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USING GIS AND SATELLITE IMAGERY TO ESTIMATE THE HISTORICAL EXPANSION OF GRAZING COUNTRY IN THE DALRYMPLE SHIRE

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INTRODUCTION

In the 1860s when pastoral enterprises were first established in the Dalrymple Shire, cattle were managed using an open-range system, with low inputs and low outputs (Allingham 1976). Despite the shire's vastness, the area available to pioneering graziers was restricted by proximity to water. The establishment of artificial water points, and changing from the European (*Bos taurus*) to Brahman (*Bos indicus*) cattle breed have substantially eased this restriction. As for other cattle grazing districts, the Dalrymple Shire is rich with anecdotal accounts of the impact of changing technologies, but little quantitative evidence exists. The focus of recent rangelands research has expanded in both temporal and spatial scale. Concurrently, new modelling methodologies have sought to capture these extended scales (Gross *et al.* 2004). To support this new research, historical quantitative data are required to provide an empirical benchmark. Here we used remote sensing, combined with GIS, to estimate how cattle breed and proximity to water have historically changed available grazing land within the shire.

APPROACH AND RESULTS

Our general approach was to estimate water availability at a point of time, then select all land within an assumed grazing radius of water, the radius being based on whether European or Brahman cattle dominated at that period. For our grazing radii we used unsubstantiated anecdotal ranges of two km for European and ten km for Brahman cattle respectively. Water is not limited in the shire's average wet season, so we only considered dry season water availability, which we estimated using Normalised Difference Water Index (NDWI) and manual analysis of Landsat TM 7 satellite imagery (October 2002). We categorised permanent water points into natural (swamps and water courses) and human-made (dams/tanks). Each category was then given a two or ten km buffer zone for grazing effect of European and Brahman cattle respectively. We assumed that only natural water points were available to pioneering graziers. Nowadays, dry season water is supplemented by artificial water points which have increased the grazing area for cattle. We used anecdotal and quantitative records to estimate the transition between an open-range system with European cattle to the present day system dominated by Brahman cattle which are less restricted by proximity to water (Figure 1).

DISCUSSION

Intensification of primary production is a common feature world-wide. In water limited extensive grazing systems such as the Dalrymple Shire, technologies that attempt to overcome water shortages, including dams and selective cattle breeding, have entirely changed the nature of land use in the region. Crude estimates of stocking rates in the Dalrymple Shire show a steady increase in intensity since 1887. When we adjust these stocking rates using our estimates of land within dry-season grazing radii, we see that stocking rates are much more stable. Even though we require some crude assumptions, this analysis provides us with a benchmark over a broad spatial and long temporal scale. This work represents an important input into the CSIRO Emerging Sciences Area - Complex Systems Science funded project "Adaptation and resilience in rangeland social-ecological systems".

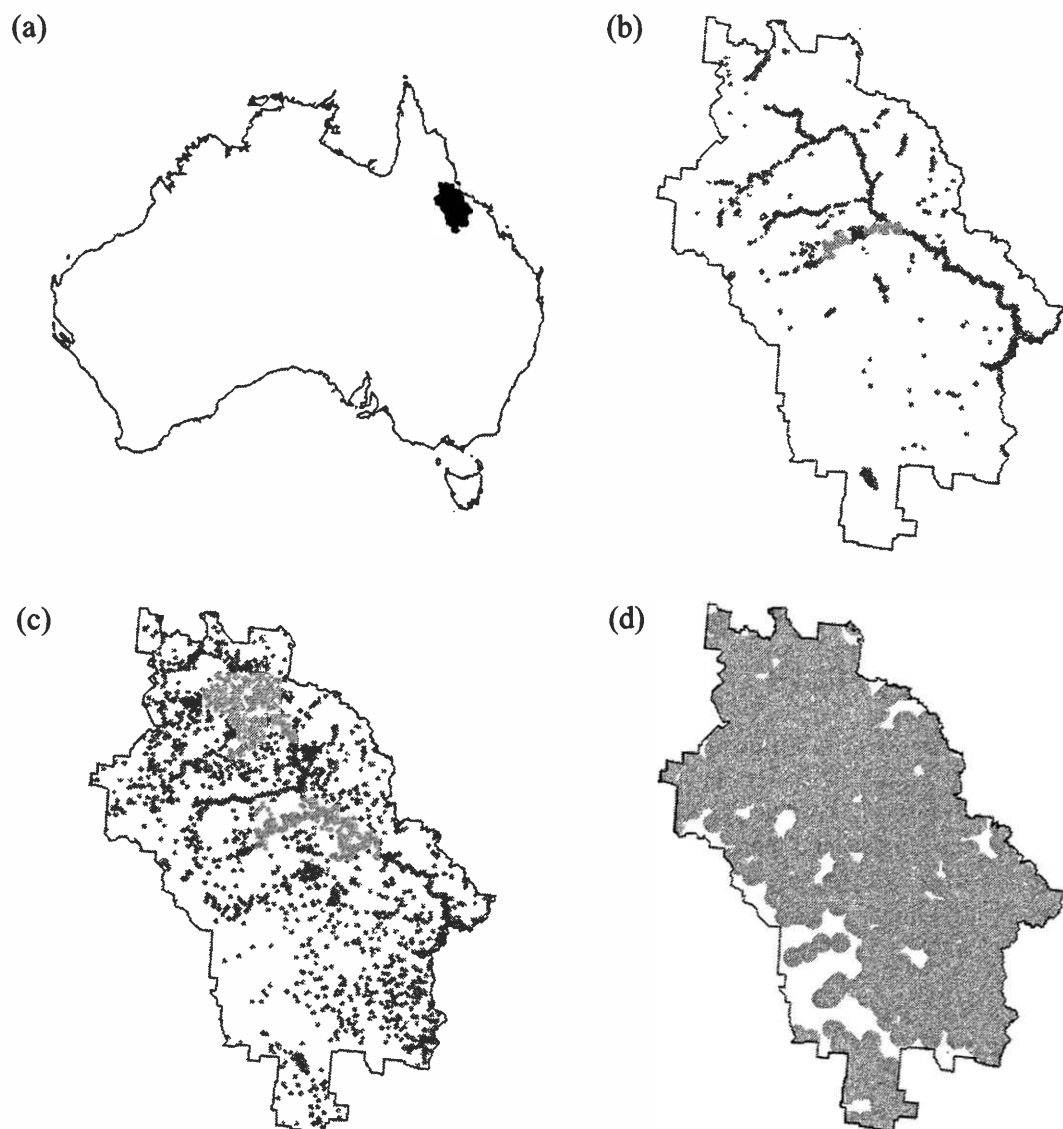


Figure 1. Geographic information maps showing estimated land available for cattle grazing in the Dalrymple Shire under various assumptions representing different eras in pastoral development: (a) Dalrymple Shire location map; (b) pioneering era, with permanent natural water courses and swamps only and European cattle breeds (9% of total area available); (c) pre-Braham era, with permanent natural water courses, swamps, tanks and dams but still European cattle breeds (29%); and (d) with permanent natural water courses, swamps, tanks and dams and Brahman cattle breeds (88%). For additional figures see www.cse.csiro.au/research/cabm/cars.htm.

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