



TROPICAL SAVANNAS CRC

Cooperative Research Centre for Tropical Savannas Management

Annual Report 2008–09

*Established and supported under the Australian Government's
Cooperative Research Centres Programme*



Mission: To achieve sustainable use and conservation of Australia's tropical savannas through excellence in collaborative research, communication and education.

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CENTRE OBJECTIVES

The Centre will provide up-to-date and scientifically sound information to underpin management of the tropical savannas for sustainable use and for conservation. It will develop scientific principles and conceptual knowledge about the ecological, economic and social functioning of landscapes for the benefit of Australia's tropical savannas and the people who use them.

The Centre will tie its studies into the broad context defined by governments, stakeholders, land users and the community. In addition to its basic research, it will facilitate better management by conducting research, development and learning experiences in participation with tropical savanna stakeholders.

In particular, the Centre will produce:

- management options, along with assessments of their benefits and costs.
- policy options, with analyses of their benefits and costs.
- information packages and training in their use.
- educational packages and access processes.

Achievement of the objectives will be focused through the following key result areas and their specific output targets.

Healthy landscapes—ecological, economic, and social

- indicators and attributes of health.
- predictive models of landscape function and the impact of interventions.

Sustainable management systems

- landscape monitoring systems and associated management tools and packages.
- management strategies for fire, grazing, tree clearing, restoration and decision support tools and packages.
- environmental management systems and codes of practice.

Viable and socially desirable regions

- policy and management options for regional planning and development and associated guidelines and tools.
- regional strategies for multiple land use, restructuring and reinvigoration.

Productive and capable people

- communication strategies and processes.
- learning packages and education strategies.
- knowledgeable and employable postgraduate researchers.
- participating staff are more skilled and knowledgeable and able to work in multidisciplinary teams using participative processes.

EXECUTIVE SUMMARY

The overarching function of the Tropical Savannas Management CRC has been to enable Australia to use the natural resources of its savanna lands in a wise and sustainable way. The TS–CRC has provided both the necessary science and the extension processes to facilitate its adoption. The Centre used a structured theme-based approach based on the following four Themes:

1. Landscape Ecology and Health
2. Industry and Community Natural Resource Management
3. Regional Planning and Management
4. Human Capability Development

Thanks to the generous support of the Department of Innovation, Industry, Science and Research, funding for the TS–CRC was extended from the original wind-up date of June 2008 to December 2009. This reflected the Rudd Government’s desire to return to greater emphasis on public good CRCs. The extension allowed time to develop concepts for a possible new bid for funding, or alternatively, a bid for an extension of the existing CRC. The support came at a time when existing research projects were at or near completion and since it was felt that it was important to maintain engagement with research groups over the period of the extension, a series of five pilot projects were put in place, all of which will be completed by December 2009 at the latest.

The Deed of Variation, extending funding to December 2009, was finally signed by all core parties and accepted by DIISR in May 2009, thereby initiating release of the relevant funds.

The extension of funding also required modification of the wind-up plan for the TS–CRC. In parallel with the five pilot projects, a major focus of the 2008–2009 year was the implementation of wind-up strategies, particularly with regard to the successful delivery of the CRC’s research portfolio. Staff security beyond the life of the CRC was also a top priority.

In this final phase the TS–CRC was run with a minimum of staff. Leadership for Theme 4 continued to be provided by Communication Manager, Dr Peter Jacklyn, while Theme leadership for the pilot projects was combined with that of Contracts Manager and was the responsibility of the CEO. Financial management has remained the responsibility of the Business Manager, with the support of an Administrative Assistant.

The following five pilot projects form part of the activities agreed for funding by the Commonwealth as part of our extension to December 2009. So far one project has been completed while the other four continue to be on track for completion by December 2009:

Project 1: Indigenous economies built on the TS–CRC’s *Outback livelihoods* work, and also benefited from collaboration with Charles Darwin University on the economic case for Indigenous participation in natural resource management. It recognises the unique character of Indigenous economies in remote regions and, in particular, the importance of acknowledging and managing interactions among the customary, state and market sectors. Specifically, the project examined approaches to optimising production factors in each of the sectors. The results of the project will be discussed at a workshop in November 2009, and will be presented as a series of papers at a major symposium, also in November.

Project 2 - Northern agricultural development and climate change: This project assesses the utility and performance of the Full Carbon Accounting Model (FullCAM) for estimating carbon stocks and fluxes under different land use scenarios in the high-rainfall regions of the Northern Territory. FullCAM was developed by the Australian Greenhouse Office as part of the National Carbon Accounting System (NCAS). The FullCAM tool integrates a range of models which model carbon cycles associated with biomass, litter and soil pools in forest and agricultural systems on a fine spatial scale of one hectare. The tool is capable of carbon accounting for different land activities such as afforestation, reforestation and deforestation, and estimates carbon exchanges, uptake and loss between the terrestrial biological system and the atmosphere. But like any model, its performance is strongly dependent upon the quality of the data on which predictions are based and the robustness of model parameterisation.

The first phase of this project used FullCAM to model and map estimates of above and below ground carbon stocks in the high-rainfall region of the NT. This map shows the spatial variability of carbon in

the landscape. Similarly, a map was produced showing estimates of greenhouse gas emissions from the future clearing and burning of savanna vegetation. Ongoing emissions from converting savannas to a grazing scenario and a cropping cycle scenario have also been estimated and compared.

The second phase of the project is now near completion and aims to produce an NT-wide map of above and below ground carbon stocks, maps showing greenhouse gas emissions from clearing and burning, and emissions from converting native savannas to grazing and cropping land uses.

Project 3: Fire Management for greenhouse gas abatement focused mostly on Central Arnhem Land, providing the continuity needed to retain skills and meet partner expectations in what it is hoped will be an ongoing project. The work has also begun to add understanding of the role of fire in soil carbon dynamics.

It has also drawn together researchers working on policy options for ensuring that fire management delivers important contributions to Australia's greenhouse gas (GHG) mitigation efforts, at the same time facilitating Indigenous access to markets through robust business models.

Research activities centred on:

- addressing overarching biophysical research issues, such as assessment of the seasonality of emissions of the accountable greenhouse gases CH₄ and N₂O, and the development of savanna-wide accounting frameworks incorporating both 'top down' (e.g. remote sensing) and 'bottom up' (e.g. empirical field studies) approaches.
- development of robust regional GHG emissions accounting baselines and frameworks for each of the new projects based on the West Arnhem Land Fire Abatement model.
- addressing core legal issues (e.g. role of Native Title) in respective jurisdictions, and nationally.
- addressing governance and marketing issues involved with the development of business enterprises, including in cross-tenure, multi-party arrangements.

Project 4: Best practice grazing in northern Australia aimed to increase adoption rates of innovative best-practice grazing management for beef producers throughout Queensland, Northern Territory and the Kimberley and Pilbara regions of Western Australia. These practices will benefit up to 3 million square km of northern Australia by identifying cost-effective solutions for:

- restoring and maintaining productive capacity.
- improving water quality and soil health.
- improving risk management; and
- delivering economic benefits.

This project integrates, enhances and extends key findings and knowledge generated from completed grazing research funded by Meat and Livestock Australia, TS-CRC and other research organisations throughout northern Australia. It is developing innovative best-practice grazing management for enterprises across a range of geographic locations, production scales and management goals. It will integrate and synthesise the results of existing research with producer knowledge within a bio-economic, whole-enterprise modelling framework to identify a range of best-bet grazing management options for each region of northern Australia.

A draft report containing a synthesis of research on infrastructure development, managing stocking rate, pasture spelling and prescribed burning plus draft regional best-bet guidelines for managing these factors has been completed and circulated to regional producers and technical specialists. Further modifications to the GRASP and ENTERPRISE computer models were made to enable various stocking rate strategies to be simulated.

Project 5: Carbon accounting and environmental services had to be modified, with the agreement of DIISR, as a result of the late withdrawal of funding originally promised by Xstrata—a direct result of the global financial crisis. The review is now complete and two reports submitted:

1. **Carbon Markets and related incentives to reduce adverse environmental impacts of humans**, which provides an overview of developing carbon markets, both mandatory and voluntary, and the evolving relationship between the two.

2. **Carbon Markets;** their relevance to the development of small to medium ventures in northern Australia and research needed to support such ventures, which examines the opportunities for research in northern Australia and identifies shortfalls in knowledge and skills relating to:
 - a. Stakeholder communication and cooperation
 - b. Business, policy and legal procedures
 - c. Ongoing management and monitoring
 - d. Technological expertise
 - e. Basic ecological information and application.

Such research could provide the additional value that has been missing from ineffective past endeavours to improve northern Australian livelihoods and could help tip the balance from failure to success.

Strenuous efforts continue to be put into establishing long-term support for the CRC's websites and for the staff that support them. This is particularly important for the North Australian Fire Information website, which has seen a rapid increase in usage by fire managers (particularly in Queensland) over the last year.

By the end of June 2009 all externally funded projects had been completed, were very close to completion, or, in the case of the Dugong and Marine Turtle project, had been awarded further funding to continue beyond the life of the CRC. The success of the Dugong and Marine Turtle project was reflected in it winning two awards: the NT LandCare Award and also the prestigious national Banksia Environmental Award (Indigenous section) which was presented by Environment Minister Peter Garrett.

Dr David Garnett, CEO, Tropical Savannas CRC, Charles Darwin University

Context and major developments during the year

The year has seen a continuing focus on northern Australia at a national level.

The final report of the Garnaut Climate Change review was released in September 2009. It included a number of recommendations of particular relevance to northern Australia, relating to carbon sequestration accounting, improved grazing management practices and reduction in methane emissions from livestock. It also highlighted the fact that projects such as the West Arnhem Land Fire Abatement project had demonstrated the potential not only to reduce emissions in the savannas but also to increase sequestration of carbon stocks. Much of the science under-pinning these recommendations were informed by CRC research.

The North Australian Indigenous Land and Sea Management Alliance (NAISMA), which has been hosted by the CRC, completed the transfer of most of its administrative responsibilities to Charles Darwin University and its long-term future is now secure.

The CRC's range of websites and web tools continued to expand, reflecting the vital role of knowledge acquisition and transfer in the management of northern Australia.

NATIONAL RESEARCH PRIORITIES

National research priority goals

Transformation of existing industries in a sustainable manner by improving understanding of underlying processes has been an important aim of the CRC. The socio-economic tools developed by the CRC to achieve greater understanding of the social fabric of northern Australia will all lead directly to more intelligent use of limited resources.

Some 80% of carbon in savanna landscapes is stored below the surface in soils. The CRC's rigorous work on savanna carbon dynamics is timely in view of the heightened urgency to understand drivers of climate change. It is important to understand not only how much carbon is present but also how those carbon levels may be affected by changes in land management patterns and processes.

In addition, on-going research on fire management continues to demonstrate that it is possible to develop economically sustainable fire management solutions for savanna land managers. Reduction of greenhouse gas emissions and improved biodiversity are two of the benefits of these solutions.

The CRC has committed significant resources to its websites and other communications media, in the belief that efficient information acquisition and transfer is absolutely vital in the widely spread and thinly populated regions of northern Australia.

Table 1: National Research Priorities

National Research Priorities	CRC Research (%)
An Environmentally Sustainable Australia —Transforming the way we use our land, water, mineral and energy resources through a better understanding of environmental systems and using new technologies.	
Transforming existing industries	37
Sustainable use of Australia's biodiversity	5
Responding to climate change and variability	20
Promoting and Maintaining Good Health —Promoting good health and well-being for all Australians	
Preventive healthcare	3
Frontier Technologies For Building and Transforming Australian Industries —Stimulating the growth of world-class Australian industries using innovative technologies developed from cutting edge research	
Smart information use	35

GOVERNANCE AND MANAGEMENT

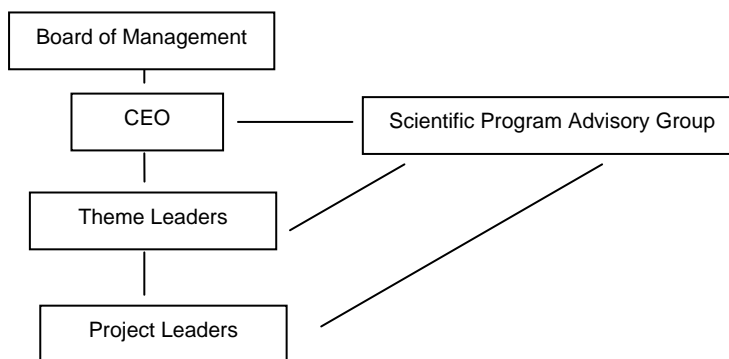
The sustainable use and conservation of northern Australia is the focal point of the TS–CRC. The Centre is an unincorporated joint venture between the Commonwealth and the partner agencies listed below:

- CSIRO
- Department of Agriculture Western Australia
- Department of Conservation and Land Management (CALM WA)
- Director of National Parks
- James Cook University (JCU)
- Meat & Livestock Australia (MLA)
- North Australian Indigenous Land & Sea Management Alliance (NAILSMA)
- Northern Territory of Australia
- Charles Darwin University (CDU)
- The State of Queensland
- The University of Queensland (UQ)

As a result of the business plan provided to the Commonwealth in July 2001, together with the Deed of Variation effective as of the 1st day of July 2008, the TS–CRC has adopted the organisational structure shown in Figure 1.

The TS–CRC has a clear strategic framework for the conduct of its scientific, educational and financial business. Stakeholders are actively involved in the policy, strategic and operational decision making of the Centre through membership of the Board of Management and through informal contacts in the case of individual pilot projects.

Figure 1: TS–CRC organisational structure



Board of Management

The TS–CRC Board of Management plays an important leadership role. The Board must be analytical and decisive, while at the same time mindful of the need to consult with, understand and incorporate the needs of partner agencies and stakeholders.

Equal representation on the Board between stakeholders and partner agencies is an important mechanism for ensuring that this leadership is provided and that the key result areas of the Centre are achieved.

Board membership as at 30 June 2009

Representatives from the TS–CRC partner agencies

Ms Diana Leeder , Northern Territory of Australia	Dr Greg Robbins , State of Queensland
Mr Roger O’Dwyer , State of Western Australia	Prof. Bob Wasson , Universities
Dr Daniel Walker , CSIRO	Ms Anne-Marie Delahunt , Parks Australia

Stakeholder representation

Mr Darryl Pearce (Chair, Savanna Advisory Committee)	Ms Jann Crase ACF (Conservation sector)
NAILSMA (Indigenous sector) Vacant following the resignation of Mr Peter Yu	(Mining sector) Vacant following the relocation and resignation of Mr Craig Stewart
Mr John Courtenay , Probe (Tourism sector)	Mr Tom Stockwell , Sunday Creek Station (Pastoral sector)

Management Group

After 2004, the research portfolio for the CRC was largely finalised and consolidated, so the project development and review role played by the Management Group was significantly reduced. During 2005–06, the advisory functions of the Management Group were largely taken over by a smaller executive, consisting of CEO, Theme Leaders, Business and Contract Managers and this arrangement continued into 2008–09.

Specified Personnel

Table 2 Specified Personnel

Title and Name	Contributing Organisation	% of total working time in CRC	Role in Centre
Dr David Garnett	CRC	100	CEO/Contracts Manager
Dr Peter Jacklyn	CRC	100	Communication Coordinator and Theme Leader 4
Mr Kieth Boakes	CRC	100	Business Manager
Dr David Garnett	CRC	100	Theme 1 Leader
Dr David Garnett & Dr Peter Jacklyn	CRC	100	Theme Leaders 2
Dr Peter Whitehead	CRC/Northern Territory Govt	20	Theme Leader 3
Dr Peter Jacklyn & Mr Joe Morrison	CRC / CDU	100	Theme Leaders 4
		20	

RESEARCH PROGRAMS

Research activities and achievements

The following five pilot projects formed part of the activities agreed for funding by the Commonwealth as part of our extension to December 2009. So far one project has been completed and the rest are progressing towards completion by the end of 2009.

1. North Australian political economy, Leader: Prof Rolf Gerritsen, CDU

Fieldwork on this project was delayed by one month because of an injury suffered by project leader, Prof. Gerritsen. The final workshop will therefore be held in mid-November. However, the delay means that the workshop can be held concurrently with a symposium on savanna land use, which is partly sponsored by the Tropical Savannas CRC.

The immediate product from the workshop will be a 20-page report, which will be followed by an edited book published Charles Darwin University Press. The target is to have ten chapters, plus link pieces by the editor/s, which should come out at 50,000 words.

Prof. Gerritsen (and his co-editor, to be appointed by November) will write link pieces and organise the book into sections; possibly two: a big-picture section, the development of North Australia, and an Indigenous section.

2. Northern Agricultural Development and Climate Change, Leaders: Dr Stephen Garnett, CDU and Dr Peter Whitehead, NRETA

This project assesses the utility and performance of the Full Carbon Accounting Model (FullCAM) for estimating carbon stocks and fluxes under different land use scenarios in the high rainfall regions of the Northern Territory.

The Full Carbon Accounting Model (FullCAM) was developed by the Australian Greenhouse Office as part of the National Carbon Accounting System (NCAS). The FullCAM tool integrates a range of models which model carbon cycles associated with biomass, litter and soil pools in forest and agricultural systems on a fine spatial scale of one hectare. The tool is capable of carbon accounting for different land activities such as afforestation, reforestation and deforestation, and estimates carbon exchanges, uptake and loss between the terrestrial biological system and the atmosphere. But like any model, its performance will be strongly dependent upon the quality of the data on which predictions are based and the robustness of model parameterisation.

The first phase of this project used the NCAS FullCAM tool to model and map estimates of above and below ground carbon stocks in the high rainfall region of the Northern Territory. This map shows the spatial variability of carbon in the landscape, ranging from 30-40 tonnes of carbon/hectare in the south to between 100–160 tonnes of carbon/hectare in north-east Arnhem Land, the Darwin region and the Daly River. Similarly, a map was produced showing estimates of greenhouse gas emissions from the future clearing and burning of savanna vegetation, ranging between 51–445 tonnes of greenhouse gas emissions per hectare.

Ongoing emissions from converting savannas to a grazing scenario and a cropping cycle scenario were also estimated and compared.

After a draft report for this first phase was distributed amongst the steering committee, it was decided that the maps could be improved in accuracy and extended in range, and that the limitations of FullCAM be further explored.

An excursion to Canberra occurred to meet with the NCAS team at the Department of Climate Change to discuss technical aspects of FullCAM and limitations for use in the NT. Limitations include the existing inadequate soil carbon data used as inputs to the RothC sub-model, default values for debris and the difficulty of incorporating savanna burning in the model.

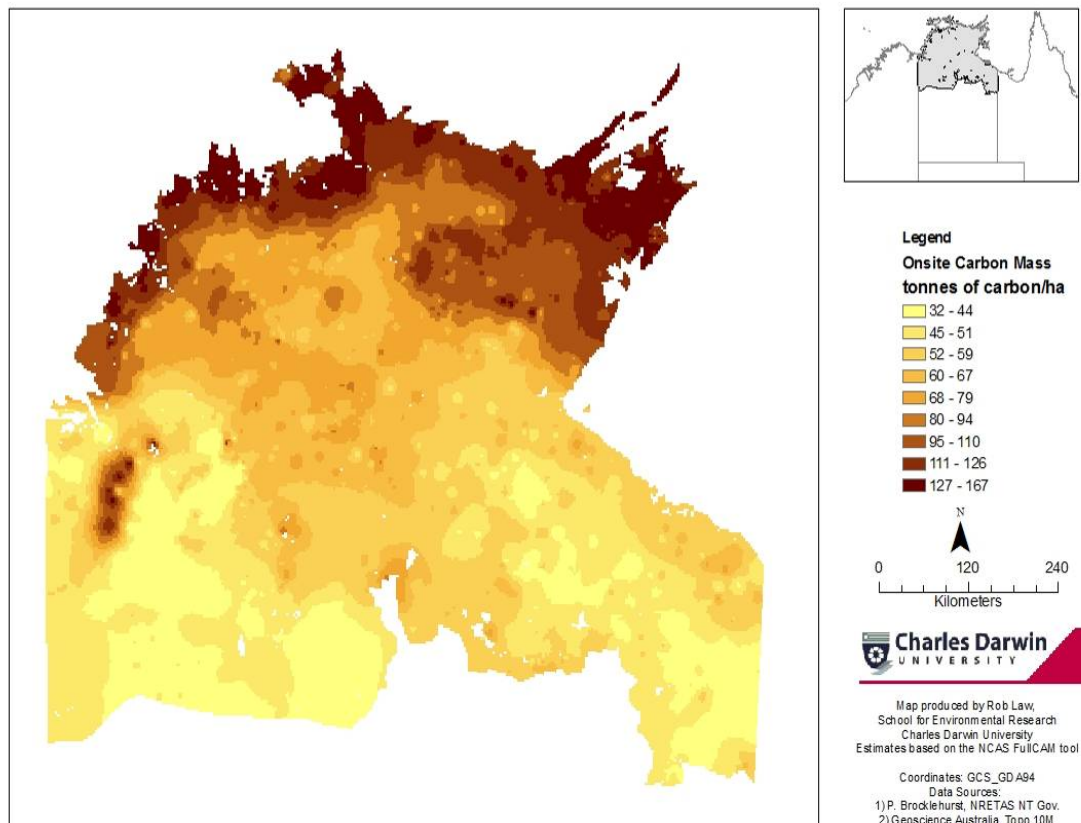
The second phase of the project is now near completion and aims to produce an NT-wide map of above and below ground carbon stocks, maps showing greenhouse gas emissions from clearing and burning, and emissions from converting native savannas to grazing and cropping land uses. These maps will

then be used to perform sensitivity and uncertainty analysis on the model, with the intention of identifying limitations in FullCAM that could be improved.

The project worked closely with staff at the NT government (DRDPFR, DNRETAS) who are also developing maps of carbon in areas of agricultural potential, and with CSIRO who are exploring the limitations of FullCAM. Care was taken to avoid duplication and to work cooperatively to assist one another to gain a better understanding of FullCAM. The final report will contribute to understanding of carbon management in the Northern Territory and the application of the FullCAM tool for decision making.

Figure 2: Variation in estimates of carbon in woody and grassy vegetation in the high-rainfall region of the NT.

Generated using FullCAM. Estimates include both above ground and below ground carbon stored in plant biomass and the top 30cm of soils.



3. Fire management for greenhouse gas abatement, Leader: Dr Jeremy Russell-Smith, Bushfire Council of the NT

Core components of the project are:

1. Ongoing development of savanna burning greenhouse emission abatement projects across northern Australia, in conjunction with NAILSMA and other partners.
2. Completion of the book, *Culture, ecology and economy of savanna fire management in northern Australia: rekindling the Wurrk tradition*.
3. Continuation of the project funded principally through Land and Water Australia: *Fire management in northern Australia: Integrating ecological, economic and social outcomes*.
4. Building on these initiatives, the project will provide critical information and assessments concerning fire management and savanna burning for applications relevant to developing a CRC rebid.

1. Ongoing development of savanna burning greenhouse emission abatement projects across northern Australia

This core activity is proceeding very well. Funding was secured to undertake biophysical, legal and policy research towards the implementation of savanna burning as an accredited greenhouse gas (GHG) emissions abatement activity, particularly for the benefit of Indigenous savanna stakeholders.

A contract was formally entered into between the Commonwealth Department of Environment, Water, Heritage & the Arts (DEWHA), and the North Australia Indigenous Land and Sea Management Alliance (NAILSMA) to deliver this applied research. Originally, funding of \$10M was allocated by DEWHA (as of March 20, 2009, media release). However, recent advice from DEWHA and Minister Garrett is that \$8M is now available.

Working with regional Indigenous bodies, the project aims to deliver four new fire and greenhouse emissions abatement fire abatement projects along the model of the Western Arnhem Land Fire Abatement (WALFA) project. These new projects target the north Kimberley, central Arnhem Land, the Gulf region (basically from Borroloola to Burketown), and western Cape York. Research activities include:

- Addressing overarching biophysical research issues, such as assessment of the seasonality of emissions of the accountable greenhouse gases CH₄ and N₂O, and the development of savanna-wide accounting frameworks incorporating both ‘top down’ (e.g. remote sensing) and ‘bottom up’ (e.g. empirical field studies) approaches.
- Development of robust regional GHG emissions accounting baselines and frameworks for each of the new projects based on the WALFA model.
- Addressing core legal issues (e.g. role of Native Title) in respective jurisdictions, and nationally.
- Addressing governance and marketing issues involved with the development of business enterprises, including in cross-tenure, multi-party arrangements.
- Additionally, in partnership with Commonwealth Indigenous ranger funding programs (e.g. Working on Country, Wild Rivers) and state and territory agencies (e.g. WA Dept of Environment & Conservation; Bushfires NT, and Queensland Rural Fires), the project is working with respective land councils and regional Indigenous ranger groups to build personnel and institutional capacity.

The initial aspiration is to attempt to develop at least one new robust regional project within three years, in accord with the current Commonwealth government’s intention to implement their Carbon Pollution Reduction Scheme (CPRS) from 2012.

Until recently, the CPRS White Paper indicated that savanna burning, as part of the Agriculture sector, would not be considered formally for inclusion in the CPRS until 2013—and, in any event, would be unlikely to be included as an accredited GHG emissions offset activity on the basis of various unfounded and uninformed technical and land tenure perspectives.

However, recent verbal advice from the Department of Climate Change indicates that, contrary to the above view, subject to one remaining technical issue to be addressed (see following), savanna burning will be formally included in the CPRS as a legitimate offset activity to (polluting industry) sectors from the program’s inception. A letter from Minister Combet formally notifying NAILSMA and partners of this change in policy is expected in October 2009.

In July, project partners held a major field exercise in western Arnhem Land to acquaint Indigenous ranger partners from across northern Australia of the WALFA program and its requirements, and undertake the first, early dry-season component of a rigorous scientific assessment addressing the seasonality of GHG emissions.

The key scientific issue addressed in this program is to test whether emission concentrations of the GHG’s CH₄ and N₂O are relatively similar between prescribed and late dry-season wildfires. If so, shifting current regional fire regimes from burning in the late dry season to early in the dry season will have substantial emissions abatement benefits. Preliminary results from the July program indicated that concentrations of both CH₄ and N₂O were relatively low, supporting the abatement argument. The program attracted more than 70 Indigenous rangers, and 30 scientific staff (including 11 international) participants. The late dry-season assessment will be undertaken in late September, 2009. In the

meantime, work is ongoing in developing new regional project emissions baselines, and building regional ranger and institutional capacities.

Completion of the book, Culture, ecology and economy of savanna fire management in northern Australia: rekindling the Wurrk tradition

This book summarises much of the work pioneered by the Tropical Savannas CRC and partners in developing the WALFA project. The book contains 15 multi-authored chapters and is to be published by CSIRO Press. The book has an anticipated publication date of September, 2009.

Completion of the LWA project: Fire management in northern Australia: Integrating ecological, economic and social outcomes.

This project has essentially added value to various research activities associated with the development of savanna burning as an emissions abatement activity. The project, administered through the Tropical Savannas CRC, was originally to run until mid-2010. All but the final milestone reporting requirements have been met. There is only one final report outstanding and it has been agreed in-principle that this report will now be completed in September, 2009. This has the additional advantage that administrative responsibilities can also be completed within the term of the Tropical Savannas CRC.

4. Best practice grazing in northern Australia, Leader: Dr Rodd Dyer, Meat and Livestock Australia

The project has contributed to the national priority of ‘sustainable farm practices’ by developing draft best practice management guidelines for extensive grazing environments in collaboration with producers and regional specialists. This will improve the effectiveness and reliability of current grazing best practice guidelines and help indicate the practices that require more extension and demonstration effort in each of the target regions.

Further, the project developed a bio-economic modelling framework for evaluating the environmental and economic impacts of various management systems, including both current practices and the draft best practice management guidelines referred to above. Initial output from these evaluations will be presented to the second series of regional workshops during September, 2009.

The project contributed to the national priority of ‘natural resource management in remote and northern Australia’ by engaging with producers and technical specialists in each of the target regions, and by integrating their knowledge into the draft best practice guidelines. The second series of regional workshops will also identify the priority practices for increased extension effort.

Achievements against milestones are detailed below.

1. Draft best practice grazing management options developed

This report is expected by the end of 2009. Its topics include:

- Scientific background on defoliation, selective grazing, infrastructure development (such as options in managing grazing distribution, and protecting sensitive areas).
- Stocking rate management such as maintaining long-term carrying capacity, varying stocking rates to match seasonal conditions and the effects of climate, land type and land condition on stocking rates.
- Pasture spelling, prescribed burning and the basis of northern Australian fire regimes.
- Interactions between management factors, regional and general recommendations and knowledge and research gaps.

2. Preliminary output from bio-economic analysis of best practice options

The information from six producer workshops on representative properties was examined in detail. Significant modifications were needed because of:

- Incomplete documentation of properties, especially in relation to animal type in particular paddocks.

- Inconsistencies in herd structure and numbers using the data provided by the workshop participants (using BreedCow).
- Incomplete specification of the animal production system undertaken by the representative properties.

Additional changes to the GRASP model were made so that alternative stocking rate strategies can be examined. These changes enabled GRASP to simulate strategies from a fixed stocking rate to a fully responsive stocking rate (based on consumption of feed available at the end of a wet season) and a 'hybrid' model where the magnitude of annual changes and overall changes (over the period of simulation) can be specified.

The ENTERPRISE model is being further modified to allow both spatial and temporal variability in economic performance to be assessed at the property level. There were significant difficulties in getting the fully functioning version operational, as two separate models needed to be combined: one model as a static 10-paddock animal allocation model (which was initially converted to a 20-paddock version); and the other a dynamic, one-paddock version.

Preliminary model runs were completed to compare the biological response to different frequencies and sequences of wet-season spelling. Preliminary model runs were also completed for assessing the impact of different grazing regimes. Studies are being developed to look at burning regimes as well. These are additional to those originally envisaged, but are necessary to support the choice of best-bet regimes for simulations.

Two management options were simulated in detail: stocking rate strategies and wet-season spelling.

Stocking rate

A range of stocking rate strategies were simulated over the period 1992–2006 for four soil types in Queensland's Burdekin catchment, encompassing a total of 224 separate simulation analyses. Results are presented here for one soil type (Burdekin neutral red duplex). The strategies are as described below in terms of the maximum annual changes when the stocking rate (SR) is above long-term stocking rate (LTSR), when SR is below LTSR and the absolute changes allowed over the time span of the simulation.

Table 3 Stocking rate regimes tested

Regime	Annual change if above LTSR	Annual change if below LTSR	Maximum change over simulation period
A	± 1%	± 1%	±1%
B	± 2%	± 5%	± 15%
C	± 5%	± 15%	± 25%
D	± 15%	± 25%	± 40%
E	± 33%	± 50%	± 100%
F	Annual stocking rate set to consume a fixed proportion of the forage available at the end of summer (over the next 12 months)		

* LTSR: Long-term stocking rate

These results have not been fully analysed and further refinement of the simulations is needed. The mean liveweight gains over the simulation period were less than 100kg/head/year for all stocking regimes. This was because of the very poor conditions during the early 2000s when animals were modelled to have lost weight when grazed at or near the long-term stocking rate.

Wet-season spelling

A series of 72 simulations were run on each of four land types—each starting in four land-condition classes—to examine the impact of wet-season spelling (total of 1152 simulations). Both the frequency (how many spells in a four-year period) and the length of spell (two, three or six months) were varied and compared to no spelling. Detailed examination and interpretation of these outputs are in progress.

5. Carbon accounting and environmental services, Leader: Dr Lesie Felderhof, Firescape Science

This project had to be modified, with the agreement of Department of Innovation, Industry, Science and Research (DIISR), as a result of the withdrawal of \$50,000 promised by Xstrata—a direct result of the global financial crisis. The review is now complete and two reports submitted:

1. Carbon Markets and related incentives to reduce adverse environmental impacts

There is great concern worldwide that human activities that increase greenhouse gases in the atmosphere may cause global warming. This is because it is predicted that global warming will ultimately result in climate change that will disrupt ecosystems and lead to widespread hardship.

Carbon markets (called carbon markets because the convention is to express greenhouse gas emissions as carbon dioxide equivalents) provide one way to generate incentives that motivate countries, businesses and individuals to mitigate climate change by reducing greenhouse gas emissions. Market-based strategies, together with other economic and regulatory incentives and philanthropic investment, are currently expanding worldwide. They often focus on other forms of ecosystem degradation and related social disruption in addition to global climate change.

The Kyoto Protocol was devised by the United Nations to foster global co-operation and standards in the campaign to prevent climate change. Developed countries that have ratified the Protocol are allocated greenhouse gas emission limits which they adhere to by reducing their own emissions or offsetting them by purchasing carbon credits or funding approved 'clean' development projects elsewhere (primarily in undeveloped countries). These methods of acquiring carbon credits are collectively termed the regulated, or Kyoto compliant, carbon market.

Implementation of the Kyoto Protocol has highlighted aspects of the procedure, such as project regulation, monitoring and reporting that need improvement. Some efforts to address these shortcomings have already been made and it is likely that even more stringent requirements will be called for when the next phase of the fight against climate change commences after 2012.

The voluntary carbon market, although much smaller than the regulated market, has also expanded as awareness of the potential impacts of climate change, and the economic benefits to be gained from tackling them, have grown. Engagement with the voluntary carbon market is usually cheaper and faster than with the regulated carbon market but the standards and accountability of the voluntary market are generally lower.

While these shortcomings of the voluntary carbon market are currently being addressed by some operators, the market now faces the likelihood of strong constraints on its continued expansion as the number of developed countries joining the regulated market grows. Carbon offsets generated by voluntary market projects located in developed countries (i.e. countries with annual Kyoto and national emission targets) would count towards the annual emission reductions of that country. They could not also be sold by the voluntary market unless the country made special provisions to prevent double counting, such as retiring an equivalent number of carbon credits from their annual abatement totals. The economic incentive to fund voluntary carbon market projects located in undeveloped countries would also decline.

In recent years the need to emphasise social and environmental benefits and avoid adverse impacts is becoming better recognised. Innovative ways of encouraging this, such as adding value to offsets from projects that include favourable co-benefits; bio-banking; penalties for negative actions; payment for positive actions and philanthropic investment are increasing.

Australia already had some of these strategies in place before ratifying the Kyoto Protocol in 2007 and is now committed to reducing greenhouse gas emissions to 8% above its 1990 levels during 2009–2012. As part of the strategy to achieve this target the Australian Government is setting up a cap and trade system, the Carbon Pollution Reduction Scheme, scheduled to begin in mid-2011. In addition, the Government will provide a package of measures to assist households, businesses, workers and communities cope with the new economic regime and adapt to any inevitable climate change impacts. There will also be international initiatives to stimulate sustainable development in undeveloped countries. The fate of the voluntary carbon market in Australia is uncertain but it is likely decline because of the broad coverage of the Carbon Pollution Reduction Scheme and its related processes.

The mechanisms being developed worldwide provide some assurance that serious attempts are being made to prevent catastrophic climate change and further social harm and environmental damage. Only future events will reveal for certain whether these efforts are sufficient or not.

2. Carbon Markets: Their relevance to the development of small to medium ventures in northern Australia and research needed to support such ventures

There are numerous regulatory, social and environmental constraints that limit the choice of greenhouse gas abatement activities available to northern Australian enterprises seeking to engage with the carbon market. In addition there is still much confusion and uncertainty about the final decisions the Australian Government will make regarding eligibility to generate income from carbon offsets by abatement.

Four activities that fit well within current constraints, and have potential for ventures based on carbon abatements, are:

- Feral ruminant reduction
- Creation of biochar
- Qualifying (Kyoto compliant) reforestation
- Savanna fire management using Indigenous methods.

Enterprises that are set up to reduce emissions in these ways would also be well prepared to fulfil their commitments should the Government eventually decide that their emissions need to be offset. In addition, these activities all have social and environmental co-benefits that could allow them to be funded by other means if the carbon market becomes unavailable to them.

Before ventures connected with these four activities can be set up there is a need for social and physical research to address shortfalls in knowledge and skills relating to:

- Stakeholder communication and co-operation
- Business, policy and legal procedures
- Ongoing management and monitoring
- Technological expertise
- Basic ecological information and application.

Such research could provide the additional value that has been missing from ineffective past endeavours to improve northern Australian livelihoods and could help tip the balance from failure to success.

Table 4: Research Outputs and Milestones

Output / Milestone Number	Description	Contracted Achievement Date	Achieved (Yes/No)	Reasons why not achieved	Strategies to meet milestones
North Australian political economy					
1. Establishment	Research plans produced by participants	Dec 2008	Yes		
2. Research phase	Workers conduct fieldwork and prepare initial papers for workshop	Aug 2009			
3. Final workshop	Papers are presented in near-final form	Nov 2009			
4. Publication	Report published by CRC Book to go to CDU Press or other academic publisher	Dec 2009			
Northern Agricultural Development and Climate Change					
1. Dataset assembled	Dataset assembled and tested to satisfaction of project team and potential/limitations understood	Oct 2008	Yes		
2. Routines for interrogation of dataset	Routines written to permit interrogation of datasets at different spatial scales, in language available to partners	Nov 2008	Yes		
3. Scenarios agreed	Tractable range of scenarios developed assuming different constraints on exercise of development options	Nov 2008	Yes		
4. Estimates generated	Estimates of areas subject to development and associated economic and GHG estimates generated	Dec 2008	Yes		
5. Report	Report submitted including summary of estimates, limitations and caveats, and proposals for further work, including regional foci	Jan 2009	No	Delayed start due to delays in finalising funding	On track for completion by Nov 2009
Fire management for greenhouse gas abatement					
1. Manuscript delivery	Delivery of completed manuscripts for book on savanna burning	Dec 2008	Yes		
2. Fuel and carbon stocks data	Compilation of semi-arid fuel accumulation and carbon stocks datasets derived from available information sources	May 2009	Yes		
3. Fire effects assessment	Assessments of fire effects on plant species biodiversity	May 2009	Yes		
4. LWA milestones	Ongoing delivery of LWA project milestones	May 2009	Yes		
5. New bid information	Fire information and assessments as required for CRC new bid	May 2009	No	Delayed start due to delays in finalising funding	On track for completion by Nov 2009
Best practice grazing in northern Australia					
1. Integration and modelling frameworks	Integration framework and bio-economic modelling framework developed; draft best-bet recommendations for VRD and Burdekin.	June 09	Yes		

Table 4: Research Outputs and Milestones

Output / Milestone Number	Description	Contracted Achievement Date	Achieved (Yes/No)	Reasons why not achieved	Strategies to meet milestones
North Australian political economy					
2. Final Report	Final report including: Best-bet practices identified for VRD, East Kimberley, Burdekin and Fitzroy regions; Identification of research gaps; and a plan to support producers implement, test and adopt best practice recommendations	Nov 09			
Carbon accounting and environmental services					
Literature review	Survey of current published carbon accounting knowledge	Dec. 08	Yes		
Expert consultation	Discussion with key experts in carbon trading and carbon/social/biodiversity credits	Feb. 09	Yes		
Integrated scoping document on carbon accounting. Research needs identified.	To include summaries of how global and national carbon markets operate; knowledge on biodiversity credits and links, or issues, with carbon markets; knowledge on social credits and links, or issues, with carbon markets; and suggested priority research areas for a Northern Ventures CRC bid	May 09	Yes		

Research collaborations

The pilot projects of 2008–09, although necessarily more limited in scope than previous projects, still drew on the collaborative links established by the Centre.

The TS–CRC aims to break down the barriers to cooperative R&D in north Australia by encouraging collaboration between different researchers and between researchers and end-users. The Centre is well placed to do this as its partners comprise most of the NRM research organisations working in the tropical savannas: CSIRO and the universities; and government land management agencies. The partners also include representatives of the main research users: Aboriginal land managers, pastoralists and again land management agencies that employ park rangers etc.

The collaboration takes the following forms.

Collaboration between jurisdictions across northern Australia allows different regions to learn from each other about common land management challenges. Four out of the five pilot projects operate across the three northern jurisdictions.

Collaboration between different industry sectors including conservation agencies and primary industry agencies allows practices and strategies that take a whole-of-savannas approach to be developed. This cross-sectoral approach is seen in this year's pilot projects –for example the Fire Management project involves the conservation and Indigenous sectors and has links with the fire management components of the Sustainable grazing project.

Collaboration with national bodies is extensive and many draw on the Centre's key role in developments like the wildfire and greenhouse gas abatement projects. There is collaboration with Federal Government Departments, particularly the Department of Climate Change, with Meat and Livestock Australia and (the now former agency) Land and Water Australia.

Collaboration between researchers and end users allows relationships to develop and learning to occur that ultimately enables research to be used effectively. In 2008–09 this collaboration was seen in the continued development of the NRM websites with end-users. The North Australia Fire Information (NAFI) website, for example, was substantially re-developed with end-users and now features tools that make the site more useful such as a facility that allows fire data to be downloaded to hand-held GPS units.

An important partner in the Centre's collaboration is the North Australian Land and Sea Managers Alliance (NAILSMA)—a partner in the Centre, and itself a collaborative group of Indigenous land and sea management groups across north Australia. NAILSMA and its networks play a major role in a number of Centre projects.

COMMERCIALISATION AND UTILISATION

Strategies and activities

The year 2008–09, the eighth year of the Centre, sees the end of the regular project portfolio and the implementation of pilot projects largely focused on the future of NRM in the savannas. The major areas of utilization in 2008–09 involved the Fire Management for Greenhouse Gas Abatement project, NRM websites still managed by the Centre and the NAILSMA Marine Turtle and Dugong project, which was administered by the Centre.

This utilisation is an outcome of our basic strategy to produce research-based tools and information that tropical savanna land managers can use, that can make a difference by enhancing their ability to manage country sustainably, and to support the use of such tools with long-term funding from industries that benefit from their use.

Strategies

To achieve these goals some key challenges in the tropical savannas needed to be overcome:

- Researchers are often isolated and can find it difficult to establish the critical mass of people needed to produce useful, innovative research products.
- Research users, many of whom are in small to medium sized enterprises (SMEs) such as pastoral enterprises or Indigenous land management corporations, are also isolated and do not have the access to information and expertise that allow them to use new research products effectively.
- This isolation is exacerbated by the cultural gulfs that often exist between researchers and the varied mix of research users.
- Researchers and research users have to deal with new, emerging natural resource management issues which have not been the subject of major research efforts.

These challenges imply we need to invest in people's skills and knowledge resources as part of the pathway to the development of innovative products. The following strategies are therefore used.

Strategy 1: Build critical mass and end-user engagement by collaborative, participative research

The sparseness of the research community in the tropical savannas underlines the need to develop links across research disciplines, across industry sectors, and with researchers across Australia and overseas to achieve the critical mass needed to produce high quality, innovative tools and information for savanna land managers and planners.

Research needs to be relevant and useful, so it should be driven by the 'pull' of users, not the 'push' from researchers to get their projects funded. Therefore participative research, which involves end users—many of whom are involved in savanna SMEs as active participants—is fostered in our projects. This process will often involve establishing strong personal relationships on the ground between researchers and end-users that can bridge cultural distance, and will also involve using local knowledge together with researchers' knowledge.

Strategy 2: Develop practical tools

One of the most effective ways of making research useful is to convert it into practical tools useful to research users. For example, the Centre's NAFI fire-tracking website <www.firenorth.org.au> is used every day during the fire season by fire managers across north Australia. These tools feature integrated research findings and knowledge that could not be created easily by individual partner agencies.

Strategy 3: Invest in access to information and knowledge

Even relevant and practical research findings can end up on the shelf if the users and researchers do not have the capacity to ensure those findings are used effectively—and many savanna communities and researchers lack such capacity. User needs include better access to NCRM (Natural and Cultural

Resource Management) options from across the tropical savannas and in 2008–09 the Infonet website technology <www.infonet.org.au> provided this access in an innovative way.

People can also need to use their own local knowledge systems more effectively together with western research-based knowledge. For example in the fire and greenhouse gas abatement projects the Indigenous Ranger groups involved draw on traditional and western knowledge from “two tool kits”. Therefore helping people to better use their local NRM knowledge can also be an important component of enabling more effective use of knowledge in NRM.

Strategy 4: Develop better education and training resources

Savanna researchers also need additional skills, such as the ability to engage more effectively with Indigenous communities and pastoral enterprises. The TS–CRC helped establish the Masters, Graduate Diploma courses and professional Doctorate in Tropical Environmental Management, which will continue after the CRC has closed. It not only allows agency staff enrolled in the courses to learn about the latest NRM research, but also exposes them to the issues and concerns of the varied group of research users in the savannas. The Professional Doctorate of Tropical Environmental Management, established at Charles Darwin University in 2006, offers those already working in tropical environmental management to gain a professional doctorate in their area of expertise. The doctorate has a research component, coursework, and a professional placement at one of the CRC’s partner agencies where candidates can conduct their research on the ground.

Over the course of the Centre’s life, its PhD program has produced more than 25 new researchers in tune with research users’ needs. Refer to the Education section, p. 27.

Strategy 5: Ensure access to information and knowledge resources is sustainable

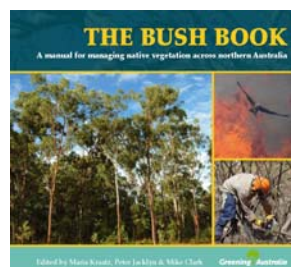
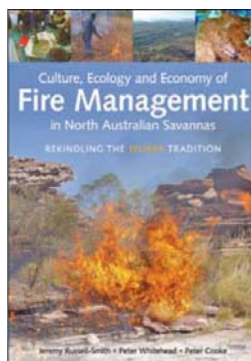
CRCs have limited lives and it is important to ensure that the products and processes that are developed through the CRC and that are valued by end-users do not die with the CRC. We have an extension until the end of 2009 strategies have been put in place to ensure the core outputs of the CRC will continue.

It is intended to set up a Savanna Communication Unit based at Charles Darwin University, and this unit will continue to maintain and develop web-based tools based on the *NAFI*, *Infonet* and *Land Manager* website technology. These sites already receive substantial funding from external sources and it is anticipated that this will continue.

This Unit will also maintain the *Environorth* website for schools and the general community. The original CRC website will be archived as a legacy site. The unit will also distribute remaining publications.

New or improved products, services or processes

Many of the TS–CRC’s services and products are web-delivered and there were a number of new developments in this area in 2008–09.



- *Culture, Ecology and Economy of Fire Management in North Australian Savannas: Rekindling the Wurrk Tradition*, edited by Jeremy Russell-Smith, Peter Whitehead and Peter Cooke documents some of the collaboration and knowledge underpinning the West Arnhem

Land Fire Abatement (WALFA) project. The WALFA project has shown how to build partnerships for controlling fire—the collaborative, cross-cultural two toolkit’ approaches and commercially supported environmental services programs—at scales that were, until this demonstration, thought beyond effective intervention.

5. New features were developed for the NT Infonet website for NT land managers and planners, <www.ntinfonet.org.au> these include a facility for generating illustrated management guides for any threatened species likely to be found on or near a given area in the NT.
6. Two new websites were developed using the Infonet application: Prioritize NT, <www.ntinfonet/prioritize> which is used by the NT NRM Board to help it with strategic planning decisions; and a trial infonet site for Cape York Peninsula <www.cypinfonet.org.au> developed for Cape York Sustainable Futures.
7. The North Australian Fire Information (NAFI) website was extensively upgraded with the following features:
 - capacity to handle a greater number of map requests per day
 - more standard code behind the application so it can be easily maintained by third parties
 - re-designed interface with more tools for fire managers – including tools for hand-held GPS units to make fire monitoring easier for groups like Indigenous Rangers using *Cybertracker* and similar software.
8. The NAILSMA Turtle and Dugong Project have greatly expanded the I-Tracker network in 2008–09, a network of Indigenous Land and Sea Managers and researchers who are working together to collect and share information for better land and sea management.
9. A new interactive module for upper primary and lower secondary school students has been largely developed in 2008–09. The module deals with grazing land management in an accessible way and will complement existing modules on biodiversity and fire management on the Environorth website for schools: <www.environorth.org.au>. The latest module is due to be launched at the start of the 2010 school year.
 - *The Bush Book: a manual for managing native vegetation across northern Australia*, edited by Maria Kraatz, Peter Jacklyn and Mike Clark. This practical guide to managing for healthy bushland across northern Australia includes sections on managing fire, weeds, revegetation and regeneration, as well as advice on earning income from good bush management. The book is an initiative of Greening Australia but received support and involved staff from the Tropical Savannas CRC. It is due to be released in late 2009.

Outcomes

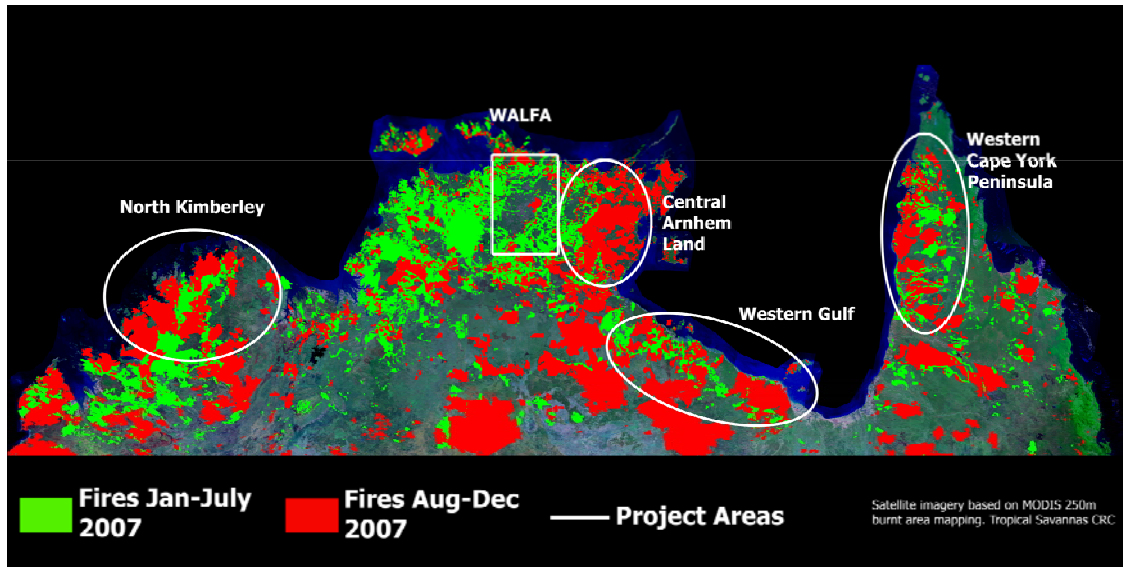
Continued success of the West Arnhem Land Fire Agreement and prospects for expanding this approach across north Australia

Now in its fourth year, this \$20M, 17-year agreement between the Darwin Liquefied Natural Gas (DLNG) consortium and Indigenous fire managers has dramatically reduced the incidence of wildfire across the Arnhem Land Plateau with consequent benefits to the significant natural and cultural values of this region. The fire managers have done this by implementing patchy burns across the landscape early in the fire season to reduce the fuel available for wildfires.

Due to the success in reducing wildfire, in the first four years of operation total Greenhouse Gases equivalent to 488,000 tonnes of CO₂ were abated (relative to the baseline average emissions 1995–2004)—around 20% ahead of the agreed target of 100,000 tonnes abatement per year. .

In a significant development for north Australian Indigenous communities and their country, the model whereby payment for environmental services are gained through better management of bushfires, developed in the West Arnhem Land Fire Abatement Project (WALFA), is to be extended across far northern Australia. Indigenous land management groups, major companies and governments are investigating the feasibility of entering into similar Greenhouse Gas offsets agreements in five areas in the fire-prone savannas shown below.

Figure 3: Potential project areas for greenhouse gas and fire abatement projects

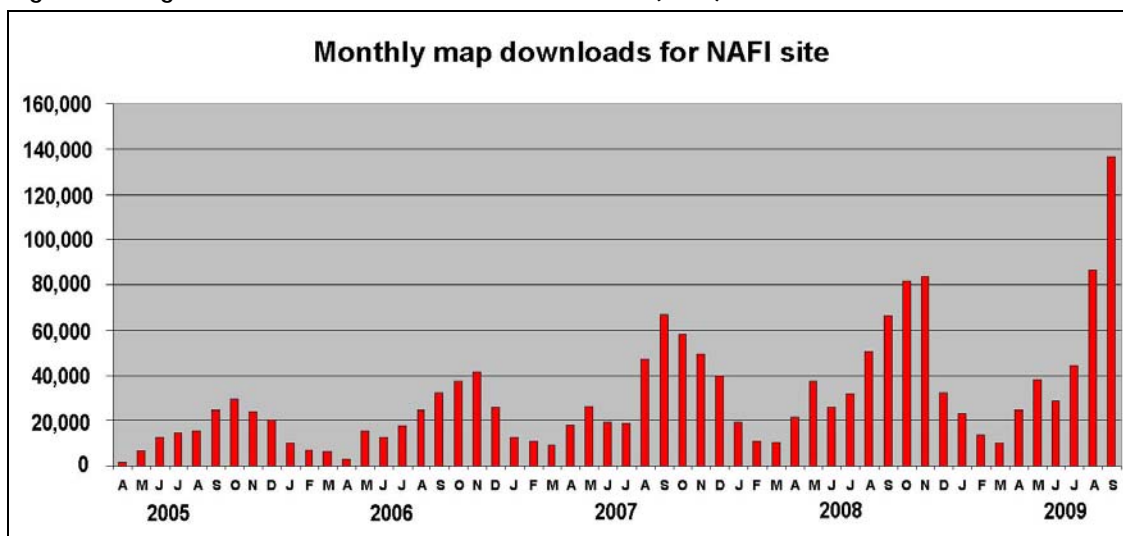


Like the WALFA project, these future projects will be underpinned by research and verification monitoring conducted by the TS-CRC, and its fire-tracking website <www.firenorth.org.au> which is used by the WALFA fire managers daily.

Increased uptake of fire management tools across north Australia

Beyond the WALFA project, better fire management is a crucial factor in sustaining productivity and biodiversity in north Australia—each year around 80% of the area burnt by bushfires in Australia occurs in the north. The TS-CRC’s North Australian Fire Information (NAFI) fire-tracking website <www.firenorth.org.au> now plays a key role in improving fire management, being used by fire managers across the Kimberley, the NT and outback Queensland. The site has seen substantial growth in use since its launch in 2004 as shown below (note that usage peaks in the northern wildfire season from August – November).

Figure 4: Usage of the North Australian Fire Information (NAFI) website, 2005-2009



The site was updated in 2008–09 to include new tools for fire managers like the Indigenous Ranger groups that can now download NAFI fire data to their hand-held GPS units.

Continued uptake of a strategic approach to fire management using preventative patch burning and break burning in the early dry season is also being promoted through networks established through the North Australian Fire Managers Forum in which the main bushfire agencies in north Australia meet

with fire researchers. Established by the TS–CRC in 1998, the sixteenth forum was held in June 2009. Preventative burning is being increasingly adopted across Queensland partly through the efforts of the now completed Rangelands Fire Project, and this project was partly responsible for the increased uptake of the NAFI website in 2008–09.

Uptake by fire management policy-makers

The Federal Government’s forthcoming *Carbon Pollution Reduction Scheme* (CPRS) and the associated Emissions Trading Scheme (ETS) is likely to have the most significant potential impact on fire management in north Australia, as the way fire management is treated by an ETS will affect the income generated by good fire management. The success of the WALFA Project and submissions and briefings by the TS–CRC and NAILSMA on fire management have helped shape the approach of the Department of Climate Change to savanna burning. Once the Department is satisfied that the scientific methodologies used to estimate emission abatement is robust, it will help facilitate the trading of offsets from such abatement of the voluntary market, and may also facilitate trading with the CPRS market once the relevant legislation is passed.

Uptake of management tools in the Dugong and Marine Turtle Project

The project involves communities across northern Australia from the Kimberley to Cape York and Torres Strait working to a long-term goal of “healthy and sustainable populations of marine turtle and dugong in northern Australia that support Indigenous livelihoods”. The project, which is run by the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) and administered by the TS–CRC, made significant progress in enhancing Indigenous capacity for the sustainable management of dugong and marine turtle as well as supporting the development and delivery of government policy and process.

In 2008–09 the project rolled out ‘I-tracker’ technology in which Indigenous rangers can use hand-help GPS units to help them monitor the health of their country. The I-tracker technology is now used by around a dozen ranger groups across northern Australia.

Uptake of techniques and options for managing biodiversity

A range of guidelines for managing biodiversity are now available through the north Australia Land manager website <www.landmanager.org.au> and these are now being used by NRM groups and land managers across north Australia.

Use of the land manager website grew consistently in 2008–09; particularly by regional NRM groups and NRM agencies and on-ground land managers. Web statistics show that one of the most used areas of the site are the management guidelines and information links the site provides for all problem weeds, pest animal species and threatened species in north Australia.

The use of the Land manager website information has been enhanced in 2008–09 by its integration with the NT Infonet website <www.ntinfonet.org.au> which allows lists and management guidelines for threatened species to be accessed for any area by drawing a map.

Use of Educational Material in schools

Use of the *EnviroNorth* website and interactive learning modules (*Savanna Walkabout* and *Burning Issues*) by primary and lower secondary schools throughout the Northern Territory continued to grow in 2008–09 with a new module on grazing land management being largely completed. The interactive modules have now been included in pre-service teacher training education units at Charles Darwin University. These modules have also been included as resources in teachers’ networks in Queensland (particularly through the Primary Connections¹ science program) and Western Australia (including Katherine and the Kimberley Schools of the Air). The site is also attracting interest in other Australian states. The website and modules were produced by the *Tropical Savannas Knowledge in Schools* project. The learning module was developed collaboratively with the NT Education Department and teachers and is integrated into the NT curriculum.

Commercialisation and Utilisation Outputs and/or Milestones

The Commercialisation and Utilization outputs for the Tropical Savannas CRC are not listed separately in its Centre of Agreement but as individual milestones under each Theme. This year, outputs are listed against milestones for the five projects established under the Centre's extension agreement. Table 3 (p. 12).

Intellectual Property Management

All IP generated by the Centre's activities is owned by the Centre partners as tenants in common in proportion to their participating shares. The partners are obligated to use their best efforts to identify IP generated by Centre activities, and to vest ownership of such IP in the partners. If patenting or other registrable forms of IP protection are pursued it is to be in the joint names of all the partners as tenants in common proportional to their participating shares.

The Centre partners may bring background intellectual property to the Centre's activities - and such IP remains the property of the partner concerned but can be used royalty-free by the other partners in the Centre's activities other than for commercialisation. The Centre's Business Manager maintains a register of such background IP.

Communication Strategy

In 2008–09 the Centre's Communication Strategy helped raise the awareness of the Centre's activities. It was, however, mainly focused on assisting the take-up of research by users.

Communication, SMEs and the pathway to adoption

The Centre's communication strategy is focused on ensuring our research gets used and makes a difference. The communication used here is not tacked on to the end of the research process but is integrated into the management and conduct of the research as described in the section on technology transfer and use and in the section on collaboration:

- End users, many of whom are in SMEs, are asked about what research projects they need through the extensive networks built up by the Centre over the last few years so that research is initiated by user demand where possible.
- SMEs and other end users are actively involved in participative research
- Communication resources are provided to assist capacity building in both researcher and user groups.
- Communication resources are provided so that project participants keep in touch and work collaboratively
- Theme leaders are given communication roles to ensure collaboration
- Once an area of research emerges as being ready for successful adoption, considerable communication resources are then provided to produce practical tools. A range of media are used to suit different users and applications.

The isolation, cultural diversity and low capacity of many savanna user groups and even many research groups means that the TS–CRC does not focus on research-based Knowledge Brokers like some other CRCs. Instead the CRC uses a mix of people, some of whom broker knowledge, others of whom may broker resources and funds to implement the broad adoption strategy above.

Links with Business and Strategic Direction

The Centre's links with business and subsequent use and commercialisation are premised on the research and adoption achieved through participative projects. For example, the TS–CRC's fire management projects have established a research-based case for reducing greenhouse gases and conserving cultural and biodiversity values through improved fire management on the Arnhem Land Plateau. The CRC's projects have seen Arnhem Land fire managers take up techniques and tools that allow them to manage fire more effectively. Against this background, the NT Government was able to

negotiate a 17-year, approximately \$20 million dollar agreement with Darwin Liquefied Natural Gas to support fire management in Arnhem Land in return for the greenhouse gas reductions that could be offset against the emissions from DLNG's Darwin plant.

Other large corporations in the mining and energy and philanthropic sectors are in talks with the Centre to broker similar offset agreements with local land managers that are based on the Centre's research and adoption record in more effective fire and land management in north Australia. Such commercial agreements should yield long-term support for better management of greenhouse gas emissions and biodiversity as well as significant social and economic benefits for the local communities of land managers. This is the key strategic direction being pursued by the Centre.

Communication and raising awareness

In the longer term it may be difficult to sustain well-informed land management policies and practices in the tropical savannas without having a well-informed broader, mostly urban community. To raise awareness of the tropical savannas in this broader community requires considerable resources, and the TS-CRC's strategy here is to use the education system to raise awareness rather than focusing on the mass media or public presentations. The recently established project *Tropical savannas knowledge for schools* aims to provide information on the tropical savannas tailored to the primary and secondary school curricula in northern Australia.

In the short term, however, some sections of the broader community can be targeted effectively. TS-CRC researchers continue to attract widespread media interest through our partner agencies, with appearances on national television shows such as ABC's *Catalyst*, as well as local print media and radio. Care is taken not to jeopardise the pathway to adoption strategy above with these awareness-raising activities—collaborative links will not be risked for the sake of high-profile media coverage.

End-User Involvement and CRC's Impact on End-Users

In 2006 the Centre for International Economics assessed the impacts of the Centre's research on the industries that were end-users of that research (CIE (2006) *Evaluation of the CRC for Tropical Savannas: looking back* Report). They made the following findings:

- The net value to the pastoral industry of pastoral research taking place in this round of the TS-CRC is \$25.8 million due to higher stocking rates in some regions; higher productivity due to better pasture management and lower management costs. This assessment did not take into account the potential for establishing 'green' credentials for marketing.
- The net present value of the fire management tools produced by the TS-CRC to the pastoral industry through improved grazing productivity was estimated to be \$39.0 million over the 20 years from 2001. The industry would also benefit from reduced infrastructure losses, resources used for fighting major fires and health impacts due to smoke haze.
- As a result of fire management tools such as NAFI, mining operators are likely to have fewer shutdowns due to better preparation for fires and fewer electricity outages. The value to mines in terms of the potential reduction in shutdowns less their implementation costs is estimated as many millions of dollars from reduced loss of infrastructure.

In total the benefits due to the CRC's fire management research total \$120.5 million over the next 20 years.

The CIE Report did not include a thorough assessment of the impact of the more recent WALFA project, which is supported by TS-CRC research and tools. It is delivering around \$1M a year to Indigenous ranger groups in Arnhem Land with flow-on social and economic benefits which include facilitating the establishment of Indigenous NRM enterprises; the improvement of English language skills and cross-cultural confidence; the transfer of Indigenous Knowledge between generations; and regional collaboration.

The successors to the WALFA project promise to deliver even greater benefits given the greater numbers of Indigenous people involved in some of these new areas and the expected higher returns per unit of greenhouse gas abated compared to that negotiated for the WALFA project.

There are also likely to be long-term benefits for the community, tourism and environmental services from enhancing efforts to conserve of biodiversity.

Impact of publications across the savannas

The TS–CRC plays a key role in synthesising NRM knowledge from across north Australia and making it easily accessible to end-users. In 2008–09, the Centre sold 1411 copies of its books and 307 hard copies of free publications were distributed. Downloads of publications online (a variety of reports, articles, newsletters and information sheets) reached 140,156 over the Savanna Explorer, Land Manager, EnviroNorth, NAILSMA, and the CRC site websites hosted by the CRC. Research findings also available on websites aimed at land managers and schools. These websites <www.landmanager.org.au> and <www.environorth.au> are showing good growth in usage.

Following is Table 5, which summarises end user involvement in CRC activities.

Table 5 End user involvement in CRC activities

End User	Relationship	Type of Activity and Location	Nature/scale benefits to end-users	Actual expected benefit
<p>North Australian fire managers:</p> <ul style="list-style-type: none"> • Grazing land managers • Conservation land managers: public and private • Indigenous Rangers • Defence forces • Mine site operators 	<p>All the major fire managers are participants in the Centre.</p>	<p>Fire management advice and monitoring tools that reduce the incidence of late dry-season wildfires.</p> <p>These are being applied across northern Australia</p>	<p>These benefits apply across northern Australia</p> <p>Economic</p> <ul style="list-style-type: none"> • Reduced resource costs needed to manage fire • Reduced infrastructure losses • Creation on an Environmental services market (WALFA) • Reduced mine shut-downs due to fire damage to power lines • Reduced incidence of death and injury • Reduced smoke-related illnesses • Improved cattle productivity due to reduction in woody scrub land. <p>Environmental</p> <ul style="list-style-type: none"> • Reduced degradation of native flora and fauna/biodiversity • Reduced greenhouse emissions <p>Social</p> <ul style="list-style-type: none"> • Development of sustainable income options for remote communities • Recognition of traditional land management practices 	<p>Average net benefit of \$120 M in present value terms using a 5% discount rate.*</p>
<ul style="list-style-type: none"> • North Australian grazing land managers: • Owner-operators • Grazing Companies • Indigenous community based owners and operators 	<p>Some company and owner operators are participants, but most are Industry end-users.</p>	<ul style="list-style-type: none"> • Development of property scale decision support and risk management tools • Improved tools for estimating sustainable carry capacities • Improved tools for estimating land condition <p>These are being applied across northern Australia</p>	<p>These benefits apply across the pastoral estate in northern Australia</p> <p>Economic</p> <ul style="list-style-type: none"> • Increased production • Reduced operating costs per beast • Increased capital stock • Reduced risk of running out of feed • Reduced risk of further regulation <p>Environmental</p> <ul style="list-style-type: none"> • Reduced land degradation • Reduced degradation of native flora and fauna/biodiversity <p>Social</p> <ul style="list-style-type: none"> • Increased inter-generational equity • Increased human capital • Eased psychological burden • Better relationship between researchers and producers 	<p>Average net benefit of \$26 M in present value terms using a 5% discount rate.*</p> <p>*Centre for International Economics (2006) Evaluation of the CRC for Tropical Savannas: looking back.</p>

EDUCATION AND TRAINING

The Education and Training Program wound up in 2006-07 with the administration of the courses it has developed in Tropical Environmental Management being taken over by Charles Darwin University.

Eight PhD students are yet to submit their theses.

Recruiting and supervising PhD and masters students

The TS-CRC reached its target with Higher Degree by Research (HDR) student recruitment overall. The TS-CRC Round 2 recruited 33 new HDR students (above the target). Of these, 19 have now either submitted or lodged their theses. Six withdrew during the last five years (Appendix 2, Table 7, p. 33). No new students were recruited since 2006-07.

Almost all HDR students were involved in part-time or short-term employment contracts (Appendix 2, Table 8, p. 38). While this slows completions times, it is good for longer-term employment prospects of these students and demonstrates the regional need for capacity presented by TS-CRC supported HDR students.

Involvement of industry in research supervision

Each TS-CRC research student had at least one industry supervisor (Appendix 2, Table 7, p. 33) although in some cases supervisors have moved either to or from academia during the student's candidature.

Graduate destinations, if known

Available information about graduate destinations for Round 2 HDR students is presented in Appendix 2, Table 8, (p. 38).

PERFORMANCE MEASURES

As the research program of the Centre ended in 2007–08 to be replaced by smaller pilot projects that look to the future rather than address the performance measures of the previous research program, what follows is a subset of the standard performance indicators that still applied in 2008–09.

Strategy for Utilisation and Commercialisation of Research Outputs

- Specific issue forums such as the North Australian Fire Managers Forum are well-supported (see Research Collaborations, p. 17.)
- As the Centre wound down during 2008–09, media coverage focused mainly on the West Arnhem Land Fire abatement project and the fire information website. The centre's email and hardcopy newsletters remained well supported by stakeholders such as land managers, conservation managers and other research user groups.
- Easily accessible research findings and information
 - More than 1400 hard-copy publications were sold and more than 300 distributed free in 2008–09 (excluding Annual Reports and newsletters). In 2008–09, the number of downloads of publications (a variety of reports, articles, newsletters and information sheets) reached 140,156 over the Savanna Explorer, Land Manager, EnviroNorth, NAILSMA, and the CRC site websites hosted by the CRC. Research findings also available on newly developed websites aimed at land managers and schools. These new sites <www.landmanager.org.au> and <www.environorth.au> are showing good growth in usage.
- Uptake of outputs (for more details see Commercialisation and Utilisation, p. 18):
 - Feedback from users and website usage indicates that the CRC's NAFI website <www.firenorth.org.au> is now the major fire tracking tool used to manage large scale fires in the fire prone areas of northern Australia. During the northern fire season the site delivers many thousands of fire maps a day and is used regularly in projects like the West Arnhem Land Fire Abatement Project (see below).
 - Fire monitoring techniques developed by the CRC underpin fire management across north Australia including the West Arnhem Land Fire Abatement Project in the NT and the Rangelands Fire Project in Queensland.
 - Sustainable land management guidelines for grazing developed by the TS–CRC are now taken up by grazing managers through the Grazing Land Management Workshops delivered across northern Australia.
 - Based on the two case studies conducted by the Centre for International Economics, the uptake of the TS–CRC's grazing tools are likely to produce a net benefit of \$25.8 million, while uptake of the fire management tools will produce a net benefit of \$120.5 million over the next 20 years. Alone, these two returns imply a return on CRC investment of almost \$7 for each dollar investment in the CRC. (CIE (2006) *Evaluation of the CRC for Tropical Savannas: looking back* Report)
- Commercialisation of outputs: TS–CRC research and uptake has underpinned greenhouse offset agreement between the NT Government and DLNG in which DLNG will fund Arnhem Land fire managers for 17 years from 2006 at over \$1M a year (see p. 18).

Education and Training

- The education program is now completed.
- A total of 33 research students received support from the TS–CRC, as either full scholarships, top-up scholarships or operational support (Table 7, p. 33). Of these six withdrew, 19 graduated or have theses under examination, with a further eight expected to graduate in the next year. The great majority of these students secured employment related to their studies, almost all in industry-related positions, see Table 8 (p. 38).

Resources, Management Structure and Performance Evaluation

- Effective and efficient project management system.
- Resources committed in accordance with the Commonwealth's agreement under direction of the Board of Management, taking into account input from the Savanna Advisory Committee and the Management Group.

FINANCE

All financial information was provided to the Department of Education, Science and Training as per annual report instructions via the Internet.

ABBREVIATIONS AND ACRONYMS

ANU	Australian National University
APA	Australian Postgraduate Award
APCC	Animal and Plant Control Commission of South Australia
ARC	Australian Research Council
CALM WA	Department of Conservation and Land Management, Western Australia
CDU	Charles Darwin University
CIE	Centre for International Economics
CSIRO	Commonwealth Scientific Industrial Research Organisation
DEWHA	Department of Environment, Water, Heritage & the Arts
DIISR	Department of Innovation, Industry, Science and Research
DLNG	Darwin Liquefied Natural Gas Pty Ltd
DTEM	Doctorate of Tropical Environmental Management
EFTSU	Equivalent full-time student unit
ERISS	Environmental Research Institute of the Supervising Scientist
HDR	Higher Degree Research
HERDSA	Higher Education Research and Development Society of Australia
JCU	James Cook University
LTSR	Long-term stocking rate
LWA	Land & Water Australia
MLA	Meat & Livestock Australia
MTEM	Master of Tropical Environmental Management
NAILSMA	North Australian Indigenous Land & Sea Management Alliance
NRM	Natural resource management
NRMB	Natural Resources Management Board of the NT
NGRMG	Northern Gulf Resource Management Group
NT DBIRD	Northern Territory Department of Business, Industry and Resource Development
NT DEET	Northern Territory Department of Employment, Education and Training
NT DIPE	Northern Territory Department of Infrastructure, Planning and Environment NOW:
NT DPIF&M	Northern Territory Department of Primary Industries, Fisheries and Mining
NT NRETA	Northern Territory Department of Natural Resources, Environment and the Arts
QDPIF	Queensland Department of Primary Industries and Fisheries
QDNRM&E	Queensland Department of Natural Resources, Mines and Energy
QEPA	Queensland Environmental Protection Agency
QFRA	Queensland Fire and Rescue Authority
QPWS	Queensland Parks and Wildlife Service
SAC	Savanna Advisory Committee
SME	Small to Medium Enterprises
SPAG	Scientific Program Advisory Group
TEM	Tropical Environmental Management
TRARC	Tropical Rapid Appraisal of Riparian Condition

TS-CRC	Tropical Savannas Management Cooperative Research Centre
UQ	University of Queensland
VRD	Victoria River Downs / District
VRDCA	Victoria River District Conservation Association
WA FESA	Western Australia Fire and Emergency Services Authority
WALFA	West Arnhem Land Fire Abatement
WRA	Weed Risk Assessment
WRM	Weed Risk Management
WWF	World Wide Fund for Nature

APPENDIX 1 FINANCE

Table 6 Consultancies and Research Contracts

Type	Consultant	Consultancy	Funding Source	Amount
1	Government	J. Russell-Smith, TS-CRC	Fire Management in Northern Australia	LWA \$547,000 Dec 06 – Sept 09
1	Government	J. Morrison, TS-CRC	Fund Enterprise Development Officer	NRMB \$246,000 July 06 – May 09
1	Government	P. Jacklyn, TS-CRC	Web-based Mapping of Biodiversity and Feral Information	NRMB \$279,000 July 06 – Nov 08
1	Government	J. Woinarski, TS-CRC	Maintaining Ecosystem Systems in Tropical Agricultural Landscapes	LWA \$455,825 June 06 – Sept 09
1	Government	J. Russell-Smith, TS-CRC / NT BFC	Improving Greenhouse emissions estimates associated with savanna burning in the Northern Territory	Greenhouse Office \$400,000 May 05–July 09
1	Government	G. Duff, TS-CRC	Dugong and marine turtle management	NHT \$4,150,000 Jan 05–Aug 09
1	Government	D. Garnett, TS-CRC	Dugong and Marine Turtle Supplementary Funding for TSRA	NHT \$700,000 Nov 06 – Feb 09
1	Government	D. Garnett, TS-CRC	Extension Dugong and Marine Turtle Project	C 4 C \$600,000 Oct 08 – June 09
		P. Jacklyn, TS-CRC	Web Based Decision Support Tool	NRMB \$60,000 April 08 – Dec 08

1. Consultancies administered by TS-CRC

APPENDIX 2 EDUCATION

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
Adele Acton (Vagg)	UQ	19/03/01	01/07/01	31 Mar, 06	O Bosch (UQ) H Ross (UQ) D Walker (CSIRO)	Integrating on-ground actions that contribute to regional and property goals for sustainable land management
Kristine Brooks	CDU	03/03/04	03/03/04	01 Jul 08	S Setterfield (CDU) M Douglas (CDU) B Grace (NT NRETA)	Evaluating exotic grass management in terms of native vegetation restoration
Caroline Chong	JCU	01/04/03	31/03/04	02 Jul, 08	M Waycott (JCU) W Edwards (JCU) R Pearson (JCU) G Morgan (QEPA)	Regeneration dynamics of Melaleuca in a disturbance-prone riparian environment
AnnaMarie van Doorn	Florida	31/03/01	31/03/01	01 Dec, 06	B Brook (CDU) J Woinarski (NT DIPE) P Werner (U Florida)	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District
Leasie Felderhof	JCU	01/07/03	01/06/03	01 Apr, 07	D Gillieson (JCU) J Ludwig (CSIRO) G Cook (CSIRO)	Fire management in Queensland's North West Highlands
Ron Firth	CDU	31/03/00	06/02/01	31 Dec 06	R Noske (CDU) P Whitehead (CDU) T Griffiths (CDU) J Woinarski (NT DIPE)	Ecology and conservation status of the Brush-tailed Rabbit-rat (<i>Conilurus penicillatus</i>)

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
John Guenther	CDU	01/09/02	01/02/03	19 Oct,05	I Falk (CDU) A Arnott (CDU) G Ramsay (ICAT)	VET as a tool for regional planning and management in savanna communities
Kasper Johansen	UQ	102/02/04	01/07/04	31 Jul, 07	S Phinn (UQ) M Douglas (CDU) J Lowry (ERISS)	A framework for riparian zone mapping over local to regional scales in Australian tropical savannas
Allyson Lankester	JCU	21/07/03	03/03/04	31 Oct, 06	P Valentine (JCU) M Fenton (JCU) R Landsberg (Trafalgar Station)	Social investigation into the knowledge and management practices of riparian areas by landholders in the upper Burdekin catchment region
Gillian McCloskey	CDU	05/03/04	05/03/04	31 Jul, 08	G Boggs (CDU) M Douglas (CDU) J Ludwig (CSIRO) B Wasson (CDU)	Indicators of riparian health in tropical savannas: impact of domestic livestock
Eva McRae-Williams	CDU	27/07/05	27/07/05	Sept/Oct 08	Kate Senior (Menzies, CDU), Rolf Gerritsen (TS CRC) David Mearns (CDU)	Obligations, Opportunities and Outcomes of Training Programs: A Ngukurr Case Study
Jenny Moffatt	UQ	05/02/01	01/07/01	February 09	H Ross (UQ) G Lawrence (UQ) J Taylor (Rangelands Australia)	Graziers' perceptions of sustainable development and what this means for policy

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Submission date	Supervisors	Project Title
(A) CANDIDATES WHO HAVE SUBMITTED						
Lionel Pero	UQ	17/03/03	03/03/03	01 Nov, 06	T Smith (CSIRO) C McAlpine (UQ) P Lawrence (Q DNR&M)	An analysis of regional NRM priority setting processes and approaches for achieving sustainable NRM in the Queensland tropical savannas NRM regions
Aaron Petty	UC Davis	15/09/99	03/03/04	31 Jul, 07	M Douglas (CDU) D Bowman (UTAS) R Kennett (NAILSMA)	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park
Euan Ritchie	JCU	01/07/02	01/07/02	01 Nov, 06	C Johnson (JCU) A Krockenberger (JCU) S Garnett (CDU)	The ecology and conservation status of a tropical kangaroo: the Antilopine Wallaroo (<i>Macropus antilopinus</i>) on Cape York Peninsula
Natalie Rossiter	CDU	04/03/02	09/02/04	10 Dec, 07	M Douglas (CDU) S Setterfield (CDU) L Hutley (CDU) G Cook (CSIRO)	The impacts of invasive grasses on ecosystem processes in Australia's savannas
Colin Trainor	CDU	30/04/03	30/04/03	31 Jul-08	R Noske (CDU) J Woinarski (NT DIPE)	Responses of wildlife to environmental variation and land use in Lautern District, Timor-Leste (East Timor)
Leonie Valentine	JCU	24/03/02	26/10/00	10 Dec, 06	C Johnson (JCU) L Schwarzkopf (JCU) T Grice (CSIRO) J Ludwig (CSIRO)	Impacts of burning for weed management on bird and reptile assemblages in grazed open woodlands
Mark Ziembicki	UAdel.	31/03/01	01/07/02	August, 2009	D Paton (Uni. of Adelaide) J Woinarski (NT DIPE)	Ecology and conservation of the Australian Bustard (<i>Ardeotis australis</i>) in northern Australia

Table 7 Details of HDR student progression

(B) CANDIDATES WHO ARE YET TO SUBMIT						
Name	Uni	Enrol Start	CRC Start	Proposed Submission date	Supervisors	Project Title
Jenny Brazier	CDU	17/06/03	03/03/04	December 2009	D Parry (CDU) N Munksgaard (CDU) H Hejnis (ANSTO) A Bollhoefer (ERRISS)	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia
Nicole Cranston	CDU	14/03/03	14/03/03	Withdrawn	M Douglas (CDU) A Fisher (NT DIPE) S Setterfield (CDU)	The effectiveness of riparian fencing for biodiversity conservation
Michelle Watson	CDU	05/02/01	05/02/01	December 2009	P Whitehead (CDU) J Woinarski (NT DIPE)	Faunal responses to alteration in plant community structure in tropical savannas
Christopher Holloway	JCU	04/02/04	01/07/04	TBA	D Gillieson (JCU) P O'Reagain (QDPI) I Gordon (CSIRO) P Valentine (JCU)	Hierarchy, distribution and spatial utilisation of patches by cattle in a semi-arid tropical savanna
Peta-Marie Standley	JCU	21/03/05		TBA	D Gillieson (JCU) P Novelty (AgWA)	Kuku-Thaypan fire management research project. The importance of campfires to effective conservation.
Steve Johnson	UQ	02/07/01	01/07/02	December 2009	D Hafner (UQ) J Bradley (UQ) P Cooke (Northern Land Council)	Culture as process: Correlativity, contest and tourism on Yanyuwa Country/ Tourism and two laws on the Gulf Savanna (NT): an examination of the interrelationship between social and environmental well being on the savanna lands of the southwest Gulf of Carpentaria

Table 7 Details of HDR student progression

Name	Uni	Enrol Start	CRC Start	Proposed Submission date	Supervisors	Project Title
(B) CANDIDATES WHO ARE YET TO SUBMIT						
Elizabeth Poon	UQ	17/03/03	03/03/03	TBA	S Schmidt (UQ) J Ludwig (CSIRO) H Possingham (U. of Adel.)	Impact of tree clearing on nutrient dynamics in low nutrient tropical savannas
Kathy Seton	UQ	02/07/02	01/07/02	TBA	J Bradley (UQ) D Hyndman (UQ) P Cooke (Northern Land Council) B Hocking (QUT)	"Li-Yanyuwa li-nhanawayaya li-murndangumara": Yanyuwa women, land rights and relations to country
Katherine Witt (nee Taylor)	UQ	11/02/02	03/03/04	TBA	W Carter (UQ) D Cameron (UQ) R Greiner (River Consulting)	Rights and responsibilities in land ownership and natural resource management

Table 8 Employment status for Round 2 TS–CRC supported research students

Name	Institution	Project Title	Employment
Jenny Brazier	CDU	Fate of heavy metal contaminants from Rum Jungle uranium mine into the Finiss River, NT, Australia	Contract position with CDU as research associate. Now in a permanent position with ERISS as an environmental chemist
Nicole Cranston	CDU	The effectiveness of riparian fencing for biodiversity conservation	Part-time position in research administration at CDU
Ron Firth	CDU	Ecology and conservation status of the Brush-tailed Rabbit-rat (<i>Conilurus penicillatus</i>)	Consultant wildlife ecologist, trading as Indicus Consulting. Now working as a scientist with EWL Sciences Pty Ltd, Darwin.
John Guenther	CDU	VET as a tool for regional planning and management in savanna communities	Education & training research consultant, based in Tasmania
Natalie Rossiter	CDU	The impacts of invasive grasses on ecosystem processes in Australia's savannas	Position as Weeds Risk Assessment Research Officer, NT NRETA
Colin Trainor	CDU	Responses of wildlife to environmental variation and land use in Lautern District, Timor-Leste (East Timor)	Consultant, Environmental Impact Assessment for the proposed Iralalero Hydropower project in the Los Palos area, East Timor (consultancy now completed)
Michelle Watson	CDU	Faunal responses to alteration in plant community structure in tropical savannas	Threatened Species Officer, South Australian Arid Lands Natural Resources Management Board
AnnaMarie van Doorn	Florida	Ecology, conservation and management of Purple-crowned Fairy-wren in the Victoria River District	Lecturer, Batchelor Institute of Indigenous Tertiary Education, January 2005 - December 2006.
Leasie Felderhof	JCU	Fire management in Queensland's North West Highlands	Contracted position with Queensland Rural Fires
Christopher Holloway	JCU	Hierarchy, distribution and spatial utilisation of patches by cattle in a semi-arid tropical savanna	Studying part-time while employed full-time as a research associate, CSIRO
Allyson Lankester	JCU	Social investigation into the knowledge and management practices of riparian areas by landholders in the upper Burdekin catchment region	Social Scientist, Australian Centre for Tropical Freshwater Research, James Cook University.
Euan Ritchie	JCU	The ecology and conservation status of a tropical kangaroo: the Antilopine Wallaroo (<i>Macropus antilopinus</i>) on Cape York Peninsula	Scientist, Victorian Museum (Melbourne) working on the molecular systematics and phylogeography of dragons
Leonie Valentine	JCU	Impacts of burning for weed management on bird and reptile assemblages in grazed open woodlands	Lecturer, School of Marine and Tropical Biology JCU. Now with EPA for a short-term contract as a Senior Project Officer in the Savanna District.
Mark Ziembicki	UAdel.	Ecology and conservation of the Australian Bustard (<i>Ardeotis australis</i>) in northern Australia	Research Associate, Indigenous Knowledge of savanna mammals, ANU/ NT NRETA. Project Officer, Conservation biology in French Polynesia.
Aaron Petty	UC Davis	The historical and cultural context of landscape change within the South Alligator River system, Kakadu National Park	Research Associate, School for Environmental Research, CDU.

Table 8 Employment status for Round 2 TS–CRC supported research students Cont.

Name	Institution	Project Title	Employment
Steve Johnson	UQ	Culture as process: Correlativity, contest and tourism on Yanyuwa Country/ Tourism and two laws on the Gulf Savanna (NT): an examination of the interrelationship between social and environmental well being on the savanna lands of the southwest Gulf of Carpentaria	Land and Sea Ranger coordinator, Borroloola
Jenny Moffatt	UQ	Graziers' perceptions of sustainable development and what this means for policy	Project Officer, Centre for Social Responsibility in Mining, Sustainable Minerals Institute, UQ. Senior Review and Evaluation Officer, Strategic Review, Evaluation and Research Branch, Department of Communities, Queensland
Kathy Seton	UQ	"Li-Yanyuwa li-nhanawayaya li-murndangumara": Yanyuwa women, land rights and relations to country	Consultant research anthropologist