OBJECTIVE INDICATORS FOR MONITORING DROUGHT IN GRASSLANDS

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ABSTRACT
Australia's National Drought Policy was ratified by the Commonwealth (Federal), State and Territory governments in 1992. However, a sequence of El Niño-based events that started in Queensland in 1991 culminated in much of Australia experiencing abnormally low rainfall throughout 1994 and into 1995. Many farmers experienced substantial loss of income. The Commonwealth government therefore devised measures to determine which areas had been exposed to exceptional drought so that financial assistance could be directed as effectively as possible. In this paper we discuss progress in developing regionally-sensitive indicators and methodologies to aid in future assessments of drought exceptional circumstances.

KEYWORDS
Drought policy, drought mitigation, sustainability, simulation models

INTRODUCTION

The National Drought Policy (NDP) was developed to encourage primary producers and others sections of rural Australia to adopt self-reliant approaches to managing for climatic variability, to maintain and protect Australia's agricultural and environmental resource base during periods of extreme climate stress, and to ensure early recovery of agricultural and rural industries, consistent with long-term sustainable levels (White and O'Meagher, 1995). If drought conditions are so intense and protracted that they are beyond the bounds of normal risk management practices, the Commonwealth Minister for Primary Industries may declare affected areas as experiencing 'drought exceptional circumstances' (DEC). This qualifies producers in these areas to apply for Commonwealth financial support. Declaration of DEC is based on an assessment process involving analysis of objective scientific information, and independent advice from the Rural Adjustment Scheme Advisory Council (RASAC). The assessment is based on six core criteria agreed to by the Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ, comprising Commonwealth, State and Territory Ministers) in October 1994. These are meteorological, agronomic and livestock, and environmental condition, water supply, farm income levels, and the spatial extent of the drought. The Bureau of Resource Sciences (BRS) assists RASAC to analyze and assess applications from the States for DEC. BRS scientists accompany RASAC on most of their visits to drought-affected areas. Final decisions are made by the Commonwealth Cabinet.

MEASURING THE CRITERIA

Meteorological condition. ARMCANZ agreed that requests for support should first satisfy the meteorological criterion before the five remaining criteria would be assessed. For the meteorological conditions being experienced to constitute a 'rare and severe event', it must be established that they are likely to occur only once in 20-25 years and to be of greater than 12 months duration. Calculations of rainfall percentiles must be cognizant of the effectiveness of any rainfall that occurred.

Agronomic and Livestock Condition. Affected farmers were consulted in all States, and the Northern Territory, in assessing the impact of drought. They were asked questions about pasture cover, supplementary feed reserves, stock sales and intended sales should the drought continue. Other information used included remotely sensed data, historical data on land use, livestock numbers and productivity, and the output of soil moisture and vegetation models.

Environmental Condition, Water and Scale of the Event. Vegetation cover is important as an indicator of available fodder and to protect the soil resource from erosion. Cover can be estimated using remote sensing, grassland models and farm survey data. Soil types that are naturally vulnerable to erosion were identified. Information on stock water was provided by State governments. The geographic scale of the event indicates how far feed or stock needed to be transported, and the availability of off-farm agistment.

Net Farm Income. The Australian Bureau of Agricultural and Resource Economics provided survey data on the financial profile of farms, ensuring that the economic circumstances of farms in areas being assessed for DEC were 'severe' enough to warrant assistance.

INDICATORS OF DROUGHT EXCEPTIONAL CIRCUMSTANCES

Agronomic models are being used by BRS, and collaborating organizations, to improve the assessment of the effectiveness of rainfall and the objective estimation of DEC.

Temperate grasslands. White et al. (1995) simulated weekly changes in soil moisture and pasture availability from 1901 to 1992 in northern Victoria using a model of a Merino ewe flock grazing an annual ryegrass and subterranean clover pasture. The study highlighted the significance of the timing and intensity of rains, low temperatures and solar radiation during winter, and the phenology and senescence of the annual pasture plants that makes them unresponsive to summer rains. It also showed that the ranking of droughts varied according to the length of the 'analysis windows' (e.g. 12 v 18 v 24 months).

Donnelly and Freer (1996) used their GrassGro model to analyze and rank droughts between 1901 and 1995 by simulating an annual grass and subterranean clover pasture grazed by either Merino wethers or breeding ewes in the Central Tablelands of New South Wales. Available green herbage and particularly the weight of supplement fed, as determined by the model, were found to be more relevant criteria than rainfall for ranking the impact of droughts.

Tropical and semi-arid rangelands. Drought severity since 1885 at Charleville (semi-arid shrublands, sheep) and Charters Towers (seasonally arid woodlands, cattle) in Queensland was assessed using the GRASP model (Stafford Smith and McKeon, 1996). Rainfall, soil moisture at different depths, pasture growth, annual liveweight gain and annual cash surplus could all be used to identify major droughts, but these measures differed considerably in terms of which marginal events were highlighted. Pasture growth is more immediately relevant to grazing animals than soil moisture, so that even though rainfall, soil moisture and pasture growth identified some of the same major droughts, they also suggested different critical periods. Animal growth and economic productivity (based on 1996 prices and costs) also showed some variations from the other measures, highlighting the fact that biological and economic hardship are not always synchronized.

Spatial analyses. A major issue in drought declarations has been determining the boundaries of exceptional droughts, in that the impacts of drought seldom align with the boundaries of Local Government Areas. Brook et al. (1996) have applied the GRASP model to estimate changes in Total Standing Dry Matter across Queensland. This approach, which has been extensively tested against field and remotely sensed data, has been of considerable assistance to RASAC in evaluating the severity of drought across that State.

DISCUSSION

There are a number of methods and indicators available to assess the extent and severity of drought. Rainfall, soil moisture, grassland production, liveweight gain, and supplementary feed requirements have been shown to be useful indicators of exceptional drought in grasslands. Of these, the most reliable indicators of rainfall deficit and effectiveness are simulated grassland production and the requirements of livestock for supplementary feed. The feasibility of taking account of significant long-term climate shifts was also demonstrated. It is not envisaged that drought assessment based on biophysical and economic information systems will totally substitute for field visits and information. However, they will ensure a level of objectivity that will help ensure that Commonwealth intervention occurs only when the extent and severity of drought are clearly beyond the degree of commercial risk that farm managers would normally encounter.

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