

Savanna carbon dynamics

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Savanna carbon

Savannas constitute approximately 30% of Australia's carbon stocks, and make a substantial contribution to national Greenhouse gas (GHG) emissions. GHG emissions from Australian rangelands derive from three main sources: land-use change, livestock production and savanna burning. Between 1991 and 2005, the range of emissions has been, respectively, *ca.* 50-130 Mt CO₂-e y⁻¹ (deforestation); 60-66 Mt CO₂-e y⁻¹ (livestock); and 5-15 Mt CO₂-e y⁻¹ (fire).

Understanding the stocks, flows, responses of savannas to elevated CO₂, savanna sequestration capacity and the markets for savanna carbon have been the foci of this project.

Carbon stocks, flows and sequestration capacity

We have estimated carbon stocks from several sites using direct harvest and allometry in the Darwin, Katherine, Kidman Springs regions of the NT. Above ground and root biomass depends on tree density and diameter; soil organic carbon is the main component of savanna carbon, but does not appear to vary with tree population structure. We are examining the application of the National Carbon Accounting System (NCAS) and remote sensing techniques such as RADAR and LIDAR for estimating stocks and changes to stocks at medium-large spatial scales.

We have estimated the bio-sequestration potential of the mesic savannas of the Northern Territory, using several different methods (empirical inventory, remote sensing, eddy covariance) and under different fire regimes. These analyses have indicated that the savannas are a weak sink, even when burnt almost annually. Net Biome Productivity (NBP), a production index that accounts for carbon fixation, and losses to both respiration and disturbance, is of the order of -1 t C ha⁻¹ y⁻¹. Reducing annual area burnt and the incidence of more intense late dry season fires is likely to increase the sink size. Temporal and spatial uncertainties surround these estimates of sequestration strength at landscape scales, and better estimates are needed of area burnt, burning efficiencies, poorly documented fuel types such as coarse woody debris, and the duration of the sink strength, and the sensitivity of sequestration strength to other land uses such as pastoralism.

FAC Experiment

A Free-Air Carbon Dioxide Enrichment (FACE) experiment using three levels of CO₂ - 370 ppm (current ambient); 460 ppm and 550 ppm - was established at Townsville. Transplanted seedlings of both eucalypts and acacias show evidence of enhanced growth under elevated CO₂, with a stronger response in the acacia (nitrogen-fixer) than the eucalypt. There are indications of rising soil moisture levels under elevated CO₂, which might be due to increased water use efficiency of vegetation.

Likely carbon markets

Global carbon markets traded more than 800 million t CO₂e worth \$13 billion in 2005. These markets are expanding, primarily from the entry into force of the Kyoto Protocol in 2005. While carbon markets are still disparate and emerging, businesses are voluntarily paying \$1-30 per tonne of CO₂e and investing in a wide range of emission reduction projects, pointing to the increasing economic potential of actions that aim to reduce global emissions of GHGs.

Carbon and Natural Resource Management

Worldwide, the storage of carbon on land as a greenhouse gas abatement strategy is controversial because of (1) difficulty in measurement and verification, (2) the high risk of their transfer to the atmosphere, (3) the potential for diversion from the main goal of reduction in fossil fuel emissions and (4) difficulty in partitioning fortuitous from deliberate carbon sequestration. There is a risk of perverse outcomes in some savannas if they are managed primarily carbon sinks as an end in itself, at the expense of other natural resource management objectives. Where carbon sequestration would have unintended negative consequences for broader land management goals, these trade-offs need to be acknowledged and balanced in land management decisions. Where synergies exist between carbon sequestration and other land management objectives, it would be desirable to promote these combined benefits through existing natural resource management initiatives.