast expanses, together with the potential for significant co-benefits has stimulated considerable research interest.

Required Actions

Although the methods needed to implement and measure emissions reductions are still under development, the underlying premise of rangelands abatement is simple: the amount of carbon in rangelands soil and vegetation - and the rate of its release- can potentially be modified through land management actions (e.g. grazing and burning). Due to the variable nature of arid and semi-arid environments, as well as the different ways that factors such as rainfall, soil type and vegetation interact, it is more likely that a multi-faceted approach will be the most effective in reducing GHG emissions. This could potentially involve a range of strategies such as;

- Carbon sequestration through woody regrowth
- Land rehabilitation to increase soil carbon
- Improving water capture and storage on rangelands
- Reducing fire emissions through controlled burning and managing weeds
- Reduce methane emissions through livestock and forage management
- Stock management (changing stocking rates and managing grazing pressure)
- Improving herd production efficiency
- Management of invasive species (weeds and ferals)

Mapping a project area and the resource conditions existing within it (vegetation, soils etc...) is a crucial first step in creating a methodology. It will then be necessary to establish a 'baseline' which sets out the course of events likely to occur within this defined area, were the project not to be implemented. Satellite imagery for vegetation mapping supported with field data collection, firescar maps, corporate records or other evidence of land use practices will be used to populate a model and predict a baseline scenario for the duration of the project (100 years). Predictions would regularly be compared against data from field measurements.

Optimal economic outcomes may be achieved through full destocking of some parts of a property, moderate or light destocking of other parts, and potentially no change in management elsewhere. Managing fire regimes -even in arid central Australia- can also enhance storage in carbon pools. Other management interventions may include land rehabilitation such as rills, banks and dams to enhance water retention and primary productivity on rangelands while retention of regrowth or even limited reforestation may be appropriate in some areas.

Benefits

The potential to achieve offsets appears to be linked to landscape attributes; soils, vegetation types, rainfall and land condition. Managing land for carbon offsets may be a valuable opportunity for property managers who have unused and degraded areas on their properties which they wish to restore - particularly as the most degraded lands may be those with the best potential for restoration and sequestration of carbon. An informed abatement strategy would only focus management interventions (such as reducing stocking rates) on land systems of the highest potential, while maintaining productivity elsewhere on the property. Overall, intensified rangelands management combining stock and fire components has potential to restore land condition, improve soil condition and increase the sustainability of pastoral operations. Careful monitoring is required however as there is a risk of woody thickening negatively affecting the grassy understorey under a full destocking regime.

Risks and Limitations

While abatement through biosequestration on rangelands may appear attractive to Territory landholders - at least on some areas of their properties- there exist very high levels of uncertainty regarding the development and applicability of this activity. There is currently no formally approved methodology, and carbon storage achieved through rangeland management would not register in the national GHG inventory or be eligible for Kyoto compliant credits.

Carbon Forestry

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Around 23% of the Territory land area is designated as native forest and includes rainforests, vine thickets, closed forests, woodlands and coastal mangroves. In addition to other ecological functions, these areas are thought to constitute a net carbon sink. A relatively intact habitat, Territory forests and savanna woodlands have been subject to minimal widespread clearing, and it is mostly concentrated in select areas (namely the Katherine-Daly region). The NT's plantation history is relatively short and is mainly confined to recent developments on Melville Island (magnium) and Douglas Daly (African mahogany). However, there has been little change in the area under pine plantation.

Forestry and GHGs

Land clearing and deforestation emits GHGs through burning, decomposition of unburnt vegetation and soil disturbance. Native savanna woodland clearing in the Top End emits between about 50-240 tonnes CO2-e ha-1, depending on the location of the area cleared and the vegetation type. As of 2006 Land Use, Land Use Change and Forestry contributed about 7.1 % of total Territory GHG emissions. Reforestation of cleared native savanna woodlands results in very slow recovery of the emitted carbon. Therefore, from an abatement perspective, it is far better to retain mature savanna woodlands than to reforest an equal area.

Required Actions

A number of possible strategies could be employed:

- Integrating livestock enterprise and forestry
- Establishing plantations on previously cleared pastoral or agricultural properties in small blocks, alleys or windbreaks complementary to more usual land management.
- Integrating trees in northern pasture or crop lands to improve water and soil function and enhance pasture production and sustainability.

Territory landholders undertaking a forestry project must first meet CFI eligibility criteria, address any special conditions (e.g. demonstrating that plantings will not adversely affect local water catchment) and define which methodology will be used. Once completed, the process falls into the following stages; site mapping and evaluation to establish a baseline scenario, identifying possible risk factors and developing a project plan. After any relevant land preparations such as exclusion fencing or weed management, the site would be planted and followed by post-planting management, pest control, irrigation, management of competing vegetation, monitoring forest health and fire risks and collecting data.

Overall, more productive land systems in high rainfall zones will have greater carbon forestry potential than arid lands, and more intensive plantation forestry will achieve higher offsets than environmental plantings.

Benefits

New plantings – notably of native species - and the re-establishment of forests and woodlands offer one of easiest ways for land managers to offset GHG emissions as the amount of carbon sequestered is measurable and verifiable. The establishment of forest plantations and retention of regrowth, (especially environmental plantings of native species) also offers important biodiversity benefits. Stands of vegetation, even non-native, may provide habitat to wildlife as well as improving connectivity between other areas of native woodlands and habitat.

Risks and Limitations

Depending on the character of the region and the history of land use, certain CFI strategies under this approach may have limited application. The risk of losing replanted areas to bushfire or drought could diminish returns over the long term and in areas with rainfall over 600mm p.a, additional justification would be required. The 'Avoided Deforestation' approach also has limitations as it may be difficult for Territory landholders to demonstrate eligibility under the current permit system for land clearing. Assuming landholders could justify a case for avoided land clearing, it is most likely this CFI strategy would follow the internationally accepted Reduced Emissions from Deforestation and Forest Degradation (REDD) procedure.

Reducing Livestock Methane Emissions

Livestock is the Territory's most valuable primary industry and the NT beef herd has gradually grown over recent decades in response both to strong demand from local and international markets as well as productivity improvements. Latest figures put the Territory herd at over 2 million which constitutes about 7% of the total Australian herd, and nearly half of all Territory cattle are concentrated in the Victoria River District

Livestock and GHGs

Like all ruminants, cattle produce methane through digestive processes. They also produce small amounts of nitrous oxide (N2O) through manure and urine. The amount of methane produced is related to the quality and digestibility of their forage diet. As tropical pastures provide a poorly digestible food source, northern beef cattle under extensive grazing produce higher per animal emissions than from southern grazing or feedlot systems. Annually, the NT beef herd produces an approximate average of 1.8 t/CO2-e per Animal Equivalent. These methane emissions have stead-

ily increased since 1990 and now constitute the third largest source of GHGs in the Territory, with the northern beef industry accounting for approximately 4.5% of Australia's total GHG emissions.

Required Actions

Any approach must focus on reducing the amount of GHG emissions for every kg of beef produced, as well as reducing overall emissions. The most immediate potential comes from increasing production efficiency by modifying herd management and stocking rates, as well as enhancing health and nutrition with options like selective breeding becoming more important in the medium term. Improvements to production efficiency should also seek to increase enterprise profitability.

Each animal in the paddock produces about 200 grams of methane daily although this amount varies by region. Research indicates that Central Australian producers are achieving lower emissions than those further north, suggesting an opportunity to reduce GHGs in the latter region. By growing a steer and turning it off for market more quickly, or by increasing the calving frequency of cows, more kg beef may be produced per kg methane emitted. However, selling animals at lower liveweight necessitates a larger herd to produce the same quantity of beef. It is therefore important to calculate the optimum turnoff age, herd size and structure to minimise overall herd emissions. These factors will vary according to regional production conditions and systems.

Improving weaning rates through feed supplementation, improved animal health and removal of unproductive cows from the herd would also reduce emissions. It has been estimated that a 10% increase in weaning rates in low performance cattle grazing systems would reduce CO2-e emissions by 2kg for every kg of live weight gain. Improving breeder herd performance will also likely improve enterprise profitability. Herds run at high stocking rates appear to have higher emission levels as animals have less choice of feeds, resulting in poorer nutrition and slower growth rates. This means more emissions per kg live weight produced. However, trials also show that overall beef production per hectare tends to increase at high stocking rates.

Diet directly influences methane emissions, and those raised on northern pastures have higher emissions due to a low quality diet. Using feed supplementation to increase digestibility may be an option especially as some feed supplements are known to directly inhibit the production of methane (e.g. oilseeds or legumes). From a logistic and economic point of view, this solution would not always be practical considering the extent of many NT pastoral properties, but there may be opportunities for providing supplements to cattle through water supplies or lick blocks. Alternatively, finishing cattle in feedlots would achieve reduced emissions. A more practical alternative may be to improve some northern Australian pastures by establishing Leucaena (a tropical woody legume), which would enhance the diet (and therefore growth rates) of cattle, while suppressing methane production and also helping to sequester carbon. One focus for livestock methane abatement research is to identify the most suitable legumes for this purpose.

Other research potential including genetic selection or vaccines to suppress methane-producing bacteria are being investigated but the most immediate and realisable opportunities to reduce methane emissions from livestock are based on enhanced improved herd management, pasture management and feeding practices.

Benefits

Even though a relevant methodology has not yet been developed, strategies have already been identified that could improve livestock production efficiencies and so abate overall methane emissions from Territory herds. Some researchers anticipate that up to 20% a reduction in GHG emissions may potentially be achieved at no loss to (or even with an increase in) enterprise profitability.

Risks and Limitations

There is currently no formally approved methodology for achieving offsets through GHG abatement from livestock though this is expected within the next few years. Any strategy to enhance productive efficiency will invariably raise costs of production, requiring investment in new technologies, training and an intensification of management though these costs should be offset by improved efficiencies

Carbon Storage K NK

Soil is both a 'sink' and a 'source' of carbon. Sequestration occurs as plants capture CO2 through photosynthesis, die and decay and deposit captured carbon onto or into the soil. While this occurs continuously, there is also a simultaneous process of decomposition and mineralisation which emits carbon back into the atmosphere. The amount of carbon stored in soil therefore reflects the balance between sequestration and emission rates. In crop agriculture, carbon accumulating in plant matter is harvested and removed from the soil and in 2009, agricultural soils accounted for approximately 4 % of Territory GHG emissions.

Carbon storage and GHGs

There has been growing interest around Australia in strategies to offset GHGs by increasing soil carbon storage on cropped lands. Converting pristine lands to cropping tends to reduce the amount of soil organic carbon stored as well as depleting nitrogen. While many Australian soils have inherently low soil organic carbon, Territory soils have particularly low carbon content, and a relatively low potential for increasing this.

The most suitable soils for agriculture are in the Douglas-Katherine area as they have amongst the highest levels of carbon content in the Territory. Much of the Territory's cleared agricultural land is under improved pastures. Cropping occurs on a very small scale (36,664 ha) and is dominated

by forage crops and hay production although some coarse grains and broad acre crops such as peanuts and mung beans are also grown. Horticulture is concentrated on small holdings in the Darwin rural and the Katherine areas and main crops include mango, citrus, other irrigated orchard crops and Asian vegetables.

In many respects, field cropping is still in its infancy in the Northern Territory; most cropped lands have only recently been cleared for cultivation and in some cases the soil is still stabilising. There are no defined farming systems as yet and producers are still establishing the best farming techniques and crop combinations. Land managers face problems maintaining soil as they are of a poor quality and vulnerable to nutrient leaching during the monsoon season. Consequently, agricultural and horticultural production is heavily reliant on the application of artificial fertilizers - especially nitrogen based fertilizers. These fertilizer regimes may be highly inefficient and over 50% of urea and potassium nitrate can be lost as N20 in warm, wet soil conditions.

Farming techniques intended to better conserve soil organic material and nutrients are generally labelled as 'conservation farming' and encompass a range of actions applicable to the Territory. These could deliver a distinct range of benefits to Territory growers; reducing the loss of Top End soil through water erosion, increasing soil fertility and moisture retention, and reducing some farm labour and machinery costs.

Required Actions

Perhaps the most important innovation in conservation farming is reduced, minimum, or zero tillage. This is a farming system in which crops are established without disturbing the soil through ploughing. However, sandy soils in drier regions appear less responsive to changes in tillage and residue management, so the technique would have less application in Central Australia. 'No till' agriculture utilises heavy mulch cover to suppress weed growth and help insulate and protect the soil, retaining nutrients and carbon. Rates of about 3 tonnes/hectare have been recommended for the Top End environment.

A second underlying principle of conservation farming is to enhance soil carbon through cover crops and rotation. Crops which typically produce little biomass (e.g. sesame, mung bean, peanuts), should ideally be rotated with high mulch crops (e.g. sorghum) to increase surface cover. The practice of fallowing land to restore soil moisture, nitrogen and reduce weeds can exacerbate soil carbon losses as leaving land bare creates favourable conditions for decomposition and soil erosion. Conversely, ensuring that land always remains under crop reduces erosion risks and continues sequestration of atmospheric carbon into the soil. 'Cover crops' are grown quickly, specifically for the purpose of protecting the soil and providing mulch.

Benefits

Crop rotation can improve soil structure and fertility. In rotations, substituting legume pastures for field crops has a high potential to fix nitrogen and restore soil nutrients, reducing the need for nitrogenous fertilisers and avoiding N2O emissions. Seasonal erosion and soil loss from monsoonal rains can be mitigated through physical structures such as contour banking to reduce runoff. These can be vegetated with hedgerows to help bind soil and contribute to sequestration of carbon. Conservation agriculture also requires managing land for fire or grazing as these factors can strip soils of protective mulch, exposing it to erosion.

New soil management techniques may substantially improve fertiliser use efficiency. Incorporating legumes into a crop rotation can reduce the quantity of additional fertilisers required and enhanced efficiency fertilisers can reduce GHG emissions by up to 65%. New fertiliser management regimes are expected to deliver healthier root systems and improved crop yields but would cost more than current methods, requiring greater investment and additional management. Adopting a conservation farming method in combination with improved fertiliser management can deliver a more efficient, sustainable and productive farming system along with carbon abatement.

Risks and Limitations

A transition to new systems of land management will invariably carry additional costs and increased labour inputs, at least initially until the benefits of the new system are achieved. In the southern part of the Territory, soils are generally sandy, carbon and nutrient deficient, and subject to erosion. Rainfall is low, vegetation is sparse and degraded soils have limited capacity to retain moisture. Soils are more heterogeneous across the Top End and Gulf Savanna regions. However, most of them are highly erodible and subject to leaching and weathering. Like desert soils, these have relatively low natural fertility.

Feral Animal Control

While small populations of GHG-producing feral animals such as camels and water buffalo are managed in domestic herds for production of meat, milk, hides or tourism, the majority are not considered to be productive and can damage native habitats and private property. Methane production from large populations of feral camels and water buffalo contributes to GHG emissions in the Territory. It has been proposed that offsets generated through the control of these animals could be accounted for under the CFI.

The north Australian water buffalo population is estimated at 80,000, mostly concentrated around coastal floodplains, river valleys and swamps – where they cause significant environmental damage. The fastest growing population of Top End buffalo is in Arnhem Land. Buffalo have been suc-

cessfully controlled across the Top End using aerial shooting along with some ground shooting and the NT government is working with indigenous groups to develop effective management programs. Accurate population estimates for feral camels are more difficult due to their high mobility and the remoteness of their distribution. The latest population estimates suggest there are around a million feral camels in central Australia with around 1/3 of this population in the NT. At high densities, camels can cause serious environmental damage and destroy critical watering points – essential to the survival of native desert species. Camels also inflict damage on pastoral property infrastructure, including fence lines, yards and watering points. In 2006 the Australian government signed a contract with Desert Knowledge CRC to deliver a control strategy ('Cross jurisdictional management of feral camels to protect NRM and cultural values').

Feral animals and GHGs

In addition to their direct environmental impacts, camels and buffalo are ruminant species and are therefore a source of methane emissions. Camels produce an estimated 0.97t /animal CO2-e yr-1 (slightly less than rangeland beef cattle) while water buffalo produce approximately the same emissions as cattle - about 1.3t /animal CO2-e yr-1. In the Territory, feral camels alone will produce approximately 248,500 tonnes CO2-e yr-1, with water buffalo potentially producing an additional 100,000 tonnes. Combined, these emissions would amount to nearly 2% of net Territory GHG emissions.

Required Actions

The preferred control method for feral camels is aerial shooting (from a helicopter), which involves low level flight to position a marksman. Both pilot and marksman need to undertake special training and accreditation before engaging in aerial shooting as animals must be culled humanely. Aerial shooting is arguably the only practical method for controlling large numbers of vertebrate feral animals over large-scale regions or in accessible areas.

Risks and Limitations

However, one apparent problem with aerial culling is the increasing marginal costs as feral animal densities decrease. At low animal densities, costs can become prohibitive. Available data suggests that per animal aerial shooting costs range from $20 - $100 as population densities drop off. Another approach is ground shooting, which is usually been carried out by pastoral landholders or hunters (with landholder permission). There are no current legislative requirements governing the skill or proficiency of the marksman, other than regular firearms licensing, and animal welfare legislation. However, model codes of practice for humane control and standard operating procedures for ground-based shooting have been prepared for other species and should be followed.
Once culled, animal carcasses are generally left due to the complicated logistics of removing them,

but in some areas limited shooting for pet meat occurs. It should be noted that aboriginal people do not generally condone shooting 'to waste' and may have cultural objections to this on their lands. There is little available evidence on the effectiveness of ground shooting, as accurate records are rarely kept and anecdotal evidence provides mixed results. However, ground shooting is known to be cheaper than aerial shooting and has been achieved for as low as $7.50/animal kill on commercial pet meat shoots.

Blue Carbon

'Blue Carbon' refers to carbon sequestered and stored in coastal habitats and include wetlands, tidal salt marshes, seagrass meadows, mangroves, kelp forests and coral reefs. These highly productive ecosystems serve a range of important ecological functions; supporting marine and terrestrial species, retaining shorelines and enhancing water quality. The potential for carbon sequestration and storage in coastal environments may be greater than the most productive of terrestrial environments. This is of particular note in northern Australia where terrestrial landscapes hold relatively poor sequestration potential.

Blue carbon and GHGs

Coastal ecosystems store carbon in living biomass and soil carbon. As intact coastal ecosystems have largely mature vegetation that maintains a steady biomass, most sequestered carbon finds its way into the soil carbon pool. Although the total area of coastal habitats is comparatively small, carbon storage per hectare is typically three to five times more than that stored in tropical forests. Saltmarsh and mangrove habitats sequester between 6-8 tonnes CO2-e ha-1 yr-1, while seagrass habitat sequesters around 4 tonnes CO2-e ha-1 yr-1. An estimated 440,000 ha of mangroves extend along approximately 4,600 km of Territory coastline. Due to low population density the vast majority of this has been little impacted by human development and Territory mangroves are considered among the most pristine in Australia and possibly the world. The majority of Territory coastline is under the ownership and active management of aboriginal groups.

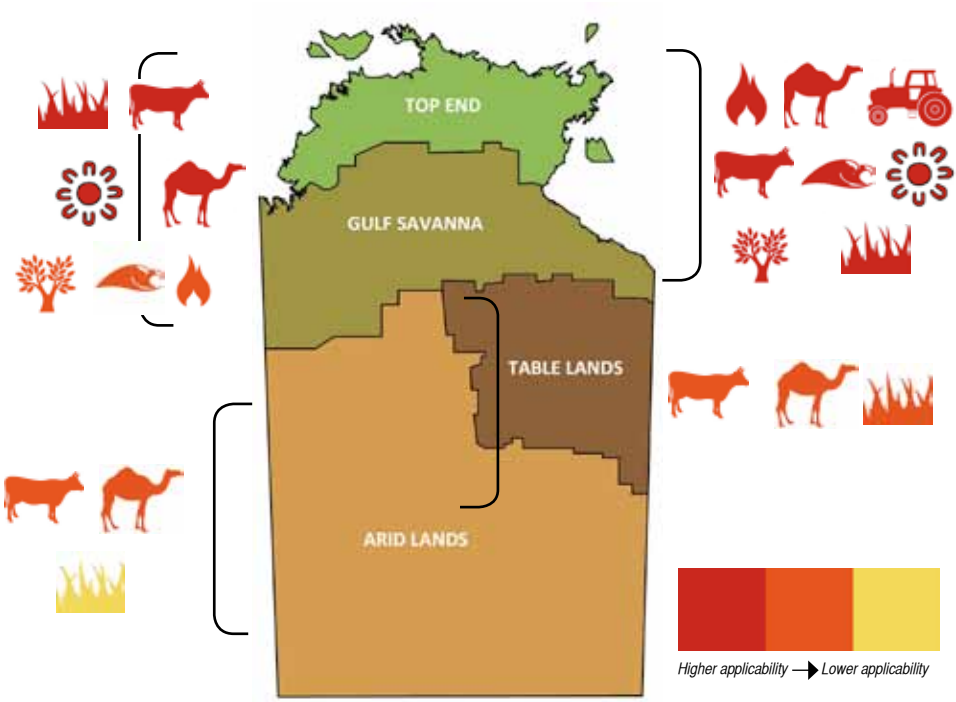
Benefits

While coastal mangrove forests could be protected through the international REDD initiative, it is presently unclear whether other types of coastal habitat could be included. There is a growing international interest in developing market-based mechanisms to support blue carbon management projects and finance the protection of high value coastal habitats. One future opportunity (currently being piloted in south-east Asia) may be to create economic incentives for the sustainable management and protection of coastal carbon stocks.

In northern Australia this opportunity would be available primarily to indigenous communities, and income from offsets achieved could be utilized to provide livelihood support as well as to build local capacity for ongoing coastal management.

Risks and Limitations

There is currently no methodology in Australia for achieving carbon offsets through management and protection of blue carbon resources. The main obstacle to developing a methodology under the CFI is the underlying premise is that in the absence of a project, carbon stocks would otherwise be lost through some form of change in land use or condition. The current situation in the Territory is that there is little imminent threat of coastal habitat being disturbed or lost. Like aboriginal and pastoral landholders who have stewardship over large tracts of terrestrial savanna which constitute major stores of carbon, there is no basis for a claim for offsets under the CFI. Any future blue carbon stewardship program in Australia would probably need to be developed on a different basis to the CFI - possibly some form of biodiversity crediting.



Summary

The emerging carbon economy is a complicated and sometimes contentious area of NRM policy. The Carbon Farming Initiative (CFI) introduced in September 2011 is of particular significance to the northern Territory, where land and natural resource management activities predominate in many aspects of economic social and cultural life.

An overall review of the various carbon farming opportunities suggests that, in contrast to sequestration, emissions reductions do not require land managers to commit to 100 year standards for permanence and thus gives them greater flexibility in year-by-year decision making. Until greater understanding of (and trust in) the CFI is achieved, it is likely that Emissions Reductions strategies will continue to be perceived as lower risk.

This summary booklet is intended to provide a succinct overview about GHG abatement opportunities across the Territory within the context of the CFI. The information provided here is a condensed version of a much broader scope of available research and anyone seeking additional information about research or points of contact should contact Territory NRM. Additional information can also be found at the following web address;

http://www.climatechange.gov.au/,

including the CFI reference document, which can be downloaded here:

http://climatechange.gov.au/en/government/initiatives/carbon-farming-in

For more information visit:

- CFI e-news: http://www.climatechange.gov.au/government/initiatives/carbon-farming-initiative/subscribe/2012-11.aspx (latest edition, just released, and includes a link to the subscription page)
- CFI overview (8pp in pdf format): http://www.climatechange.gov.au/government/initiatives/carbon-farming-initiative/about.aspx
- CFI Handbook (44pp in pdf format): http://www.climatechange.gov.au/government/initiatives/carbon-farming-initiative/handbook.aspx

www.territorynrm.org.au

Territory Natural Resource Management

CARING FOR OUR COUNTRY