Sessional Committee on Environment and Sustainable Development Inquiry into Sustainable Agricultural Production in the Northern Territory

Briefing on climate change and agriculture in the Northern Territory

Paul Purdon, Manager Environment and Greenhouse Policy

This paper briefly outlines some of the implications of climate change for sustainable agriculture in the Northern Territory. It covers two main themes: the impacts of a changing climate on agriculture, and the impacts on the agriculture sector flowing from the policy response to climate change.

Specific issues include:

1. Climate change projections for the Northern Territory (page 2)
2. Potential impacts of climate change on agriculture in the Northern Territory (page 4)
3. Greenhouse gas emissions from the agriculture sector (page 5)
4. Mitigating greenhouse gas emissions from the agriculture sector (page 8)

Climate Change in Australia
Northern Territory at a glance

Observed changes

Australian temperatures have increased by 0.9°C since 1910, with most of the warming occurring since 1950. Warming over most of the Northern Territory has been weaker than the national average, with the north-western half warming by less than 0.5°C since 1950 (a few areas along the Western Australian border have even cooled slightly). The far south of the Territory has warmed more strongly, with increases reaching 1.2°C in the south-east.

Rainfall in the Northern Territory has increased since 1950, at a rate of up to 5 mm/decade in the south to more than 50 mm/decade in the north. This increase in rainfall has contributed substantially to limiting the rise of temperatures, particularly during the summer monsoon season.

Projections

The Intergovernmental Panel on Climate Change (IPCC) developed a range of greenhouse gas and sulphate aerosol emission scenarios for the 21st century based on various assumptions about demographic, economic and technological factors likely to influence future emissions. These emissions can affect climate. Computer models of the climate system are the best tools we have for estimating future climate change.

Projections are relative to the period 1980-1999 (referred to as the 1990 baseline for convenience). Projections for 2030 are given for a mid-range emission scenario. Beyond 2030, changes become more dependent on greenhouse gas emissions, so projections for both high and low emissions scenarios are given for 2070. Detailed projections for the Northern Territory are available at www.climatechangeinaustralia.gov.au.

Temperature

By 2030 annual average temperatures over the Northern Territory are projected to increase by about 1.0°C (range of 0.7-1.4°C) in the north through to 1.2°C (range of 0.8-1.6°C) in the south relative to the climate of recent decades. By 2070 this increase is around 1.8°C (range of 1.2-2.5°C) across the Territory under a low emissions scenario or 3.5°C (range of 2-5°C) under a high emissions scenario, with warming slightly larger in the south.

The chance of a 1°C warming in 2030 is 30-50% in the north and 60-70% in the south, rising to over 90% by 2070. The chance of a 2°C warming is 10-30% in the north and 40-50% in the south for the 2070 low emission case, and over 90% for the 2070 high emission case.

Rainfall

Annual, winter and spring rainfall is likely to decrease in the south. Changes in summer and autumn rainfall are less certain. By 2030 annual rainfall in the Northern Territory is projected to change by -15 to +5% in the south and -7 to +6% in the north relative to the climate of the past century. By 2070 the change is projected to be a decrease of -25 to +10% in the south and -10 to +10% in the north under a low emission scenario, or -40 to +15% in the south and -20 to +20% in the north under a high emission scenario. Extreme daily rainfall may increase, particularly in summer and autumn.

Humidity
Little change in relative humidity in the north and small decreases in the south are projected.

Potential evapotranspiration
Evapotranspiration is the combination of evaporation from soil and water surfaces, and transpiration from vegetation. Annual potential evapotranspiration is projected to increase over the Northern Territory.

Wind
Projected average wind speed changes are small.

Tropical cyclones
Increased intensity of tropical cyclones is likely, but total numbers of cyclones may decrease.

Sea level rise
Global sea level rise is projected by the IPCC to be 18-59 cm by 2100, with a possible additional contribution from ice sheets.

Sea level extremes – storm surges
There is potential for more significant increases in inundation as a result of storm surges due to higher mean sea level and more intense weather systems.

Site specific projections

In the tables below, the projections for 2030 and 2070 show the best estimate (50th percentile) with a range of uncertainty (the 10th to 90th percentile, in brackets).

Darwin	2030 average (mid emissions)	2070 average (low emissions)	2070 average (high emissions)
Increase in annual temperature (^{o}C)	1.0 (0.7-1.4)	1.7 (1.2-2.3)	3.2 (2.3-4.4)
No. days over 35^{o}C (currently 11)	44 (28-69)	89 (49-153)	227 (141-308)
Change in annual rainfall (%)	0 (-7 to +6)	-1 (-11 to +10)	-1 (-21 to +20)

Alice Springs	2030 average (mid emissions)	2070 average (low emissions)	2070 average (high emissions)
Increase in annual temperature (^{o}C)	1.2 (0.8-1.6)	1.9 (1.3-2.7)	3.7 (2.6-5.2)
No. days over 35^{o}C (currently 90)	109 (102-118)	122 (112-138)	155 (132-182)
Change in annual rainfall (%)	-6 (-17 to +5)	-9 (-26 to +8)	-17 (-44 to +16)

Possible impacts

- Remote area communities to face increased exposure to heat stress, fire, extreme rainfall events and flooding
- 80% loss of biodiversity in Kakadu wetlands for a 30 cm sea level rise
- Greater energy demand for cooling in summer, less energy demand for heating in winter

More detailed projection information is available at www.climatechangeinaustralia.gov.au

Potential impacts of climate change on agriculture in the Northern Territory

The impacts of climate change on agriculture in the Northern Territory are uncertain, but may involve the following:

Livestock

- Increased heat stress due to increased temperatures, potentially lowering production and perhaps reproduction, possibly increasing morbidity
- Increased pests and diseases, with stock requiring greater health maintenance
- Reduction in pasture quality, particularly in water limited environments
- Reduction in water availability, particularly in central Australia – will further stress operations that are marginally viable
- In combination, carrying capacity of pastoral properties may be altered, with productivity in northern savannas expected to be less affected than more southern rangelands

Irrigated agriculture

- Changes to water availability
- Water demand likely to increase with increased temperatures and evapotranspiration
- Possible changes to sowing and harvest times
- Pests and disease issues likely to increase
- Possible increase in product damage
- Adverse impacts of extreme weather events

Fisheries

- Impacts may be mixed, depending on species and their response to water temperature, freshwater flows, ocean acidification and salinity.
- Aquaculture industry highly vulnerable to extreme weather events, particularly storm surge.

National Greenhouse Gas Inventory 2006

Overview

Australia's National Greenhouse Gas Accounts were released for the year 2006 by the Australian Government on 24 June 2008. This includes the National and State and Territory Greenhouse Gas Inventories for 2006. All documents are available at: http://www.greenhouse.gov.au/inventory/index.html.

1. National emissions profile

Australia's net greenhouse gas (GHG) emissions across all sectors totalled 576.0 million tonnes of carbon dioxide equivalent (Mt CO_2-e) in 2006 under the accounting provisions applying to Australia's 108% Kyoto emissions target. Nationally, emissions from the agriculture sector represent 16% of total emissions in 2006.

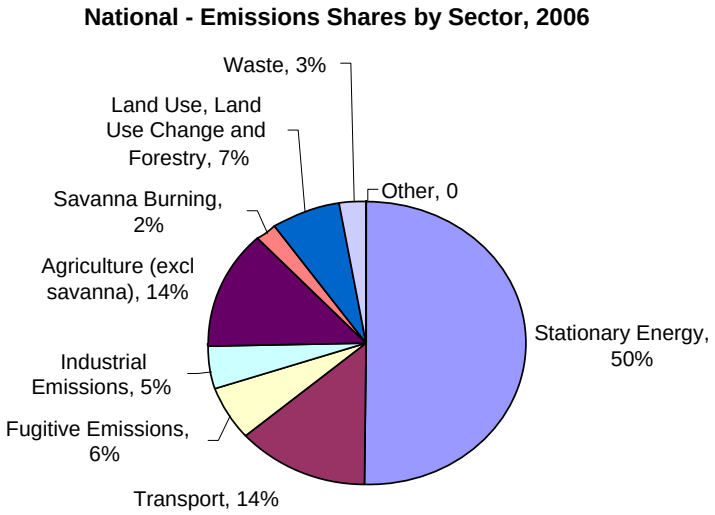

Figure 1: Australian emissions share (%) by sector 2006

2. Northern Territory emissions profile

The NT's net GHG emissions in 2006 were 16.2 Mt CO_2-e (Table 2). This represents 2.8 % of Australia's total emissions for 2006. Emissions in 2006 were 54% greater than emissions in 1990, an increase of 5.7 Mt CO_2-e. Since 2005, NT emissions increased by 1.3 Mt CO_2-e, mostly from energy consumption/production and savanna burning.

	Emissions Mt CO_2-e			Per cent change in emissions
	1990	2005	2006	1990 – 2006
Energy	3.8	5.3	6.0	60
- Stationary Energy	2.4	3.8	4.5	47
- Transport	0.9	1.4	1.4	48
- Fugitive Emissions	0.4	0.1	0.1	-71
Industrial Processes	0.0	0.5	0.5	234
Agriculture	5.7	7.6	9.0	58
- Enteric Fermentation	1.8	2.4	2.5	34
- Agricultural soils	0.4	0.5	0.6	
- Savanna burning	3.4	4.7	5.9	71
Waste	0.1	0.1	0.1	12.5
Land Use Change (deforestation)	1.0	1.9	1.2	20
Forestry[1]	0.0	-0.1	-0.1	N/A
NT's Net (Total) Emissions	10.5	14.9	16.2	54

Table 2: NT emissions by sector 1990, 2005 and 2006 (rounded to one decimal point)

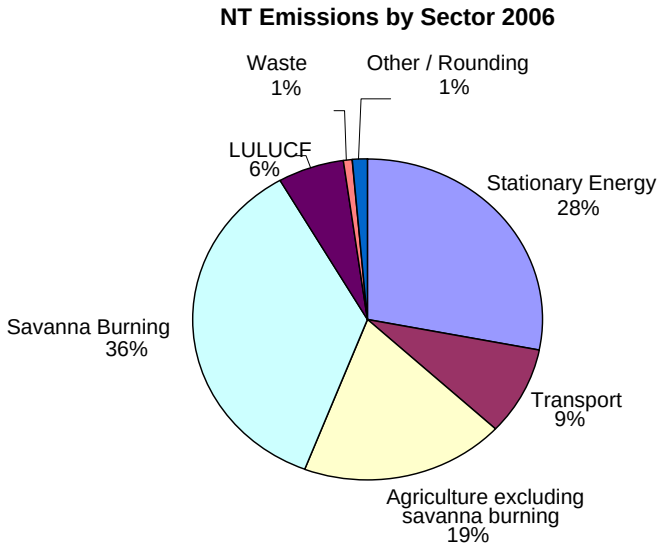

Figure 2: NT Share of Emissions by Sector 2006 (LULUCF – Land Use, Land Use Change and Forestry)

In 2006 the Agriculture sector was the largest contributor to NT emissions (55% of NT total) (Figure 2). GHG emissions in the NT agriculture sector are generated from:

- Enteric fermentation (cattle) – methane (CH4);
- Prescribed burning of savannas – carbon dioxide (CO2), nitrous oxide (N2O) and CH4;
- Agricultural soils – N2O

In 2006 savanna burning emissions accounted for 36% of total NT emissions – the major source of agricultural emissions. The second largest source of emissions from the sector is methane from enteric fermentation (19% of total NT emissions).

In 2006 emissions from deforestation in the NT were 1.2 Mt CO_2-e, or 6% of NT emissions. Although these emissions are not reported in the agriculture sector, they are largely the result of land clearing for agricultural production.

Mitigating Greenhouse Gas Emissions from the Agriculture Sector

The Carbon Pollution Reduction Scheme

The primary national measure to reduce GHG emissions is the Australian Government's Carbon Pollution Reduction Scheme (CPRS). The CPRS will establish a national cap on GHG emissions, and allowing trading of GHG emission permits up to this cap. The cap will decrease over time to reduce Australia's GHG emissions.

Proposed design of the CPRS is set out the CPRS 'White Paper', available at: www.climatechange.gov.au .

The Australian Government intends to commence the CPRS on 1 July 2010. The scheme will not cover emissions from the agriculture sector from commencement. This is due to technical difficulties associated with current ability to estimate emissions from the agriculture sector, and practical considerations of where to apply the point of obligation under the CPRS.

The Australian Government's preferred position is that the agriculture sector will be covered by the scheme in the future once further research has resolved current issues. The White Paper states that the Australian Government is disposed to include agriculture emissions in the scheme by 2015, with a final decision on this to be made in 2013.

Should the agriculture sector be covered by the CPRS in 2015, there is a case for those parts of the sector that are emissions intensive and trade exposed (subject to international competition) for assistance to meet scheme costs.

The White Paper states that savanna burning emissions would probably remain outside the CPRS, arguing that it would be difficult to cover these emissions as the complexity of property rights for Indigenous lands would make it difficult to identify single commercial entities that could be made liable for these emissions.

The Australian Government has committed to facilitating the participation of Indigenous land managers in carbon markets. There is potential for savanna fire management projects to be treated as 'offsets', generating credits for sale into the CPRS market and/or voluntary carbon markets.

The CPRS will not cover emissions from land clearing.

Although emissions from the agriculture sector will not be covered by the CPRS until 2015, the sector will be impacted by the scheme upon its commencement. The cost of farm inputs such as fuel will increase under the CPRS, impacting on-farm and transport costs. To minimise this impact, the Australian Government has committed to providing a rebate to the agriculture and fishing industries for fuel cost increases for three years. Transport fuel costs for freight are expected to receive protection from price increases only for the first year of the CPRS.

Possible options for reducing agriculture emissions

There are a range of management options in the Australian agriculture and land use sectors which can reduce greenhouse gas emissions, although barriers remain to practical implementation of many of them. These have recently been summarised by Hatfield-Dodds *et al* (2007) as:

- Changes to pasture and livestock management to reduce methane emissions from livestock
- Use of minimum tillage to reduce fuel use and soil carbon emissions
- Altered grazing and crop management to reduce emissions or increase sequestration
- Improved fertiliser management
- Improved manure and effluent management in intensive livestock situations
- Agroforestry or other farm-based revegetation

In the Northern Territory, other relevant actions include:

- Changes to prescribed burning regimes – avoid hot, high intensity fires, burn in early dry season
- Reduction in land clearing, and where clearing carrying out thinning rather than broadscale clearing

Further detail on emissions reduction opportunities from the four significant agricultural and land use emissions sources in the NT is given below.

Methane from ruminant livestock

- Currently the largest single source of agricultural emissions in Australia and constitutes 19% of NT GHG emissions.
- Hatfield-Dodds *et al* 2007 report that reductions of 30% may be achievable in the future through technologies including feed supplements and management of rumen bacteria. Further research and development is required to achieve this.

Soil management and fertiliser use

- Second largest source of agricultural emissions in Australia and 4% of NT GHG emissions.
- Reductions possible through minimum tillage, best practice fertiliser use, stubble retention, bio-char sequestration (pyrolysis of biomass to create “charcoal” which is then mixed into soil with multiple benefits including stable sequestration of carbon) and use of grasses that provide long-term carbon sequestration.

Change to savanna burning regimes

- Savanna burning contributed 36% of NT emissions in 2006.
- Land managers can reduce greenhouse gas emissions by avoiding very hot, high intensity fires which are common in the late dry season Hot fires are more likely to kill trees and burn other material, increasing total emissions.
- An existing project in West Arnhem Land aims to reduce emissions from savanna fires by an average 100 000 tonnes per year.
- Fire abatement projects may be able to generate ‘offset credits’ for sale into regulatory or voluntary markets.
- Requires further work to ensure projects can meet anticipated high accreditation standards.

Reduction in land clearing

- Land clearing produces significant greenhouse gas emissions – around 6% of NT emissions.
- Carbon stored in vegetation is released to the atmosphere after land clearing when the vegetation burns or decays.
- In the Top End the amount of CO2-e emitted by land clearing is estimated to be well over 100 tonnes per hectare cleared. This can be compared to an average annual emissions rate of around 5 tonnes CO2-e per annum per medium-size vehicle.

Kyoto Protocol Article 3.4 activities

Article 3.4 of the Kyoto Protocol relates to emissions associated with the following activities:

- 'revegetation'(human activity to increase carbon stocks through vegetation establishment that does not meet afforestation and reforestation definitions),
- 'Forest Management' (stewardship and use of forests),
- 'Cropland Management' (management of land on which crops are grown); and
- 'Grazing Land Management': management of land used for grazing (manipulation of vegetation type/amount and livestock produced).

The policy environment for Article 3.4 activities in Australia means that such activities are not reported in Australia's national GHG accounts. The CPRS White Paper makes it clear that these activities are outside of the scope of the CPRS. This is unlikely to change until the future international approach to Article 3.4 activities becomes clearer.

Issues associated with achieving emission reductions from these activities include the capacity to estimate emissions and abatement for article 3.4 activities to an adequate standard, and the cost of estimation and monitoring. There is no clear guidance on accreditation standards. There are also questions regarding the capacity for article 3.4 activities to deliver positive carbon outcomes, for example whether carbon in Australian soils can be significantly increased. There are also other inherent risks with these options such as climate and other natural events (eg fire, drought) which can quickly reduce the amount of carbon stored (and therefore emission reductions).

References and further information

Hatfield-Dodds, S., Carwardine, J., Dunlop, M., Graham, P. and Klein, C., 2007. Rural Australia Providing Climate Solutions: Preliminary report to the Australian Agricultural Alliance on Climate Change. CSIRO Sustainable Ecosystems, Canberra.

Department of Climate Change 2007, Climate Change: Potential Impacts and Costs – Northern Territory http://www.climatechange.gov.au/impacts/publications/pubs/fs-nt.pdf

Abating Greenhouse Gas Emissions through Strategic Management of Savanna Fires – NT Case Study for the Garnaut Review into the Economics of Climate Change, available at: http://www.garnautreview.org.au/CA25734E0016A131/pages/all-reports–resources

CSIRO 2008, An Overview of Climate Change Adaptation in Australian Primary Industries – Impacts, Options and Priorities, available at: http://www.csiro.au/resources/AgricultureAdaptationReport2008.html