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A COMPUTERISED MANAGEMENT SYSTEM FOR MONITORING AND PREDICTION OF DROUGHTS IN QUEENSLAND.

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ABSTRACT

Spatial simulation of pasture growth and utilisation by herbivores is being developed as an aid to rational drought management in Queensland. A geographic information system (GIS) of climatic variables, soil attributes, pasture type, tree cover and stock numbers on a 5x5 km grid facilitates the running of a pasture simulation model (GRASP) on a state-wide basis. Interaction of stock density and pasture growth with the best climatic scenarios for the next 90 days will produce estimates of current and future pasture utilisation. Where utilisation is excessive maps showing land condition alerts will be issued.

LAND DEGRADATION AND DROUGHT

In Northern Australia, 85% of cattle production is on native pasture and 60% of this is degraded or at risk of degradation. Pastoralism in Australia occurs in zones of high year-to-year rainfall variation. Heavy pasture utilisation during drought years causes the loss of desirable perennial grasses and reduces protection for the soil surface (Gardener et al., 1990). While destocking during droughts and subsequent restocking during favourable seasons, protects the land and pasture resource, it is usually more desirable economically to attempt to maintain a constant number of stock (Foran & Stafford Smith, 1990). Climatic variability on a five to thirty year time scale makes it difficult to determine a 'safe' property stocking rate which can be maintained every year (Clewett *et al.*, 1991). Hence, in any region there is likely to be a range of stocking rates used by graziers and there will be some properties which are overstocked during drought.

Similarly, variability in markets (price of stock) has led to situations where graziers are unable to sell stock even as part of a normal culling practice (beef price collapse in 1974, current wool market problems). As a result either droughts or market forces are likely to lead to high utilisation and the risk of degradation. Thus land and pasture degradation appear to be an inevitable consequence of climatic and market variability, and there is a clear need to regularly advise and update graziers and regional land care organisations on the likelihood of degradation.

The 1991/92 El Nino event in Eastern Australia caused considerable financial hardship for producers battling an economic recession and poor commodity prices. Estimates of the economic loss for the drought in Queensland approach one billion dollars. Proactive destocking by agistment or sale of animals would have successfully ameliorated some of the financial hardship of drought, improved the sustainability of the soil and pasture resource, and enhanced animal welfare.

Major aims of the QDPI drought research program are to predict the occurrence of feed deficits and land condition alerts on a quarter to half shire basis over Queensland. This will provide a rational basis for large scale management decisions by graziers, extension workers and politicians.

SPATIAL MODELLING OF PASTURE PRODUCTION

At present there is no truly objective methodology for monitoring the condition of Australia's pastoral lands in terms of productivity and sustainability. Animal numbers, which are reported by the Australian Bureau of Statistics (ABS), cannot provide this assessment. It is only when animal numbers are combined with pasture growth that important sustainability indices (pasture utilisation and plant cover) can be derived. The drought project seeks to fill this gap and provide continual and objective assessment of the pastoral resource. The proposed spatial systems will not only 'monitor' resource use but will also provide a system for the extension and transfer of existing management principles to overcome likely problems of degradation. The approach involves running the QDPI's widely validated GRASP pasture growth model (McKeon et al, 1982) on a spatial basis (currently 5 km grid) over the entire state (1.7 million sq km).

Input data for the model includes pasture type, soil type, stock numbers, percent tree cover, rainfall, maximum and minimum temperature, humidity, and radiation. The model produces estimates of pasture production and is run forward on a daily time step up to 90 days into the future. Analogue years for future rainfall scenarios will be selected from the probability distribution of historical records considering the current probability of an El Nino event. When pasture production is combined with stock estimates (ABS for historical data and stock inspectors for real time updates) from the various shires, calculations of the degree of pasture utilisation can be made and displayed as maps of feed availability and land condition.

Studies of the influence of the Southern Oscillation on seasonal rainfall (Muchow & Bellamy, 1991) have provided a powerful understanding of comparative rainfall variability and frequency of extreme events (i.e. drought or flood). During the next decade it is anticipated that other improvements to current prediction systems will enhance rainfall forecasting at a 30 day and 90-180 day time scale (Voice, 1991). These developments may improve the forecast accuracy of the spatial model.

Weather data are obtained from up to 450 Queensland meteorological stations on a daily basis by computer network links with the Bureau of Meteorology. We are supplementing this network in remote areas.Interpolated meteorological surfaces have been developed with collaboration from the Australian National University's Centre for Resource and Environmental Studies in Canberra. Cross-calibration of the generated green cover from our spatial model with National Oceanographic and Atmospheric Administration (NOAA) satellite imagery will be used to validate the model's spatial accuracy.

A prototype of the spatial model shows the technological feasibility of our methodology, but many refinements of the GIS data and modelling software are scheduled before field validation and subsequent implementation over the next few years.

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