Managing grazing systems in a variable, non-stationary climate

June 2003 – August 2004

Location: Burnett region, Queensland

Principal investigator

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The need

Analyses of national climatic events (e.g. drought, flood and extreme temperatures) suggest increasing frequency of events falling outside the long-term historical experience. As current agricultural practices have been strongly shaped by historical climate conditions, the impacts of projected changes in future climate need to be assessed in order to quantify and plan for likely changes in future productivity and landscape condition.

How this project fits with MCV objectives

This project is closely aligned with MCV's objectives to provide tools and services that help farmers and natural resource managers manage climate risks.

Project objectives

1. Assess recent climate trends and explore the resultant impacts on the grazing industries (assessment of impacts on the cropping system undertaken by QDPI&F)
2. Assess the implications of current and projected climate changes for on-farm adaptation

The sub-objectives of this project included:

- quantify historical trends in key climate factors such as temperature and rainfall (amount, duration and intensity)
- quantify the consequences of these historical trends on natural resource management issues, such as deep drainage and runoff; and on-farm enterprise issues, such as pasture production and heat stress in cattle
- assess the impact of a range of likely climate change projections on natural resource management issues, heat stress and pasture production, using the most recent consensus climate change scenarios for the Burnett study region
- discuss possible management responses to these issues

Methods

We undertook the research as a case-study using a national pasture production model (GRASP), and climate data from the long-term climate database (SILO).

We calculated climate trends using both raw and interpolated climate data on timescales ranging from daily to annual.

We incorporated the observed climate data into the GRASP modelling framework to assess historical changes in heat stress, pasture production, deep drainage and run-off.

We modified historical climate data to provide projections of likely changes in the simulated variables above, based on the most recent consensus scenarios of climate change produced by the CSIRO.

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Desired outcomes

- A detailed analysis of climate trends in the Burnett study region
- An assessment of the impact of these trends, on deep drainage, runoff, native pasture production and heat stress
- An assessment of the extent of change to deep drainage, runoff, native pasture production and heat stress in response to project climate change for this region

Achievements to date

The results showed that annual rainfall for the Burnett study region (made up of an East, North, Central and South sub-region) had declined over the period 1890 to 2002. Of the four stations examined in the East sub-region, half demonstrated statistically significant declining trends, all the stations (4) in the North sub-region demonstrated statistically significant declining trends and the Central and South sub-regions demonstrated 2 and 1 statistically significant declining trends respectively. The analysis of both historical maximum and minimum temperatures revealed a consistent pattern of warming across the study region although only the warming trends in minimum temperature were statistically significant.

The simulations of annual pasture production revealed consistent declining trends across all stations and sub-regions, although these trends were not significant at the 95% confidence limit. Similarly, the simulation of deep drainage returned non-significant declining trends across all 16 stations examined.

Projections of the future change in deep drainage, runoff, pasture production and heat stress were made by modifying historical climate data to represent likely changes in rainfall and temperature. The climate change experiments were limited by the coarse resolution of the climate projections, with individual climate model projections showing little regional variation across study region. The greatest variation in projections resulted from differences between models in response to enhanced greenhouse gas concentrations. The full range of model projections suggest possible changes of between +6% to -6% in rainfall by 2030 and +19% to –19% change in rainfall by 2070 (in response to 0.85 and 2.55oC of global warming respectively).

The simulation studies showed little change (small declines of less than 1%) in average pasture productivity when averaged across the full range of projections for the Burnett at 2030. The pasture responses from individual model projections were larger, driven mainly by the direction and extent of rainfall change. By 2070, declines in average pasture production of 4.5% were simulated when averaged across the full range of scenarios.

The impact of climate change on heat stress was large, with significant increases experienced across all sub-regions. The impacts were greatest in the Central and North sub-regions, with over 100% increase in heat stress simulated by 2070.

What is left to do?

The project has completed.

MCV is a collaborative program between the Grains, Rural Industries and Sugar Research and Development Corporations; the Australian Government Natural Heritage Trust and Department of Agriculture, Fisheries and Forestry; Dairy Australia; Meat & Livestock Australia; and Land & Water Australia. The National Farmers Federation and Australian Wool Innovation Limited are associate partners.

For more information on MCV, visit http://www.managingclimate.gov.au
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