Final Report
for the
Rural Industries Research and Development Corporation

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PROJECT No.

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RURAL INDUSTRIES RESEARCH & DEVELOPMENT CORPORATION

QUEENSLAND DEPARTMENT OF PRIMARY INDUSTRIES

Executive Summary

DAQ-124A

EVALUATING THE RISKS OF PASTURE AND LAND DEGRADATION IN NATIVE PASTURES IN QUEENSLAND

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DAQ 124A

EVALUATING THE RISKS OF PASTURE AND LAND DEGRADATION IN NATIVE PASTURES IN QUEENSLAND

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Total funds and other contributions of the Corporation, Research Organisation and Industry to DAQ 124A

	RIRDC $	Industry $	Research Organisation $	TOTAL $
91/92	59 158	38 922	49 879	147 959
92/93	57 013	73 937	94 751	225 701
93/94	NIL	79 682	102 112	181 794
94/95	73 082	36 773	47 126	156 981
TOTALS	189 253	229 314	293 868	712 435

PROJECT SYNOPSIS

Background

Surveys of Queensland's native pastures conducted in 1991 indicated that approximately 40% of the state was in a deteriorating condition and 20% was degraded. Previous research had shown that the major degradation processes resulted in loss of soil and desired perennial grass species. The major processes were driven by heavy utilisation during drought periods. Thus degradation could be reduced by early warning of heavy utilisation i.e. high stock numbers relative to pasture growth.

Research

To address these problems, we proposed that an operational simulation model of pasture growth would allow near real time calculation of the two major indicators of degradation risk, i.e. pasture utilisation and surface cover. To meet this goal in this project we:

1) developed and tested a native pasture growth model on more than 160 site x year combinations of pasture exclosure data;
2) analysed ten major historical and current grazing trials in Queensland to develop models of the effect of grazing on pasture growth, yield, consumption, decomposition and perennial grass basal cover;
3) analysed producer estimates of safe stocking rates to calculate safe utilisation rates;
4) implemented the pasture model during the 1991-95 drought by simulating in near real time pasture growth and other key variables across Queensland at a 5km x 5km resolution;
5) supported four other projects involved in the application of the models and simulation results.

Outcomes

1) A general model of native pasture growth was parameterised for major native pasture communities in Queensland and validated successfully for below average-rainfall conditions ;

2) Specific pasture community models for perennial grass basal cover and standing pasture yield were developed from grazing trials allowing simulation of surface cover and dynamic plant density as a function of utilisation ;
3) The safe stocking rates, which were estimated by graziers across a wide range of environments and pasture productivity , were shown to actually represent a relatively narrow range of average annual utilisation i.e. 15-25% consumption of pasture growth;
4) A near real time model was developed and comprehensively evaluated in a parallel project including the development of a national prototype (National Drought Alert Strategic Information System QPI20, LWRRDC)

Implications

1) For the first time in the state's history there is now an opportunity to provide alerts of degradation before it actually occurs. The challenge now is to improve the regional application and facilitate adoption;
2) The system developed in this project has provided the first comprehensive analysis of the past 50 years of experimental research on land and pasture processes together with graziers' experiences. The integration of this information and knowledge was only made possible by adopting a modelling approach thus demonstrating the importance of this scientific discipline;
3) The models developed here can be readily updated and improved as new research is conducted thus reducing the previous time lag between research and application;
4) The next phase of development has already commenced addressing the application of the sustainable stocking strategies at regional and property levels .

Specific objectives

The aim of the project was to develop a system to calculate the risks of land and pasture degradation on a Local Government Area basis so that degradation 'outlooks' or 'alerts' can be issued each season. Queensland was chosen as a case study to produce an operational system. The project was to conclude with a feasibility study for other states.

The extent to which project objectives have been met.

The proposal to develop a system for monitoring and forecasting the risks of land and pasture degradation associated with drought came at the commencement of what was to prove one of the worst drought periods for rural industries in Queensland history. As such, at the outset of this project, there was an immediate need to respond to the worsening drought by bringing forward plans to develop this operational system. For this reason there was no option but to abandon the logical order of developments we had initially proposed, and go operational immediately. We have since filled gaps in the operational system with respect to calculating risks of degradation.

The risk of land and pasture degradation namely soil erosion and change in species composition to undesirable species has been calculated from: (1) proportion of pasture eaten during the growing season and (2) plant cover of the surface soil. Alternative means of calculating risk have also been evaluated.

An existing perennial pasture computer model GRASP has been modified and validated to make the above calculations for all pasture communities in Queensland. Model deficiencies have been documented but were not considered a major limitation to the accurate simulation of degradation risk. Previously developed models of run-off and soil-loss have been incorporated in the GRASP model. The parameterisation of these runoff and soil loss models for all communities will be the subject of further investigation.

The effects of grazing on pasture condition has been examined for existing grazing trials in Queensland. The objective was to examine the sensitivity of GRASP plant growth parameters to the interacting effects of grazing and seasonal conditions. As expected, pasture communities varied in their sensitivity. The most sensitive parameters were grass basal cover in mulga lands; detachment rates in Mitchell grass; soil water range, nutrient uptake and root/shoot partitioning in the black spear grass zone.

Grazing trials results are likely to be specific to site characteristics, species and climatic conditions. Graziers have experience over a wider range of land types than those studied

in grazing trials. For this reason grazing trial studies were complemented with 3 major collaborative studies of grazier experience. These studies concluded that safe utilisation rates are 10-20% of average pasture growth. These results support grazing trial and simulation studies which indicate that such utilisation rates minimise risks of degradation and impacts on animal production in low rainfall years. Surveys (from other projects) suggest that graziers use higher grazing pressures than these safe levels to meet short-term financial goals.

A computer model suitable for real time operation using seasonal rainfall forecasts has been developed and incorporated within an existing QDPI Drought Project. The operational model calculates pasture growth, pasture utilisation and pasture yield for each of 70 000 5km^2 grid cells (pixels). For each pixel, pasture and soil attributes are estimated. For this purpose tables of model parameters have been developed, initially from pasture growth data used to develop GRASP but later reparameterised from a data bank of over 150 000 pasture yield estimations.

The final objective of the project was to conduct a feasibility study to apply the operational system to other states. The perennial pasture model GRASP has been parameterised for sites in (1) tropical tallgrass and midgrass communities in Northern Territory in collaboration with the Northern Territory Conservation Commission and the Northern Territory Department of Primary Industries and Fisheries; (2) ephemeral shrublands in central Australia, Western Australia and western New South Wales in collaboration with CSIRO Division of Wildlife and Ecology, Western Australia Department of Agriculture and New South Wales Department of Conservation and Land Management. While better models are being developed for these pasture communities, the work indicates that a national drought alert system is feasible. In fact the project QP120: "Development of a National Drought Alert Strategic Information System" has been developed to address national development of the operational system and is funded by the LWRRDC.

We have developed a capability in this project of not only monitoring current resource usage but also comparing current resource usage to that in previous years. As such we

are now in a position where, using the operational model, we can (1) examine current stocking rates in relation to safe stocking rates and (2) examine consequences of stocking rates being above or below this safe level in terms of risks to the land and pasture resource.

We have also critically evaluated existing models and recognise the need for better models in the following areas:

1) woody weed invasion
2) pasture weed (e.g. parthenium) invasion
3) grazing effects on infiltration
4) grazing effects on pasture composition
5) effects of pasture composition on animal production

An assessment of the impact of the results and conclusions of this project on industry in Australia and other parts of the world

This project and its application is at the frontier of pasture resource assessment methodology. The capabilities in resource assessment developed in this project are generic to, and have the main benefit for the national cattle and sheep industries. These industries will benefit by greatly improved access to information on pasture resource use.

At the time this project commenced there was concern as to the extent of pasture and land degradation in northern Australia. This concern prompted the Meat Research Corporation to commission a major review of the condition, productivity and sustainability of the pasture lands of northern Australia. The findings of this review suggest that while there is not yet widespread pasture and land degradation in northern Australia, there is widespread deterioration of the resource. For this reason, the reviewers suggest: “a sound understanding of the causes needs to be developed so that the trend can be reversed while there is still time”.

This project has sought to fill the need for a truly objective methodology to monitor the condition of Australia's pastoral lands in terms of productivity and sustainability. This project has addressed the four processes of major importance in these pasture lands:

1) the effect of climate on pasture growth
2) the effect of utilisation on perennial grass density
3) the effect of trees and shrubs on pasture growth
4) the effect of cover on soil loss

The project has addressed the confusion regarding the nature and cause of degradation processes, in particular clarifying the distinction between land degradation and pasture degradation and, secondly, separating the effects of grazing, seasonal conditions and woody weed incursion on land and pasture degradation. The project has developed a means by which the likely impacts of these separate processes on pasture condition can be monitored and quantified in real time.

This project has helped to increase awareness amongst industry and researchers as to the processes of degradation which operate in rangelands as well as to their extent and importance. To this end industry is more willing to support such concepts as (1) a complete environmental audit and (2) demonstrations of tactical grazing management in response to forecast seasonal conditions. This project will provide the future capability to contribute to industry needs in this area as are currently being evaluated by the Meat Research Corporation.

Conservative estimates by the Queensland Department of Primary Industries (February 1996) put the direct farm level cost of the El Niño associated drought in Queensland over the last five years in excess of $3 billion. This figure was more than doubled ($ 6.2 billion) when flow on costs through the rural service community were considered. Direct cost to the beef industry was estimated as $150 million in lost turn-off alone not including costs of drought feeding, agistment or loss to breeder herds. Including flow on costs to the rural community total losses in the beef industry were estimated at $260 million. Direct farm costs in the wool industry were estimated at $ 93 million and,

including flow on effects total costs to the rural community, total costs were estimated at $ 188 million.

In Queensland the operational system developed as part of this project has proved valuable in contributing to a timely and record response by Federal and State Governments in terms of drought relief. The operational system has also contributed toward ensuring a more equitable distribution of drought relief. In total the Queensland government contributed $40 million in freight subsidies for fodder, water and stock cartage and had allocated a further $38 million to drought recovery prior to the recent change of Government.

Proactive destocking by agistment or sale of animals as recommended by drought extension officers as part of the QDPI Drought Project would have successfully ameliorated some of the financial hardship of drought, improved the sustainability of the soil and pasture resource, and enhanced animal welfare. It is in this area that we will continue our research and extension effort using the results from this project.

Recommendations on the activities and steps that need to be taken to further develop, disseminate, or to exploit commercially the results of DAQ-124A.

The findings and computer based systems developed as a part of this project have been developed for the public good. For this reason there should be no attempt to commercially exploit these products and findings.

Further development of the findings of this project will occur under the LWRRDC funded project "Aussie GRASS" of which the principal investigators of DAQ-124A are project members. At future stages of product development and dissemination of results, every attempt will be made to acknowledge the formative contributions made by the RIRDC.

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