CALM

# —Managing for—
# DROUGHT

CaLM Technical Paper 1

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# Foreword

*Drought times are hard for all primary producers, their stock and their land.*

*These are the periods that test land use practices and the resolve and finances of the individual.*

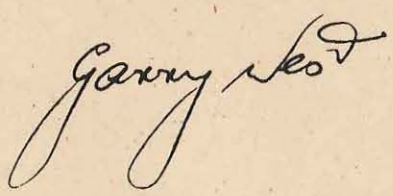
*Wherever we live we know that droughts will occur from time to time, but it is very hard to predict when a drought has started or how long it will last.*

*Farming is a business which carries many risks, only one of which is drought. Its participants need to prepare for these risks and develop means of management which reduce the adverse affects of drought and allow them to look after their stock, their crops, their pastures and their land. It is no longer acceptable to sit back until drought conditions become serious and wait for assistance. We cannot afford to allow land resources to be damaged, perhaps irreparably, by inaction.*

*This booklet puts drought into the farm management continuum and shows how normal practices affect how well one can cope with drought. It also outlines management strategies that can be employed during and immediately after drought to minimise the impact on land, stock and pastures. It provides some examples of how people have coped before, and indicates where advice and assistance can be sought.*

*The Department of Conservation and Land Management will place high priority on providing advice and assistance on land management to address the problems caused by drought. This will complement the programs and assistance provided by NSW Agriculture and the NSW Rural Assistance Authority.*

*I am very pleased that the three agencies have combined to provide this excellent practical overview of the subject, and I recognise the valuable contribution of funding by the National Soil Conservation Program which made this publication possible.*



*Garry West MP*
*Minister for Conservation and Land Management*
*and Minister for Energy*

# —Managing for—
# DROUGHT

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NSW Rural Assistance Authority

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*Cover photograph:*
*Although drought is a time of natural stress our own management will determine how well we cope.*

# Contents

# What is Drought?

## *Introduction*

Drought is often regarded as an abnormal event. In fact it is a natural recurring feature of the Australian environment.

The greater the experience land managers have with drought, the better the perception they have of the risks involved and the greater attention they pay to management practices which reduce these risks.

They are also more aware that management in non-drought years will have a major impact on how well they themselves, their land and their stock are able to cope with the effects of drought.

This booklet presents guidelines for managing to minimise the effects of drought, for managing during drought, and what to do when the drought breaks. It also outlines the types and sources of advice and assistance that are available through NSW Government departments and other organisations.

It concentrates on the land management practices recommended to prepare for and cope with drought and relates this to livestock management considerations.

## *Perception of Drought*

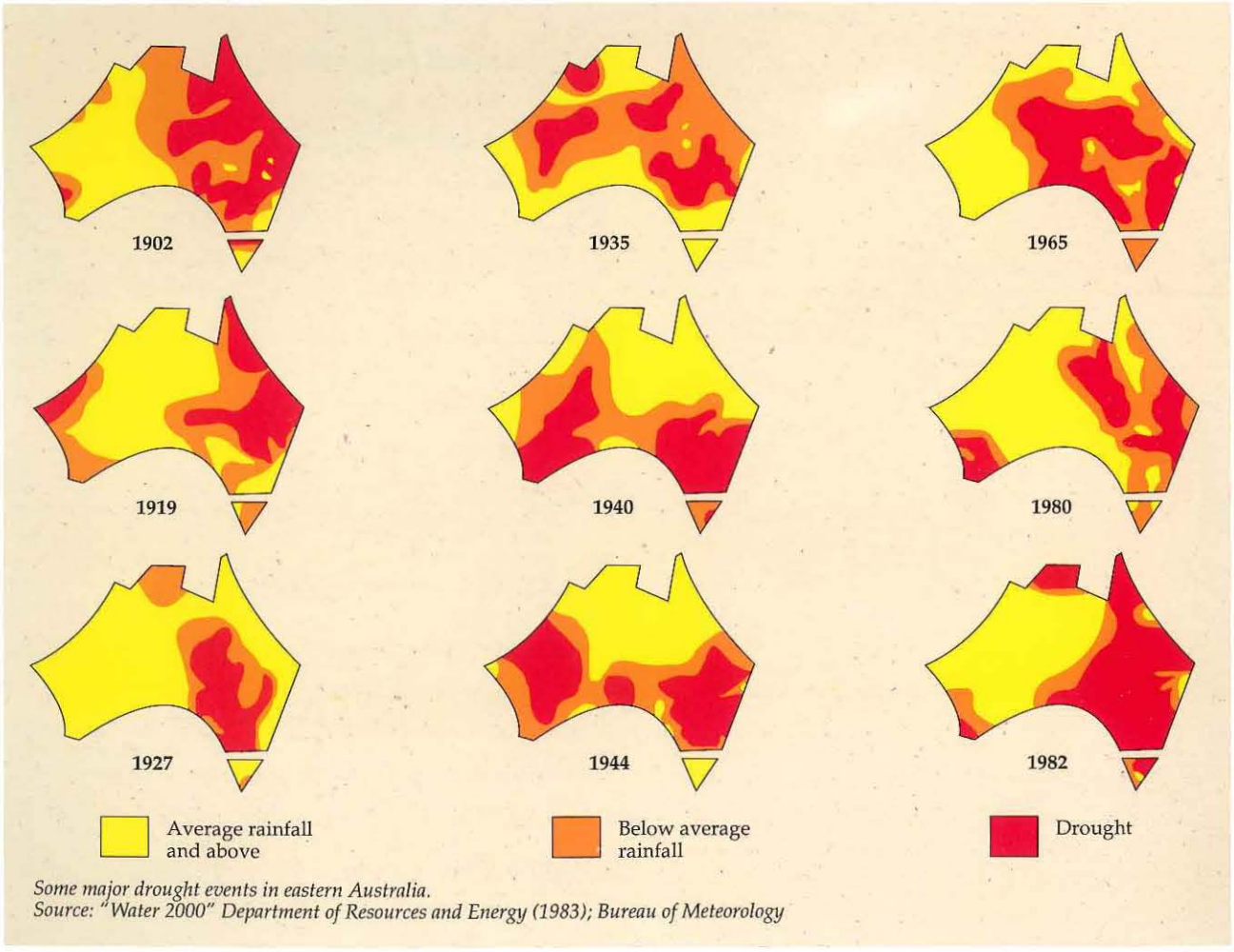
Drought has always been difficult to define, since it means many different things to different people. There are meteorological droughts, feed droughts and water droughts, and the one event can affect different managers or land uses differently.

The practical problems of defining a drought are that:

- we don't know when it starts, and
- we don't know how long it will last.

In effect, drought is one of the risks involved in carrying out a commercial business in a variable and largely unpredictable climate. No two droughts are the same and responses to them need to differ because the nature, extent and degree of the risks are changing constantly.

This means that to best cope with drought, management must be closely attuned to climatic conditions, land resource condition, financial and forage reserves, the financial status of the enterprise, and prevailing economic conditions.




*Some major drought events in eastern Australia.*
*Source: "Water 2000" Department of Resources and Energy (1983); Bureau of Meteorology*

## *Frequency of Drought in NSW*

Drought frequency, or expectation, is difficult to measure because of the various definitions of drought. For example a 3 month period of lower than usual rainfall on the North Coast would be regarded as serious, whereas a similar occurrence in the Western Division would be regarded as little more than a dry spell.

While the most widespread droughts in NSW occurred in 1901–2, 1928, 1944–47, 1965–67, 1982–83 and 1991, there have been many others which have had just as severe effects but in more localised areas.

Based on past records, it is expected that across Australia in a 100-year period:

- 21 years are likely to be free of major droughts;
- 62 years will have a drought which covers less than 20 per cent of the continent;
- 15 years will have a drought covering 20 to 40 per cent of the continent; and
- 2 years will have a drought covering more than 40 per cent of the continent.

In the years between 1967 and 1986 the average percentages of months drought declared for Rural Lands Protection Board Districts within general zones in NSW were:

| | Average | Range |
|---|---|---|
| Western Division | 32 | 25–38 |
| Slopes and Plains | 22 | 8–30 |
| Tablelands | 19 | 4–45 |
| Coast | 13 | 2–25 |

Only five Coastal Rural Lands Protection Board Districts (of a total of fifty–eight) were not drought declared during the latter stages of the 1982–83 drought, and all Districts were declared for at least 3 months during 1980–81. Various Districts in the Western Division were wholly or partly drought declared for 3 months or longer in from 13 up to 23 of the 30 years to 1986.

These figures give some idea of the return period of droughts, but not the severity. These may have been for many short periods, a few very long periods or combinations of short and long ones. Figures for individual Districts should be available from local Rural Lands Protection Board offices: these give a more accurate local picture.

The amount of planning one does for drought will be determined by local expectations. The greater the risk of drought, the more planning will be necessary for economic survival and resource protection.

## *Effects of Drought*

Drought is a time of crisis, for the land, its animals and its people. It is the critical testing time for sustainability of land management systems and will often determine whether the enterprise will survive and whether the productivity of the land on which it depends will be maintained. This crisis can be averted or diminished with careful planning and management.

The effects of drought are well known to us all, at individual, community, regional and national scales. There is a loss of production, a financial loss to the landholder, and deterioration of the environment, both temporary and permanent.

Crop and pasture yields are reduced, livestock numbers decrease, perennial and palatable plants may be replaced after the drought by less useful species, wind erosion occurs, water runs off the bare ground, and water supplies are threatened by siltation and fouling.

The individual landholder suffers a marked loss of income and this in turn affects the viability and social well-being of the local community. A lengthy drought can eventually lead to a reduction in the number of landholders in a district.

### Economics

The Australian economy is heavily dependent on the agricultural sector and as such is vulnerable to the effects of drought. It is estimated that the 1982–83 drought affected 60 per cent of the nation's agricultural and pastoral properties. The national wheat harvest in that period was only 57 per cent of the average of the previous four years. (Many producers harvested nothing!) Production of irrigated crops also fell, cotton by 25 per cent and rice by 39 per cent. Sheep numbers fell by 5 million and cattle by 2 million.

In 1982–83 farm incomes are estimated to have fallen by 23 per cent, around 100,000 jobs were lost and rural export income fell by $500 million. Lost rural production was estimated at $2,500 million, and flow-on effects (through rural businesses, food processing, etc.) put the total cost up to about $7,500 million.

*Drought is a significant time for soil loss in otherwise relatively stable areas. Soil blowing from a fallow in the Central West, February 1983.*

## Land

It is during times of climatic stress, whether drought, floods, abnormally heavy rains or fires, that greatest natural pressure is put on the land and its basic components, the soil and vegetation. Types of land use and land management systems, which can be carried out satisfactorily in good or normal times, may become out of phase with the prevailing climatic conditions when the season turns dry unless major modifications are made.

If these changes do not take place significant and often long-term damage to land and reduction of its ongoing productivity can occur.

For example, 90 per cent of soil loss at six Soil Conservation Research Centres in NSW over a period of 30 years came from only 10 per cent of runoff events, and these events were almost entirely confined to periods when groundcover was below 50 per cent. Although erosion is very episodic, the consequences remain and affect productivity and land management for a long time afterwards.

When drought, overgrazing or finely cultivated crop fallows expose bare ground, runoff after small storms or at the breaking of a drought is increased because of lack of interception by plants and litter. Soil loss is increased by detachment of particles from the bare surface by raindrops, and removal by the increased runoff. Some of the eroded soil ends up as silt in farm dams, reducing their storage capacity.

Similarly, wind is able to remove soil particles from a bare surface, which in normal times would be protected by pasture, crop or stubble. In many parts of the State significant wind erosion only occurs in severe droughts, perhaps only one year in 20 or 30 or even longer. (However, in some parts of the State wind erosion may occur nearly every summer in bare fallowed cropping lands and in pastoral lands where perennial pastures have been lost).

Of course, some soil types are more erodible than others and therefore show different levels of resistance to erosion during drought. Sandier soils are most prone to wind erosion, and loamy soils to water erosion. When topsoil is lost, it takes with it the best part of the soil for plant growth, including nutrients, organic matter, fertiliser and seeds. Often the exposed soil remaining has a much lower water infiltration rate, so subsequent runoff increases and the amount of soil water available for plant growth is reduced. Reduced nutrient levels also decrease subsequent plant growth.

*Drought-breaking rains on bare cultivated soils can have drastic and long-lasting effects. On this paddock near Condobolin the entire cultivated layer has been removed in one storm.*

*Wind tunnel studies in south–western NSW have provided some figures on the loss of plant nutrients that can occur during wind erosion. The amounts vary according to how much soil is lost and the amount of nutrients originally present in the soil.*

*In a 75 km per hour wind the nutrients removed from 1 hectare of a paddock as dust in just 1 minute were up to*

| | |
|---|---|
| *0.40 kg* | *total nitrogen* |
| *2.80 kg* | *total phosphorus* |
| *0.26 kg* | *available phosphorus* |
| *8.40 kg* | *organic carbon* |

*The cost of replacing the nitrogen lost in one minute varies from $0.10 per hectare on less erodible soils to $0.70 per hectare on sandy soils. In practice, the organic matter can only be replaced by subsequent crops or pastures.*

*The losses from soil exposed to drought and disturbed by stock for many weeks or even months can be seen to be significant in terms of lost productivity and cost of restoration.*

Unless quickly resown, such areas are often colonised by weeds, such as fireweed, thistles, capeweed, docks, cockspur, Patersons curse, roly-poly, galvanised burr, sifton bush, and many others, which thrive on the lack of competition. These may be very difficult to dislodge and replace with more desirable plants.

Recovery of pastures after drought depends on what seeds, grass butts or other perennial plants are left and at what time of year drought-breaking rains occur. Increase in soil nitrogen usually occurs due to microbial activity when drought breaks, so a flush of pasture growth normally follows. However, pasture composition may be very different to that prevailing before the drought.

In the cooler months of the year annual plants can usually become established more quickly than the seedlings of perennials, and of these annuals the weed species often get the upper hand and become dominant.

These plants will stay in the pasture until they are removed (by spraying, cultivation, grazing, competition) or die out.

A lot of the differences evident between grazing paddocks are the results of grazing management and relate to how well weeds and desirable pasture species recover from drought or other severe defoliation. Weed seeds may be introduced with imported forage, to flourish and spread after the drought breaks.

Damage to, or even loss of, perennial pasture components can be severe, long lasting results of drought, especially in those areas which depend on native pastures.

Loss of perennials can have significant effects on ongoing productivity, since pasture species diversity is reduced, ability of the pasture to respond to rainfall at certain times of the year is reduced and the feed cycle is interrupted.

Furthermore, perennial plants play a critical role in protecting the soil from wind and water erosion, and breaking up wind flow which might otherwise blow away plant seeds and litter. Many perennial plants can be grazed heavily yet remain alive unless they are repeatedly defoliated or eaten "into the ground". Even when butts appear dead they provide some protection, and many are able to reshoot once adequate rain falls.

If an adequate supply of seed is available then a perennial species can re-establish at some stage after the drought. But if a large proportion of plants die and seedling re-establishment does not take place due to lack of seed supply, grazing or a "false break", then the species will decline. This is less critical, of course, where pasture can be resown, but this costs money and for some species and areas successful resowing remains a difficult exercise.

*Dust and drift from a cultivation paddock near Balranald, February 1983. Plant nutrients are lost as fine dust while sand accumulates against trees and fences.*

Another valuable role of a vigorous grass pasture is competition with establishing woody weeds, which present huge problems in parts of the Western Division of NSW, and in some areas along the Tablelands and Slopes. Bare ground and lack of competition after drought and over-grazing have been linked to major invasion events of woody weeds in all these areas.

Many improved pastures have a low perennial grass component or have no grass at all. These pastures stand up very poorly in drought and may not adequately protect soil from erosion.

## Animals

Drought can be a time of severe stress to domestic, native and feral animals, as food sources decline in both quantity and quality (or disappear), and water may run out.

While domestic stock can be kept alive by supplementary feeding, carting water, or agistment, rarely can their nutritional status be maintained at full production level. As a result, weight gains, wool production, and reproduction are reduced, susceptibility to certain diseases and to predators is increased, and stress or mortality occur when cold wet weather follows drought. From an animal welfare point of view stock may suffer in the paddock, or while being driven or transported if their condition is very poor.

Reduction in stock numbers also usually occurs, by sale, slaughter or death, and this affects future levels of flock or herd production until numbers can be rebuilt. It can also interrupt breeding programs and optimal flock/herd structure.

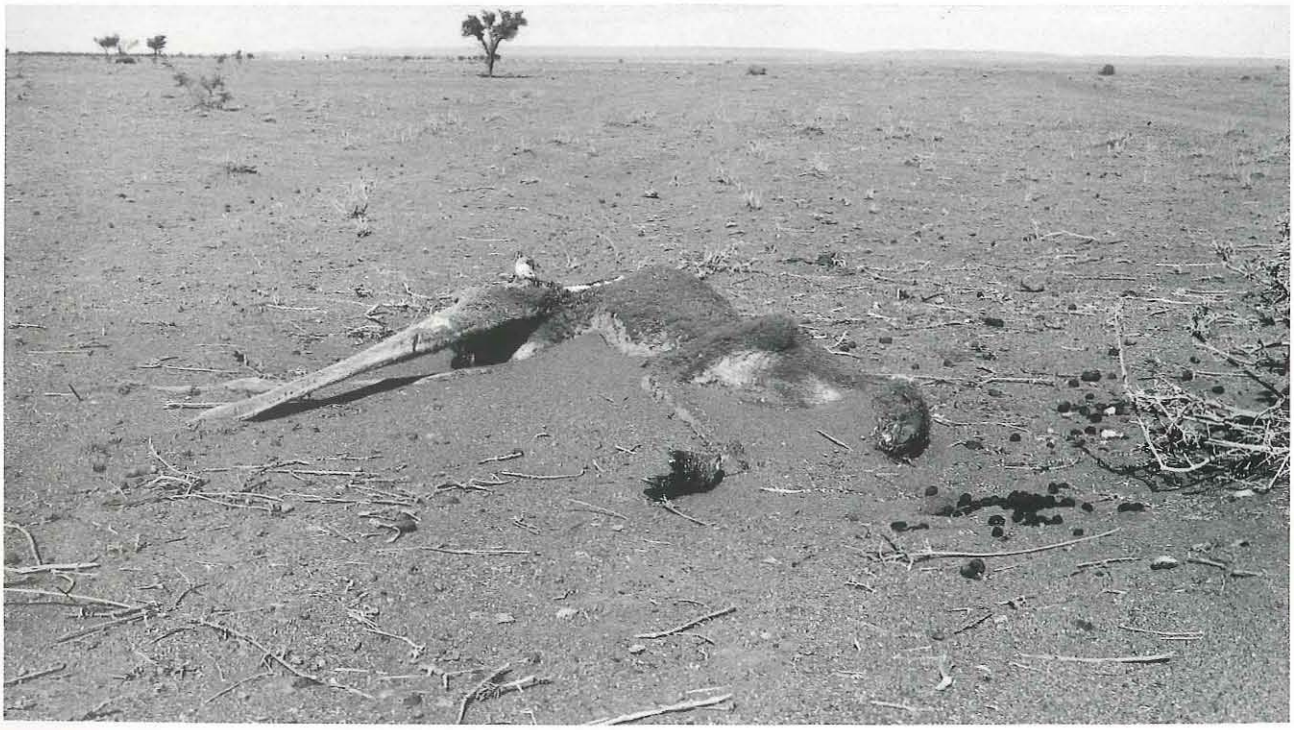
Native and feral animals, whilst making use of man-made water supplies and pastures, fare worse since no supplementary feeding is available. There is competition for feed from domestic stock, and they become more exposed to predators. Large scale deaths of these animals have often been recorded, the most obvious being kangaroos in western NSW, emus in Western Australia, and rabbits. A great many small, lesser known, native animals also suffer badly. While reductions in feral animal numbers under these conditions are beneficial to man, the animals place a huge stress on the land resource as they battle to survive.

*Serious stock and pasture loss in the Gilgandra—Collie district, August 1966. Perennial pastures have been eaten into the ground and may not recover.*

Paddocks may be eaten out by kangaroos even when domestic stock have been totally removed to save pasture.

Feral animals respond very quickly to improved seasonal conditions, and young palatable plants and new growth on shrubs and trees are subjected to intense grazing pressure after drought breaks. This uncontrolled grazing may put at risk the survival of these new plants.

*Drought takes toll of pastures, the soil and then the animals.*



*Wind erosion occurs on bare fallows, even on this well-structured soil in the Gunnedah area.*

## *Lessons from the 1982–83 Drought*

*The Soil Conservation Service carried out two surveys of management practices used by landholders during the 1982–83 drought, and of the effects of those practices on land condition.*

*The first involved completion of a detailed questionnaire by landholders in the Tablelands, Slopes and near Western Plains, and the second a statewide reconnaissance survey by district officers. Among other things, the following were noted:*

- *erosion was less severe in paddocks with more than one watering point*
- *conservation tillage and stubble retention reduced wind and water erosion and runoff*
- *denuding land by continued stocking was a major contributor to soil loss: reduced stocking was a great benefit*
- *wind erosion was generally first apparent on cultivated paddocks and then occurred on grazing paddocks as drought worsened*
- *rough ploughing or deep ripping reduced erosion, particularly wind erosion*
- *native pastures generally survived better than improved pastures*
- *deep-rooted crops (such as lucerne) persisted extremely well*
- *wind erosion occurred on open ridge-top sheep camps*
- *runoff from bare slopes polluted water supplies with sediment, litter and manure*
- *water erosion was more common on properties stocked with sheep than with cattle.*

## Planning

The main objective in a drought is survival of soil, grasses, animals and farm businesses. The basis for that survival is planning by the individual.

Only individual land managers can foresee the problems of drought as they affect their enterprises, and act in time. Stock prices, the size of the area affected by drought, the time of year, future seasonal patterns, the price of feed supplements, land stability, and agistment options all vary from place to place and from time to time. Plans have to be tailored to meet the requirements dictated by local circumstances.

It is essential to have a broad plan in place that defines the path to be followed, yet has sufficient flexibility to respond to changing seasonal, resource and economic conditions.

A survey in the New England region after the 1979–81 drought indicated that the more successful land managers:

- had a pre-prepared drought plan
- had a confident, positive attitude and an open mind
- regularly assessed a broad range of alternative strategies, feeding, marketing and investment options
- acted promptly and decisively, with attention to detail
- were market oriented.

The rationale for the many elements of drought management follows. More specific guidelines for the main production zones of NSW are given later.

More detailed information on many aspects of drought management can be found in the publications listed at the end.

## *Financial Lessons from the 1965–67 Drought*

*Lessons which emerged back in the 1965–67 drought included:*

*Landholders who enter into heavy commitments for the purchase of property and/or development within a few years of the onset of drought are in a vulnerable position. In addition to other losses, they can face the loss of the benefits of funds already spent (improved pastures for example) and the necessity to spend further funds on rehabilitation.*

*To successfully negotiate a prolonged drought a landholder must commence with a good equity—in other words he must not be over-committed. A good equity gives him a margin within which he can plan his drought strategy and/or plans to restock.*

*When it is realised that a drought will probably be experienced an early decision whether to feed or sell stock is essential. In any event aged and cull stock which would not be expected to survive should be sold. Those who retain stock in the hope that the season will break run a very high risk of heavy financial loss.*

*Associated with the decision to sell or feed should be an assessment of the length of time during which the landholder can cope with the effects of drought. This decision should be based on a careful consideration of:*

*Water supply—what water is available to maintain stock?*

*Feed availability and price. If there has been no conservation of feed supplies the type of feed and/or agistment available and the cost should be known.*

*Overall financial position—this involves an assessment of the cash and/or borrowing resources available. Where sufficient finance is available for agistment and/or purchase of feed, an estimate is required of how long financial resources will last.*

*Having fully assessed his position the landholder should then determine whether it is reasonable to assume that the drought will break during the time in which he considers he can carry on. It is obvious that the shorter the assessed "carry on" period the less risk a landholder can take and the earlier he should sell his stock.*

*A good land manager, both in physical management and ability to assess and control his financial position, will fare better under any conditions—but particularly under drought conditions.*

*Even a sound equity and the best of decision-making will not save some landholders from becoming drought casualties. This is so where holdings in normal seasons only supply a living with little capacity to service debts or set aside reserves to meet adversities.*

*In particular cases it may be possible to enhance the prospects of successful rehabilitation by a change in land use: for instance a change from grazing to a combined grazing/cropping enterprise.*

*Source: Lessons from the 1979–81 Drought. Society of Animal Production (1981)*

Not all aspects of drought are bad—it can lead to opportunities for making money from enterprises such as lotfeeding, and this experience can be used to advantage in normal seasons. Other opportunities could include:

- buying land instead of feed
- replacing older animals with younger ones
- changing proportion of stock types (i.e., cattle, sheep, goats)
- changing breeds.

While both the State and Federal Governments may provide some assistance to prepare for and manage through droughts, landholders are encouraged to be self-reliant by managing for the risks of farming associated with climatic variability. The majority of landholders already do this, but prolonged severe drought may tax resources beyond the capacity of individuals on a commercial basis.

### Preparing for drought is good land management.

There are many aids and guidelines available to assist in formulating a drought management strategy and in determining the various management options. Most of these aids are used in all kinds of seasons, and allow some level of prediction of future events and economic conditions. They are the tools good managers will use on an ongoing basis.

## *Weather Forecasting*

The value of reliable climate prediction services to landholders would be obvious, for the short, medium and longer term. For farm management, the short and medium terms (up to 6 months ahead) are most relevant.

The reliability of any forecasts can be questioned at the present time, but land managers can use them together with their own experience in their decision-making. The Bureau of Meteorology provides a wide range of weather forecasting services. A number of private services may cater more specifically to individuals' needs. The choice and use of these different services is a personal judgement.

The Bureau commenced a Seasonal Climate Outlook service in 1989. It operates from June to November inclusive and provides an estimate of the rainfall expected over the coming three months for selected areas of eastern Australia. The estimates are comparisons with long-term averages. These outlooks are published in the media, and a more detailed monthly publication can be purchased by subscription.

Considerable research is going on to improve both the understanding of weather patterns and the accuracy of forecasting.

*The Seasonal Climate Outlook is based on a strong correlation that exists between seasonal rainfall patterns over eastern and northern Australia and the Southern Oscillation Index (SOI).*

*Anomalies in the SOI are the most important single cause of extreme climatic variability in this area from late autumn to early summer and account for 20–50 per cent of rainfall variation over this period, depending on location and season.*

*The SOI in turn is affected to some degree by ocean circulation anomalies in the Pacific Ocean (El Nino events). Several research institutions are attempting to better predict these anomalies to further improve the forecasting of seasonal rainfall patterns.*

## *Decision Support Systems*

Decision support systems can collate large amounts of real data with predicted or estimated climatic and financial situations to help determine options for ongoing farm management, including options for drought management.

Many such systems have been produced already, but are in various stages of commercial availability and ease of use. Some are applicable only to certain geographic areas, some are only suitable for research purposes. They are expected to become much more available and should be of invaluable assistance to landholders developing drought management strategies.

An example of what one such system can produce is given on page 32, 'Determining Options'.

## *Farm Planning*

Development of strategies for farm management, including drought management, is best based on a whole farm plan, which identifies different land types, location of shelter-belts, areas of erodible soils, degraded areas which need attention, harbours for pests, etc. as well as fences, watering points and other infrastructure.

The plan can be used to locate:

- areas which should be destocked first
- areas with drought-resistant pastures
- areas where stock can be fed without damaging the land resource and at the same time be sheltered from winds and predators
- priority areas for pest control
- areas where additional fencing, water or trees are required
- areas where pasture or groundcover need improving
- areas which could be managed to help wildlife survive.

Farm planning services and assistance are available from the Department of Conservation and Land Management and a number of private organisations.

## *Groundcover Management*

Groundcover management must be a key element of farm management and becomes critical in times of drought for several reasons. Besides producing feed, groundcover is important in both cropping and grazing lands to:

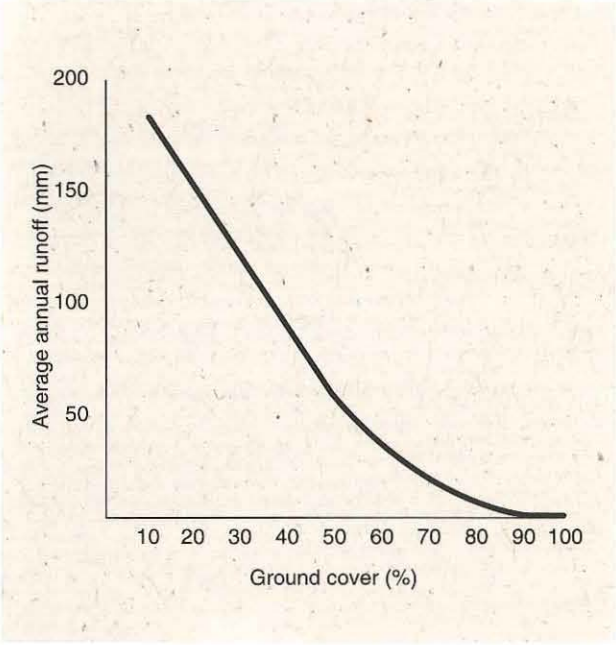
- protect the soil from erosion and breakdown of the surface structure
- increase infiltration of water into the soil
- produce organic matter and turnover soil nutrients
- stop seeds, nutrients and organic matter from blowing or washing away
- protect seeds and small establishing seedlings.

A minimum cover should be aimed for on a year round basis, to protect the soil during the periods of greatest erosion hazard.

The Soil Conservation Service has determined minimum cover levels or weights of ground vegetation necessary to minimise soil erosion rates for water and wind. For open sloping grazing lands in the east of the State this minimum cover level is about 70 per cent (see graph), and for flatter grazing lands on the Plains this gradually decreases to about 40 per cent. In Western Rangelands, because cover is not continuous even in good seasons, a pasture weight of about 200–300 kg/ha is suggested as the stage at which stock should be removed, to maintain soil protection and relieve pressure on perennial pasture species.

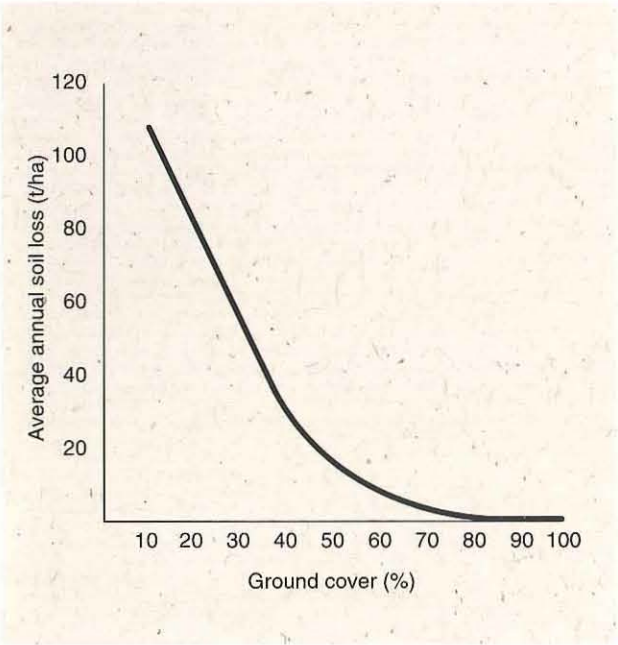
Soil loss has a serious long-term effect on future productivity. High runoff not only produces soil loss but also markedly reduces the water available for pasture or crop growth.

In grazing lands, the cover should consist of a range of desirable plants for optimum productivity in all seasons, containing some species that can respond to rainfall whenever it may fall.



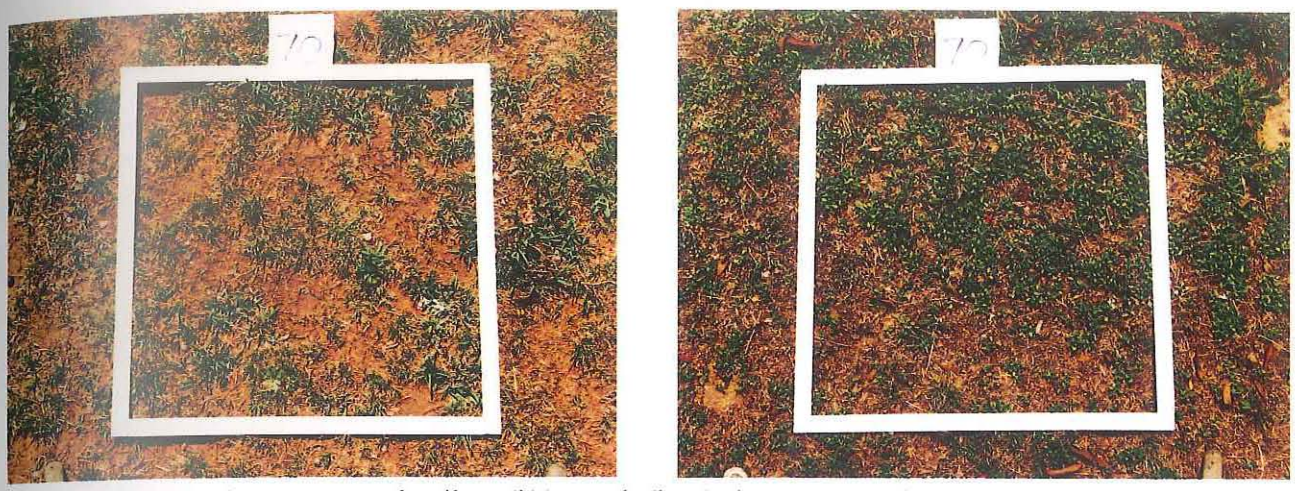

*Average annual runoff versus ground cover at Scone, NSW for the period 1981–88.*

*Sheltered paddocks are required for confined feeding of stock during drought and post-drought periods.*




*Average annual soil loss versus ground cover at Scone, NSW for the period 1981–88.*

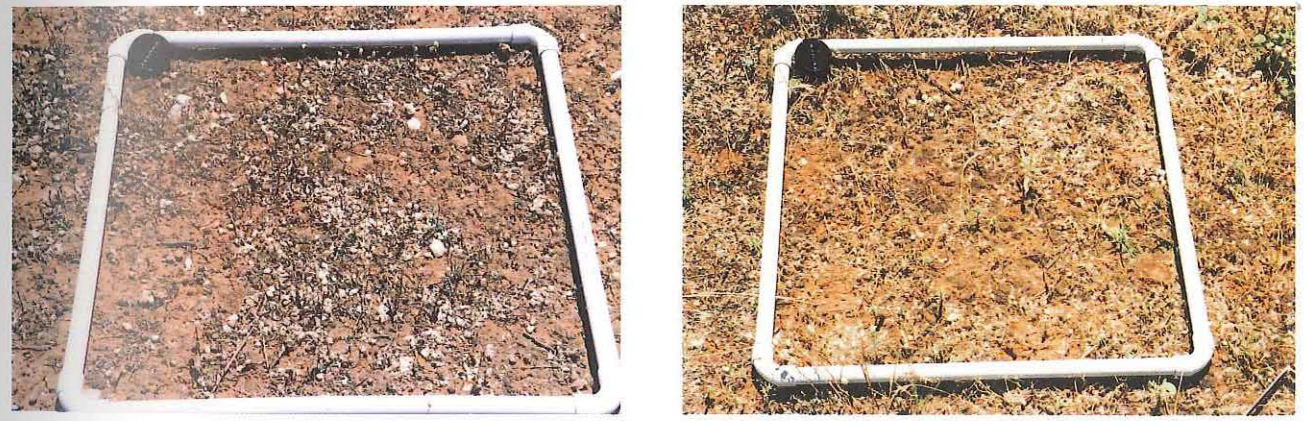
*The level of groundcover we carry into a drought will have a vital effect on how the land fares. The more cover we start with, the longer the ground will be protected and the longer can stock be maintained.*



*Once groundcover falls below 70 per cent patches of bare soil join up and soil erosion by water increases dramatically. In the Goulburn district 70 per cent cover levels for native pasture (left) and semi-improved pasture (right).*

Perennials are regarded as the "backbone" of pasture for a range of reasons: they persist, protect other plants, can often respond to rain when annual plants can't, generally produce feed for longer into dry periods, and provide competition for establishing weeds and poor quality annual grasses. While clovers and superphosphate give short-term productivity gains on the Tablelands, for long-term stability a perennial grass needs to be introduced to fully utilise the soil nitrogen that is generated.

Periodic spelling of paddocks following spring/summer rainfall in the north or autumn/winter rains in the south will improve seedling establishment of perennial grasses. The resulting build-up of feed can be used as a drought reserve or, if needed, as fuel to carry a management burn to control woody weeds.



*These pictures show about 200kg/ha or about 30 per cent cover of vegetation, barely enough to protect the soil from water and wind erosion on fairly level loamy soils near Mt. Hope. Sandier soils require more than this.*

*Minimum stubble levels for wind erosion control 600kg/ha for clay loam soils, (left), 1200kg/ha for sandy loam soils, (centre), and 2500kg/ha for sandy soils. (right).*

Cover levels for adequate protection of cropping country are shown below. Higher rates would be required on steep country not protected by contour banks or for crops with finer stubbles.

| Erosion Type | Soil Type | Minimum Amount of Standing Wheat Stubble Required to Protect Soil from Erosion (t/ha) |
|---|---|---|
| Water | Sand | 0.5 |
| | Clay loam | 0.8 |
| | Clay | 1.0 |
| Wind | Sand | 1.0* |
| | Clay loam | 0.5* |
| | Granulated clay | 0.8* |

**For flattened stubble these figures should be doubled.*

## *Stocking Rate*

In grazing country, the prevailing stocking rate will largely determine the amount of groundcover and feed reserves that are taken into drought. This will determine how long stock can be sustained with or without supplementary feeding and how well and for how long the soil will be protected.

The heavily stocked property will suffer the effects of drought long before a neighbouring lightly stocked property and will take longer to recover after the drought breaks.

Lightly stocked properties will not suffer as badly as heavily stocked properties. The cost of protection from drought is the reduced income in good years compared to properties with higher stocking rates.

It is very important that pasture budgeting be carried out continuously so that pasture availability is known for some period ahead and planning can be put in place to cope with the worst climate situation that may arise.

Maintaining a stocking rate below the maximum possible has four important implications for carrying capacity in drought periods:

- it overcomes the effects of short dry spells which may force the landholder to unload, feed or lose livestock if a higher stocking rate policy had been followed;
- by having more feed available than needed during good seasons, the landholder can conserve fodder for use during periods of severe feed shortages;
- understocking during good seasons makes animals physically better prepared to meet severe feed shortages and more dry feed is available for them; and
- areas adjoining the drought-stricken area can make their unused margin of feed production available for agistment or can purchase additional stock.

However, a heavily stocked property does not necessarily mean poor drought preparedness. But a conscious and decisive destocking and/or supplementary feeding strategy must be employed at the appropriate times, to maintain protective groundcover and to prevent destruction of the pasture. This may involve confined feeding, sale or agistment of stock, and will normally require some form of financial capacity to fund these activities and any subsequent stock purchases, pasture resowing etc.

The stocking rate strategy adopted will be a matter of individual preference, the expected frequency of poor seasons, the type of country, the resilience of the pasture, the average returns, and the attitude to risks associated with high stocking rates. The higher stocking rate strategy requires greater management skills if the cycle of seasonal conditions is to be adequately met, involves more labour, and results in higher variability of income.

## *Grazing and Soils*

*Most damage to the soil occurs following excessive grazing for long periods and basal cover (cover of grass butts) of the pasture declines or when perennials are absent. Minimal replenishment of soil nutrients follows because little or no plant material remains to decompose and release nutrients and organic nourishment to the surface soil. Raindrop impact and crust formation increase. With time these soil surfaces become biologically inactive and bare areas increase.*

*Infiltration of rainwater into the soil is reduced, and this, together with a bare surface highly susceptible to abrasion by soil particles carried by the wind, is unhelpful to establishment of new plants. As these bare areas join up and expand, runoff and soil erosion rates increase markedly. Only in years of exceptional rainfall—and usually a sequence of them —do they contract.*

*A survey in the Southern Tablelands has shown that sediment yield from pastures which had been heavily grazed for 30 years was 27 times the natural rate and 10 times the rate of well-managed native pasture.*

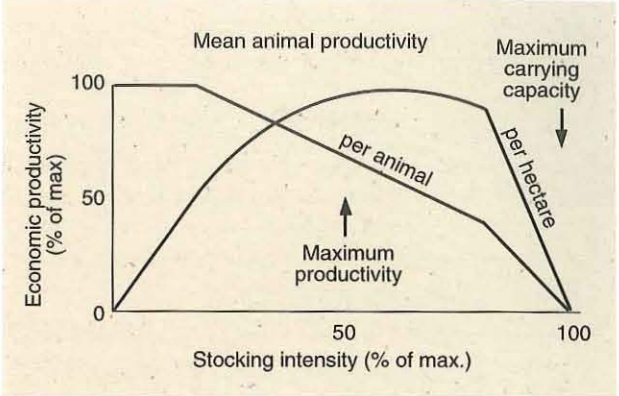
While acknowledging that the high stocking rate strategy can be successfully managed, the Department of Conservation and Land Management, NSW Agriculture and the Department of Primary Industry in Queensland all encourage lighter stocking rates which maintain or improve long-term productivity by placing less stress on pastures and land. This is particularly the case in lower rainfall areas and other areas where pastures are based on native species which are difficult to replace.

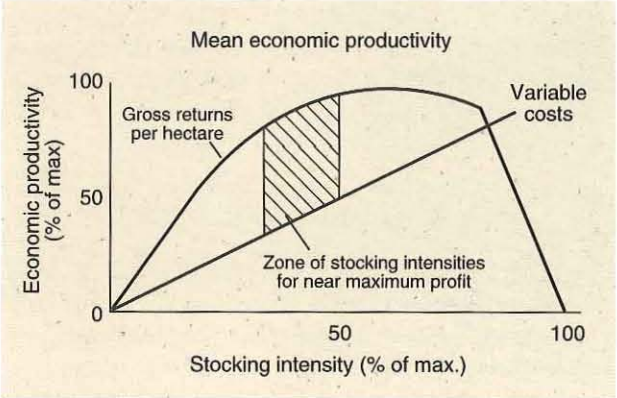
By reducing sheep numbers, for example, management costs are reduced, variation in stock numbers can be reduced and wool production per head increased. The lower stress on pasture improves its productivity, maintains soil cover, and therefore provides better protection against soil erosion.

Maximum profit is achieved at well below maximum stocking rates, as the graphs show. Nutritional stress increases the risk of "breaks" and tender wool. Deliberate stressing of stock to fine up the clip is strongly discouraged.

Maximum total productivity (or total gain in animal products) occurs at a stocking rate approximately half the maximum number of animals that can be carried. At lower stocking intensities, total production is depressed by the low number of animals. At higher rates it is depressed by the poorer performance of individual animals.

In the short term, the maximum profit occurs at the stocking intensity where the margin between gross returns and variable costs is greatest. There is usually a zone within which small changes in stocking intensity do not have a significant effect on profitability. This zone of maximum profit always occurs at stocking intensities that are lower than those for maximum biological productivity.




*Theoretical Relationships between Animal Production and Stocking Intensity, and between Economic Productivity and Stocking Intensity. Source: Management of Australia's Rangelands G. N. Harrington, et al. (1984)*

Several landholders on native pasture country have shown that by stocking conservatively net income per hectare is maximised and annual wool cut is almost independent of rainfall.

The higher income was due to higher wool production per sheep, and to higher stock sale returns due to better lambing and stock condition.

*Lighter stocking rates enable more cover and feed, and more vigorous pasture plants to be taken into a drought. Humula district, in the Riverina.*

## *Grazing and Pasture*

*When the number of stock grazed on a pasture is excessive, the pasture is affected in four ways:*

- *its ability to regenerate from seed is reduced because flowers and seedheads are eaten, often preferentially.*
- *its ability to regenerate from new shoots is reduced because these are eaten as they appear and the number of new growing points is limited.*
- *its ability to regenerate from seedlings is reduced because seedlings which emerge following rain are rapidly consumed.*
- *larger grass tussocks are replaced by smaller, less vigorous plants. Frequent close grazing of plants leads to reduced vigour and their eventual death as reserves of energy are used up.*

## *Fodder Conservation*

Conservation of fodder is a key element of the drought preparation strategy and is practised by a large proportion of land managers.

The extent to which fodder is stored will depend on stocking rates, paddock feed supplies, expected frequency of drought, attitude to risk and financial cost/benefits of storage, as compared to purchase when needed and to sale or agistment of stock.

Fodder may be produced on-farm or purchased, and may be stored as grain, hay, silage, or as "living haystacks" in the form of saved pastures, drought-resistant crops or pastures (such as saltbushes, and tagasaste) or native fodder trees (such as kurrajong, wilga and mulga). Some tree fodders require supplementation by high protein, energy, vitamin, or other additives, which usually need to be purchased.

In many parts of the State, supplementary feeding is a common practice at certain times of the year when paddock feed does not grow, or in short dry spells. Generally fodder is stored for these purposes and turned over regularly.

For droughts, additional supplies are obviously needed, and may be of a different kind (e.g. to provide survival rather than supplementary rations). Such feed will be used less regularly and its quality must be maintained in storage.

In determining a fodder storage strategy the land manager must consider the type and number of animals to be fed, the amount needed, the composition, the costs of various types of fodder and the frequency of feeding. The higher the stocking rate carried in normal seasons, the less surplus fodder is available for conservation but the greater is the need for survival feeding if drought occurs.

*Balanced pastures with grasses and annuals, and conservative stocking rates are good insurance for drought periods. Manilla district, 1988.*

*Silage is one form of fodder conservation that can be used effectively during drought times, particularly in coastal areas. (Photograph Alex Ashwood)*

There are financial incentives for some types of fodder conservation through taxation deductions for construction of storage facilities or sheds.

Detailed information on fodder conservation can be obtained from NSW Agriculture and a number of Agfacts (see list at end).

## *Water Conservation*

Adequate water supplies are essential for stock production and good land management. Watering points should be located to allow all parts of paddocks to be evenly accessed by stock, to avoid concentration of large numbers of stock in small areas, and should not be located on particularly erodible soil types. Experience has shown that small mobs can be carried on a watering point with only a very small sacrifice area.

The survey in the 1982–83 drought revealed that erosion was less severe in paddocks with more than one watering point.

The size of storages will depend on stock numbers carried, evaporation rates (for dams), the type of stock being run, the type of pastures (more water is needed by stock on saltbush pastures), the quality (salt content) of the water, and the frequency of runoff producing rains. The water needs of animals must be allowed for in drought times and when feeding in confined areas.

Fencing of waters is encouraged, to keep stock out and prevent bogging when water levels fall and stock are in poor condition. Closing of waters may also help reduce pest animal pressure on paddocks that are being saved for drought feed or some other reason.

It is sound management to have backup water supplies for short-and long-term horticultural crops, even if they can usually be grown under natural rainfall. Planting a short-term crop, such as vegetables, can be cancelled if conditions are dry and inadequate water is available. Otherwise planting should be confined to areas in the vicinity of a water supply which is sufficient for critical crop growth stages.

Taxation deductions, over a period of 3 years, are available for construction and improvement of farm water supplies. Technical and economic advice on siting, design, construction of dams, on equipping of bores, and on designs of pumping and reticulation systems is available from the Department of Conservation and Land Management.

## *Conservation Tillage*

Delaying the onset of cultivation and decreasing the frequency of tillage for crop establishment allows delaying the decision of whether or not to sow a crop in a dry season. This provides greater management flexibility and soil protection in cropping areas.

Direct drilling or no-till (allowing pasture to grow almost up to the sowing day) would be the optimum strategies for this purpose in many parts of the State. Even where fallowing is regarded necessary, cultivation can be reduced to a minimum and a vegetative cover of crop or pasture residues kept as soil surface protection. Weeds can be controlled by herbicides and, to some extent, stock. In this way a planting decision can still be aborted if the season turns dry. In the traditional wheat-growing system a fallow was opened and kept cultivated to control weeds. By sowing time the soil was bare and in a finely cultivated state.

Failure of rain in the late stages of fallow or at sowing time left this soil exposed to wind and water erosion, and of course growing no feed for stock. The paddock could suffer severely from erosion and a crop of some kind would have to be sown as soon as possible to provide some cover. If this was sown on what turned out to be a "false break" then the crop would fail or be very low yielding. Retention of some surface cover (pasture or stubble) would remove both the need for and the cost of sowing, and at the same time protect the soil surface.

Like lighter stocking rates, conservation farming is a form of ongoing management which provides better resistance to the effects of drought at little or no extra cost compared to other more exploitative strategies.

*Good water supplies and protection of land from soil erosion will allow production longer into drought.*

*Keeping stubble or pasture on the surface for as late as possible before sowing the next crop increases sowing options if the seasonal break fails. It protects the soil through dry periods and may provide some stock feed. This is the start of a chemical fallow in the Buronga district.*

## *Erosion Control*

Soil erosion results in poorer quality crops and pastures and ultimately bare ground. This reduces overall farm productivity and leads to land that cannot produce during drought when all possible feed is required and when further significant erosion of bare soil, loss of seeds and nutrients etc. will occur.

The 1982–83 survey showed that prior erosion predisposed land to a greater risk of subsequent erosion. It was believed that this land would take a long time to recover and would require more capital to restore production levels.

**Soil erosion control should not be left until emergency situations arise – it is more effective to carry out permanent works at appropriate times.**

Priority should be given to protecting those areas which will come under particular pressure in drought times (e.g. holding paddocks, areas around water and wind-erodible paddocks). This may involve planting trees for shade, shelter and wind erosion control, constructing earthworks to control runoff, soil erosion and siltation of dams, or resting these paddocks in normal times to allow buildup of groundcover.

*Observations in the 1982–83 drought confirmed that wind erosion was first evident on cultivated paddocks and later on grazing paddocks as the drought worsened.*

Appropriate stocking rates, groundcover management, pasture composition, and conservation tillage will prevent most erosion problems from occurring in the first place.

Long-term, concessional interest loans are available to eligible landholders to carry out preventative and control soil conservation works. These loans are available through the Rural Assistance Authority and require technical certification by the Department of Conservation and Land Management.

Furthermore, expenditure on soil conservation works (and other forms of land degradation prevention and control) and fencing which separates lands of different capabilities, is fully tax deductible in the year of expenditure. This deductibility will obviously be of greater benefit if the work is carried out in high income (better season) years.

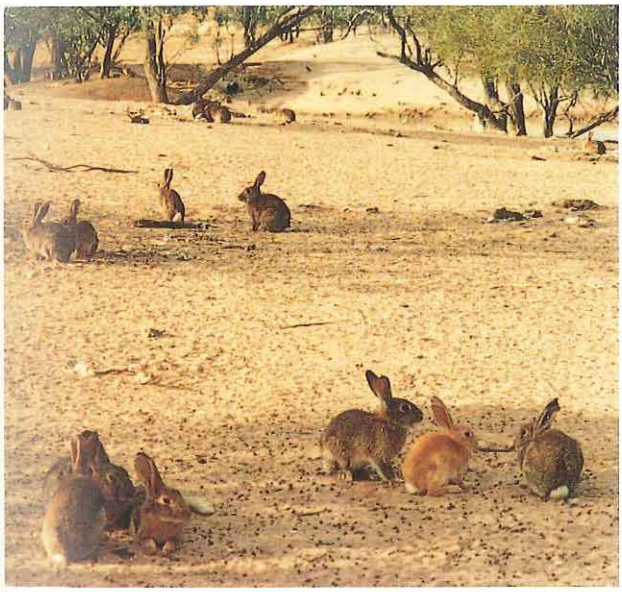
## *Control of Feral and Native Animals*

Good land managers must have control over total stocking rates on their properties if production is to be maximised and land resources protected.

High populations of feral and certain native animals can negate the positive effects of controlled stocking rates of domestic stock and of paddock spelling strategies, by competing for feed and by damaging fences and crops. Intensive grazing in small areas, such as around rabbit warrens, significantly degrades the pasture, leaving only weeds and large areas of bare soil.

Increased grazing pressure caused by these animals reduces the amount and quality of feed taken into a dry period and will lead to much earlier onset of drought conditions. As feed supply decreases the diets of these animals overlap more, so competition between feral, native and domestic animals can be severe. Ten rabbits eat about a much as a sheep, and a feral goat eats about the same amount. A kangaroo eats about two-thirds as much as a sheep.

It is important to keep feral animals, particularly rabbits and goats, to very low numbers to control this competition. The time to act is while animal numbers are relatively low, such as in dry spells and before breeding seasons. Regulations allow culling of kangaroos to reasonable levels in most areas, especially when numbers have built up after good seasons. Approval for culling should be obtained from the National Parks and Wildlife Service.



*Once rabbits are as bad as this, drought effects are apparent even in fair seasons, and carrying capacities of other animals are dramatically affected.*

## *Financial Preparation*

One of the handiest assets to take into a drought is a source of finance. This provides cash flow for living, operating and servicing debts, and increases flexibility of management options. The need is greatest in those areas where drought fodder must be purchased (rather than grown), where stock need to be purchased after the drought, and where funds are needed to plant a crop or pasture after the drought.

While State and Federal Governments may provide financial assistance during drought, the amount received is usually only a very small proportion (up to 5–10 per cent) of the total cost of operations during this period. It is important therefore to conserve finance from high income years in some form that can be used in poor years.

This might be in the form of commercial investment, short-term realizable assets, off-farm income-producing assets or employment, or sale of produce, stock or assets.

The Commonwealth Government has operated various forms of Income Equalisation Deposits (IED) since 1976 and last revised the scheme in 1989 to establish a taxation link. IEDs and income tax averaging are collectively designed to reduce the variability in income and tax payments due to the many fluctuations in income from farming. Current IED deposits are fully tax deductible in the year of deposit. Deposits become assessable for income tax purposes in the year of withdrawal, while interest payments on the principal are taxed each year.

There has been concern in some quarters that the scheme is not sufficiently attractive to land managers, particularly those who pay less than the 39 per cent marginal tax rate. Some of this concern may be due to misunderstanding of current rules.

Land managers should consult their accountants to assess their most appropriate options for financial management.

NSW Agriculture runs a Farm Cheque program which is a whole farm monitoring and management program that aims to assist land managers to:

- gain experience in assessing the financial performance of their farm
- use comparative analysis to improve their farm management
- take advantage of information and advice provided by bankers, accountants and other professionals
- improve their record-keeping skills.

There are several parts to the program, details of which are available from NSW Agriculture offices.

The NSW Rural Assistance Authority can provide information on government assistance measures to help farmers cope with drought.

Currently, drought assistance is available under the Rural Adjustment Scheme (RAS) under which emphasis is placed on individual assessment.

In the first instance RAS Part "A" is to assist eligible farmers prepare for the eventuality of drought through farm improvement, farm build-up, capital reconstruction, and financial management measures, with assistance provided by way of interest subsidies on commercial borrowings.

During drought periods emphasis is on RAS Part "B" assistance to provide interest subsidies on commercial borrowings for carry-on requirements, and finally, RAS Part "C" assistance in the form of household support and re-establishment for those who exit from agriculture in a hardship situation.

**Further information relating to the several Schemes administered by the Authority can be obtained from the NSW Rural Assistance Authority.**

Having worked out a general farm management strategy to best handle the effects of drought, the manager must develop specific strategies for stock management, land protection and crop management for dry to drought conditions.

Because no-one knows which is the first day of a drought, whether or not a current dry spell will turn into a drought, or how long a dry spell or drought will last, the land manager must continually monitor seasonal conditions, pasture and crop condition, stock numbers and condition, and market prices, and must get the best prediction as to how all these will vary in the coming weeks and months.

As soon as stock numbers, pasture availability and groundcover levels start to get out of phase then some action should be taken. **It is essential that action is taken early rather than waiting till things become serious. By then, management options are reduced, and stock losses and long-term damage to the pasture and land resource can already have occurred.**

This early action might involve minor adjustments to paddock or overall stocking rates, light culling, commencement of a low level of supplementary feeding or a decision to production feed to more quickly finish certain stock for market.

## *Stock Management*

The major drought strategies for stock management are outlined in detail in the Agfact *Drought Strategies for the Livestock Producer*, available from NSW Agriculture. These strategies are summarised in Table 1, slightly modified, from that publication. Details of how to go about implementing these strategies and a means of carrying out financial evaluation of the strategies are provided in Agfacts such as *Drought Feeding Sheep, Drought Management of Beef Cattle, Drought Feeding of Goats, Feeding Dairy Cattle during Feed Shortages and Droughts, Lotfeeding of Lambs, Agistment Guidelines, and Water Requirements for Sheep and Cattle.*

The choice of strategy will depend on a complex range of physical and financial considerations and the personal preferences of each individual land manager.

The key indicators for action should be pasture and land condition, since these usually deteriorate before stock condition. The aim should be to keep alive, or at least keep in place, a reasonable proportion of perennial grass butts, edible bushes and other perennial pasture plants so that they can regenerate after the drought and in the meantime protect the soil from wind and water erosion. If there are few or no perennials then at least a cover of dead annual plants and litter should be the aim.

In prolonged droughts these levels may be very difficult to achieve, but anything left on the surface is better than nothing.

If stocking pressure is reduced or removed the grass butts will usually survive.

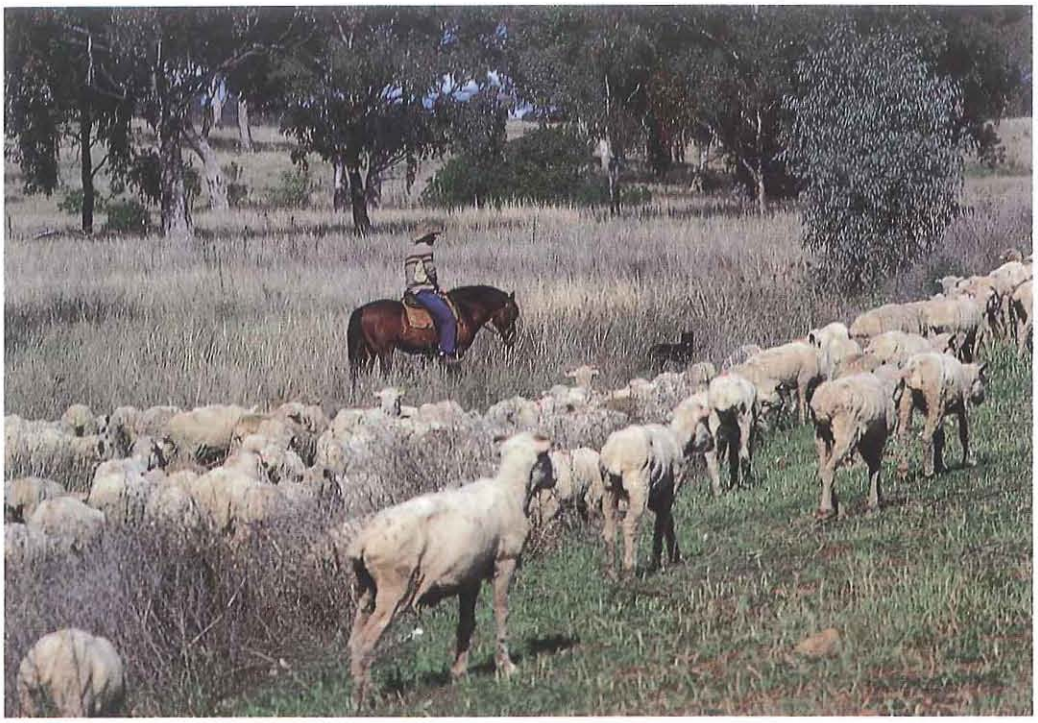
Account should be taken of the soil type, likely seed reserves of pasture species, and the ability or otherwise to re-sow a pasture that dies out. Some soils and pasture types are more resistant than others to the effects of heavy stocking and drought and this will affect how heavily they can be used. For example sandy soils and calcareous soils are most susceptible to wind erosion, while loamy soils are most susceptible to water erosion. Clays are usually less susceptible due to their better structure and because they are usually on more level ground. Sloping soils are obviously more erodible than level ones, and future production will suffer more after erosion of shallow soils than deeper soils. The soil and pasture types should have already been identified during the farm planning exercise.

*This paddock near Coonamble is reaching the stage where destocking should be carried out before cover is further reduced and grass butts are eaten into the ground.*

*This paddock near Coolabah, 1980 is past the stage where destocking is necessary, with little cover and few grass butts remaining.*

Table 1. Advantages and disadvantages of drought stock management strategies

| Strategy | Advantages | Disadvantages |
|---|---|---|
| Sell some or all stock | No cash outlay is required. Interest can be earned on proceeds of sale. Good prices are likely if stock are sold early. Damage to pastures is not severe. Improved performance of remaining stock post-drought may compensate for reduced numbers. Time is available to pursue other activities. Freight rebate may be available in Western Division. | Stock may need to be repurchased after drought (prices could be high). Income is lost because of no production. Breeding cycle may be disrupted. Stock may be sold at substantial discount if held for too long. Taxation may be affected. Genetic material is lost. |
| Production feeding | Throughput of stock is maintained. Livestock inventory can be maintained at high levels by purchasing additional stock for feeding, hence reducing restocking problems. Futures can be used to guarantee prices. Damage to pastures and erosion risk can be minimised if stock are confined to small paddocks. With breeding stock, breeding cycle, natural increase and cash flow in post-drought recovery phase are maintained | Costs are high while market prices are uncertain. High labour input is required. If used with breeding stock, stock numbers may increase with consequent extra feeding costs. Pastures are severely damaged and risk of soil erosion is extreme on most soil types if stock are left in paddocks. |
| Maintenance feeding | Income may be earned from production of progeny and/ or wool production. Restocking costs are avoided. Maintenance of breeding cycle may be possible. Subsidies for fodder transport are available. Damage to pastures and erosion risk can be minimised if stock are confined to small paddocks. | Costs are directly related to length of drought. Large financial reserves may be required. High labour input is required. Performance levels are affected. Young stock do not perform well. Weeds may be introduced in imported feed. Pastures are severely damaged and risk of soil erosion is extreme on most soil types if stock are left in paddocks. |
| Agistment | Generally, agistment is much cheaper than maintenance feeding per unit of food provided. If good agistment is available, full production may continue. Damage to pastures is minimised. Soil erosion risk is minimised. Breeding program can continue. Freight subsidies may be available. | Drought may affect agistment property. Stock must adapt to a new area. Stock thefts may occur. Handling facilities and managerial control may be inadequate. Stock may be lost during transport. When stock are returned to original property, weeds, diseases, etc. may be introduced. |
| Trade in livestock | Cash flow is provided for feeding and running costs so that total livestock numbers can be maintained. | Weeds, diseases, etc. may be introduced. Breeding cycle may be disrupted. Genetic base is lost. Pastures are severely damaged and risk of soil erosion is extreme on most soil types if stock are left in paddocks. |



*Stock can be put on the road if stock routes remain sufficiently vegetated, or can be taken to agistment.*

Annual pastures will last for a shorter period and protect the soil less effectively than perennials, and the most palatable perennials will be eaten down before less palatable species. Special drought reserve pastures (e.g. saltbush or native grasses) will last for a considerable period, but they too will die if repeatedly defoliated.

All these factors should be carefully considered when determining stocking strategies. If pastures are poor and soils erodible then destocking should be the chosen option. This could take the form of selling, agisting or moving to small paddocks for maintenance or production feeding. While there is the perceived benefit of letting stock walk over paddocks (to pick up small amounts of feed, burrs etc.) while being fed, there are the disadvantages of using up energy, denuding the soil, using up pasture seed supplies, becoming more susceptible to predators, and bogging in dams.

While ever pasture cover is adequate, soils are protected or are resistant to erosion, and stock retain sufficient energy, then paddock feeding can be safely carried on.

Feeding of edible scrub, such as kurrajong, wilga and mulga, keeps stock in the paddock, eating remaining ground plants as well as the cut scrub. This presents a management dilemma, in trying to sustain stock without severely overgrazing the pasture component. It is not feasible to cut and carry scrub to holding paddocks. It is suggested that scrub feeding commence while there is still pasture on the ground, to supplement that pasture and prolong its usefulness. Supplements of urea and/or molasses may be required to encourage stock onto scrub and to prevent dietary deficiencies.

Scrub should not be cut so severely that it kills the plants.

Selection of small paddocks for intensive feeding should have already been carried out, on the basis of slope (for drainage and runoff), soil type, fencing, water supply, protection from erosion, wind and heat, and convenient access. Information on design of "feedlots" is available from NSW Agriculture's Agfacts *Opportunity Lotfeeding of Beef Cattle*, and *Lotfeeding of Lambs*.

As conditions progressively worsen the extent of destocking and feeding need to increase, and the strategy chosen should allow for this serious situation. There is no point feeding a large number of stock and then running out of fodder or money and having to sell at low price or lose them.

A rule of thumb is that in a long drought (say 6 months or more) destocking is generally a financially better proposition, but in a shorter drought feeding is more economical. In more drought-prone areas (and in arid areas where feeding is not feasible) destocking should be the major measure and drought-feeding should be limited to small select groups of stock.

*Feeding stock in confined well-drained areas allows good husbandry and takes pressure off the paddocks.*

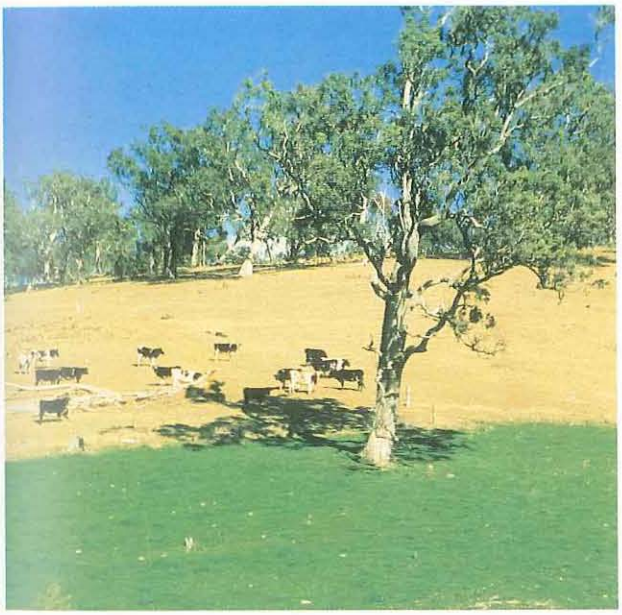
## *Irrigating to Produce Feed*

In some areas irrigated pastures or fodder crops may be grown to supplement or fully feed stock. This would normally apply to finishing stock prior to sale or to maintaining production through critical periods (e.g. dairy cattle, calving, lambing etc.). The extent to which this can be carried on will depend on water supply and irrigation equipment.

Irrigation strategies during a drought will depend on water supply, time of year, existing pastures and stock requirements.

Irrigators with a reliable water supply can maximise production per hectare and produce stock or fodder for premium returns.

Irrigators with a limited water supply must make maximum use of the available water. Survival of established perennial pastures is a priority as is achieving maximum forage production per megalitre of water.



*If water is available small areas could be irrigated to keep pasture alive. Springvale 1981.(Photograph Alex Ashwood).*

Water use efficiency depends on a well-designed and maintained irrigation system. Crops and pastures require adequate plant density, fertiliser and weed control to achieve the maximum production from the water applied.

Water must not be wasted, so irrigation scheduling must suit the soil type, root depth and rate of water use of the crop. Watering at night saves water by reducing evaporation losses.

Maximum production from limited water is usually obtained from crops which can tolerate some moisture stress such as lucerne or forage sorghum. These crops will recover quickly from partial moisture stress to make full use of available water.

For further information consult NSW Agriculture advisors and Agfact publications.

## *Animal Husbandry and Diseases*

Extra care needs to be taken in drought periods in the care and management of stock. Declining quantity and quality of feed will affect animal growth rates, production, reproduction, susceptibility to diseases, and exposure to predators and adverse weather conditions. Stress and injury may occur during transportation, while being driven in a weak condition, watering in boggy dams, and due to attack by predators and to sudden cold wet weather. Health and behaviour problems may also occur with stock being kept in small paddocks or yards on supplementary feed. Very young and old animals are more likely to suffer.

More information on diseases is available from NSW Agriculture and their Information Sheet, *Disease Prevention During Droughts.*

Consideration should also be given to the plight of native animals, which will suffer in the same way and will not have access to supplementary feed. In drought times domestic stock will compete with them for feed and water and will penetrate "rougher" country which now provides the natives with their main habitat. It would be preferable to keep domestic stock out of areas where known populations have retreated, to increase the chances of these populations surviving.

## *Control of Feral and Native Animals*

Feral and the larger native animals make their presence felt during drought periods, by competing with domestic stock for feed and water. Their presence reduces the period for which pasture remains adequate, and can counteract the spelling of paddocks to reserve feed. They will go on feeding till they starve to death or die of thirst, destroying remaining pasture in the process and increasing the risk of soil erosion.

As mentioned previously, feral animal numbers should be kept low at all times, however severe drought periods provide excellent opportunities to eradicate the hard-core populations while their numbers are low and there are no young. At these times, for example, rabbits die in large numbers and those remaining retreat to the deeper, bigger warrens. Destruction of these warrens and the resident rabbits will significantly reduce the breeding potential, which could otherwise be very high when the drought breaks. Similarly, it is the time to round up feral goats and pigs, around the remaining water and feed supplies, while they are in weak condition and more easily found than normal.

Kangaroos also create considerable competition in some regions. They prefer young green grasses, and travel large distances to green pick after isolated storms.

They also move in large numbers into paddocks where pasture is being saved, and their prior presence often deters sheep from later grazing of any remaining feed. Kangaroos present a large problem for western graziers in drought times. They may die in very large numbers, so responsible culling before and during drought will alleviate suffering, give the remainder a better chance of survival, and better preserve pasture and soil. They breed again rapidly after drought breaks so numbers soon rebuild. Permission for culling of kangaroos is required from the National Parks and Wildlife Service.

## *Management of Cropping Country*

As outlined earlier, land taken into a drought cultivated and bare is at extreme risk of soil erosion (unless the soil is naturally well-structured or cloddy). This risk is increased considerably if stock are allowed to run on it to pick up weeds and other volunteer plants. This country was observed to be the first to blow in 1982–83, and dust storms occurred about twice a week in parts of the Central West, as wind changes came through. This compares with virtually no movement in normal years.

The aim should be to keep at least minimum cover levels as close as possible to sowing time, and preferably right up to it. This requires reducing cultivation, not burning stubble, and controlling stocking which removes or breaks up the cover and tramples the soil surface. This is particularly important on the lighter soils, which are very susceptible to wind erosion. The Department of Conservation and Land Management recommends that stock not be run on fallows on sandy soils.

By keeping this cover, the decision as to whether or not to sow can be left to the latest possible stage. The minimum cover levels to aim for are shown earlier (page 13).

If a crop is already in the ground and rain fails or soil moisture runs out, a decision must be made whether to hold out for grain, graze the crop, cut it for hay or silage, or leave it ungrazed as groundcover. The latter is obviously a last resort, and will depend on weather predictions, the height and cover of the crop, and the erodibility of the soil. There will be great temptation to use it for stock feed and in some districts it will attract kangaroos. The decision should take considerations of both the short and long-term benefits and costs.

Most horticultural plantings are irrigated either from reticulated systems such as the M.I.A. and Lower Murray or from storage dams, bores, creeks or rivers. However at Young, which is one of our leading fruitgrowing districts, non-irrigated orchards are still prevalent and many plantings of prunes and cherries rely to a large extent on natural rainfall. Some vineyards and vegetable crops also rely heavily or solely on natural rainfall.

Where water storages are limited and bores are non-existent or may have moderate to high salinity levels, special strategies are necessary to minimise tree and crop losses during drought periods.

Storage dams should be de-silted when the opportunity exists and diversion drains conveying runoff should be maintained in good condition. Bore water should be regularly monitored for salinity levels during drought periods and, if suspect, diluted with other stored water before using. Trickle irrigation is the preferred system to use when salinity levels are marginal and where water supplies are limited.

Reduced Deficit Irrigation is a system used for stone fruit whereby irrigation is reduced between the pit hardening stage and the final fruit development period, thereby conserving water for use during the more critical periods.

Several cultural factors can influence tree performance and survival during drought periods. Regular pruning and fruit thinning reduces the tree canopy and crop load that must be supported in dry periods. Weed control is also critical to reduce competition for available moisture. Summer pruning of cherries is another practice that can reduce moisture needs and therefore reduce tree losses during extreme conditions.

*Retained stubble protects soil well into a drought. The decision to plant the next crop or not should be left as long as possible.*

*If water supply runs out in vegetable crops little can be done except harvest what is possible and use the rest for stock feed.*

## *Emergency Soil Conservation Measures*

If the principles outlined above have been followed to retain a level of groundcover in grazed and cropped areas, and if preventive soil conservation works have been carried out in non-drought years, soil erosion problems are less likely to arise. However, if a soil erosion hazard situation does arise during drought, a range of emergency measures can be used.

*Contour ripping used near Cowra in 1982 to break up windflow and to control runoff after the drought breaks.*

If cropping land begins to blow, roughening of the surface with a chisel plough or ripper will reduce wind erosion, but only if the soil contains enough clayey material to allow clods to be brought to the surface. There is no point bringing up small particles as this merely provides more material to blow. This ploughing should be carried out at right angles to the prevailing winds, and wherever possible on the contour (to also give some protection from the next rain).

Use wider than normal tyne spacings or leave 2 metre widths between ploughed strips, and use a slow speed (5 kph) to reduce damage to soil structure and breaking up of clods.

In Victoria wind-ridging has been a common practice during summer on sandy soils. This involves forming low ridges (or banks) of soil about 30 cm high and 3 m apart at right angles to the wind direction, using a grader or disc plough. This practice is not recommended unless it brings up clods, otherwise it too only produces more sand to blow.

These measures could also be used where practicable in grazing lands.

To reduce water erosion, contour furrowing is a low cost, rapid option on grazing or cropping lands.

Furrows are constructed with a mouldboard, disc plough or grader, following the contour as near as possible, and from 10 to 20 m apart, depending on slope and soil type. These will trap water, silt and seeds, and provide areas for rapid pasture growth after it rains. These will continue to have benefit in subsequent years unless they are filled with silt.

In areas with severe problems soil conservation earthworks can be constructed to control runoff and erosion from the bare soils.

Droughts are good times to desilt dams and even improve their capacity. However, if catchments are bare there is a risk that the dam will be re-silted if heavy rain breaks the drought. This can be avoided by using earthworks to reduce and slow down runoff, and by constructing a silt trap above the dam.

Further advice and assistance for these practices are available from the Department of Conservation and Land Management.

## *Financial Management*

Financial management is all important in drought, to maintain cash flow for living and to allow implementation of the selected drought management strategy. This will be made easier if a predetermined plan has been developed and is being followed. It is important to keep an objective outlook, be aware of what is happening in the district, other parts of the State, and in the market, so that the best opportunities can be grasped. There may be financial assistance available from the Government, financial advice is available from many sources (page 29), and in some parts of the State a Rural Counselling Service can be utilised.

There may be need to seek off-farm employment, though this will be difficult to handle if a big feeding program is being undertaken.

*Wind erosion even occurred in the Southern Tablelands in 1982–83, as in this scene near Goulburn.*

# After the Drought Breaks

## Stock Management

The period during and immediately following drought-breaking rains can be most critical for those stock which have survived dry weather and feed shortages. In all previous droughts, many properties have experienced their heaviest losses during this period.

The immediate problem is prolonged wet weather in which stock, particularly sheep, eat little or none of their rain-sodden ration, particularly grain fed on the ground. Their energy intake is well below the additional quantity needed, and sheep in poor condition often die before the rain stops.

Boggy conditions and local flooding can prevent vehicle access to the feeding area and weak stock have real difficulty moving in these conditions.

It is essential, therefore, to confine stock (particularly sheep) to feeding sites which are accessible by vehicle after rain.

The alternative is to establish an emergency feed dump at the feeding site, preferably some hay, so that sheep survive the rain period. Feeding areas should be well-drained and located where flood water will not isolate a portion of the mob.

If cold weather follows the break, extra feed in the form of hay should be fed to meet the increased maintenance needs. Shelter from cold winds, especially in the wet, is very important at this stage, hence the need for tree windbreaks.

As soon as the first green pick emerges, stock invariably leave their drought rations and expend a lot of energy attempting to graze.

At this time many potentially poisonous plants come away faster than pasture grasses, tempting stock. Animals in any one area learn which plants are poisonous and usually avoid them. However, if stock are hungry or are in an unfamiliar area they may eat poisonous plants. Stock on travelling stock routes can encounter similar problems.

## Land Management

Grazing management after the drought is a critical factor in the survival of desirable perennial grasses and in checking invasion by weeds.

Death of many plants in drought must be expected, so it is critical that subsequent regeneration be encouraged, whether by regrowth from remaining plants or from seeds in the ground. If perennials have been killed in drought there is little competition for establishing annuals, weeds and woody weeds. The post-drought pasture may be quite different from the pre-drought one.

Regenerating perennials should be allowed time to recover before restocking so that root energy reserves can build up. Germinating seedlings must be allowed to establish before grazing if they are to survive and adequately replace those plants that have died.

A vigorous perennial pasture will keep weeds suppressed, provide year-round feed and give good insurance against the next drought.

The seedling stage is the most critical phase in the life history of perennial plants. A study in southern Queensland showed that 50 per cent of seedlings died within the first fortnight and only 7 per cent ultimately flowered. Furthermore, while recruitment of seedlings may be regular, and almost annual, in the main habitat of a species, in more marginal habitats (rainfall lower or out of key season) it may be quite irregular. Mitchell grass is a good example of this. It establishes regularly in central Queensland, but good establishment in north western NSW occurs only every 20–30 years.

Since droughts very often end with big rainfall events (and there is little other plant competition) germination of perennials may be favoured. It is critical not to miss the opportunity for seedling establishment by allowing them to be grazed out in this relatively short period.

If stock have not been confined, then they should be spread as lightly as possible over the property and kept off those areas most in need of regeneration of perennials.

The decision whether to buy or breed back stock after drought will be determined by many factors, particularly the availability of money and suitable stock. When buying the usual practice is to do so as soon as possible, to get in before the peak demand. Such a move places pressure on the regenerating pastures and may lead to the poisoning problems referred to above. The pasture will benefit from a gradual rebuilding of stock numbers, consistent with a breed-back program.

## *Crop Establishment*

Drought-breaking rain will usually be sufficient to sow a crop (provided the time of year is right). There is need to get a crop in as soon as possible to restore groundcover and to generate much needed income. Alternatively, volunteer pasture should be allowed to establish or a new pasture sown. In the latter case, reasonable time should be provided before stock are returned. If a crop or pasture is to be sown then minimum cultivation should be adequate to kill emerging weeds and a post-emergent herbicide should be applied for weed control.

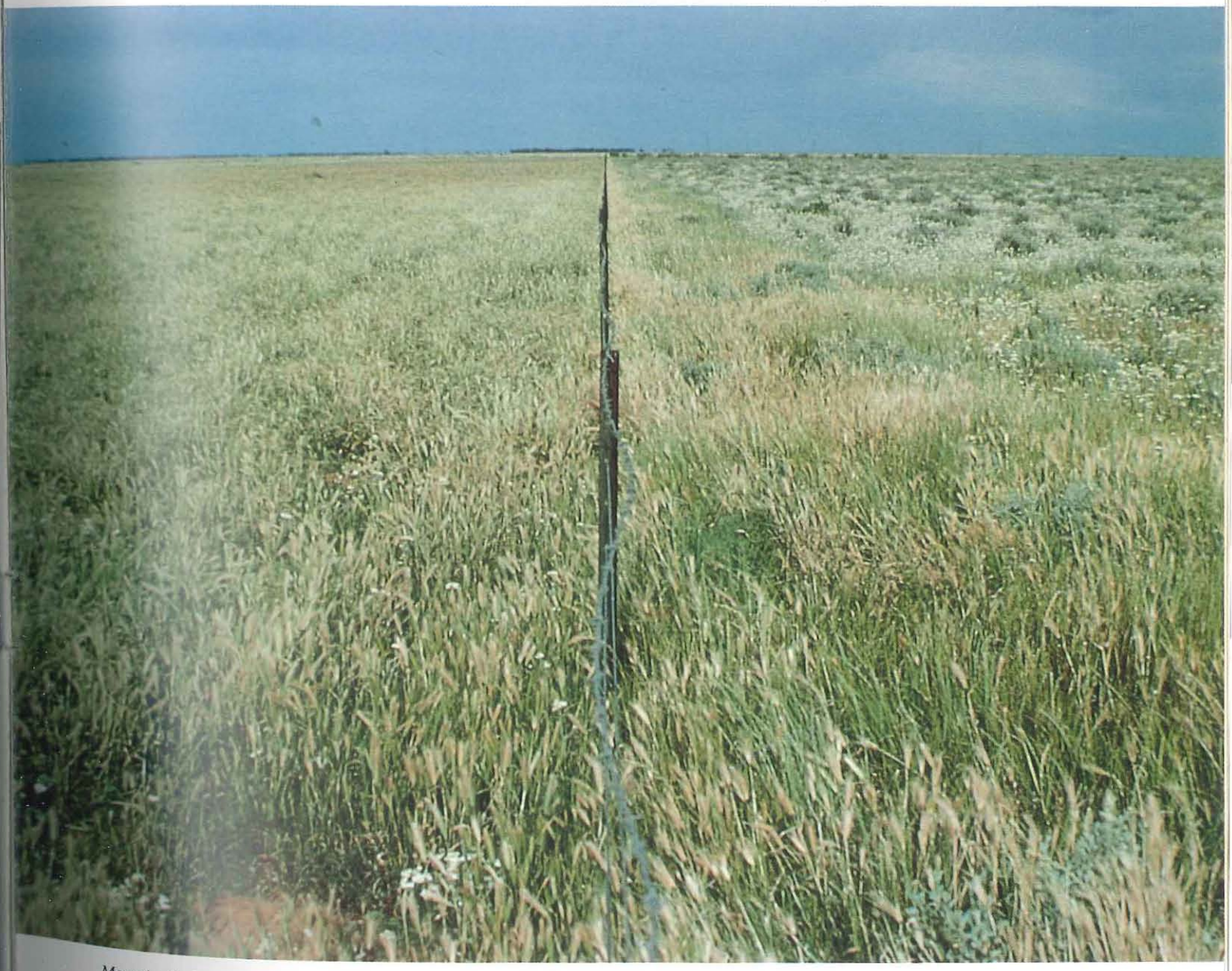
Crops and pastures after drought often benefit from extra mineralised nitrogen in the soil, although, if erosion has occurred, nutrients and previously applied fertiliser will have been lost. If a preceding crop has failed at an early stage, then the previously applied fertiliser may be sufficient or almost sufficient for the next crop.

If the soil has been severely trampled and pulverised it will benefit from a following pasture phase, to rebuild soil structure.

Advice on choice of crop or pasture type, weed control, and fertiliser needs can be obtained from NSW Agriculture.

*For the benefit of both stock and land, stock should preferably be kept in confined areas until new pasture is well established and can provide some worthwhile grazing. At that point they can be gradually weaned off their drought rations and allowed some grazing.*

*In a good spring the only difference between these paddocks in the Riverina is some bush in the right hand one.*

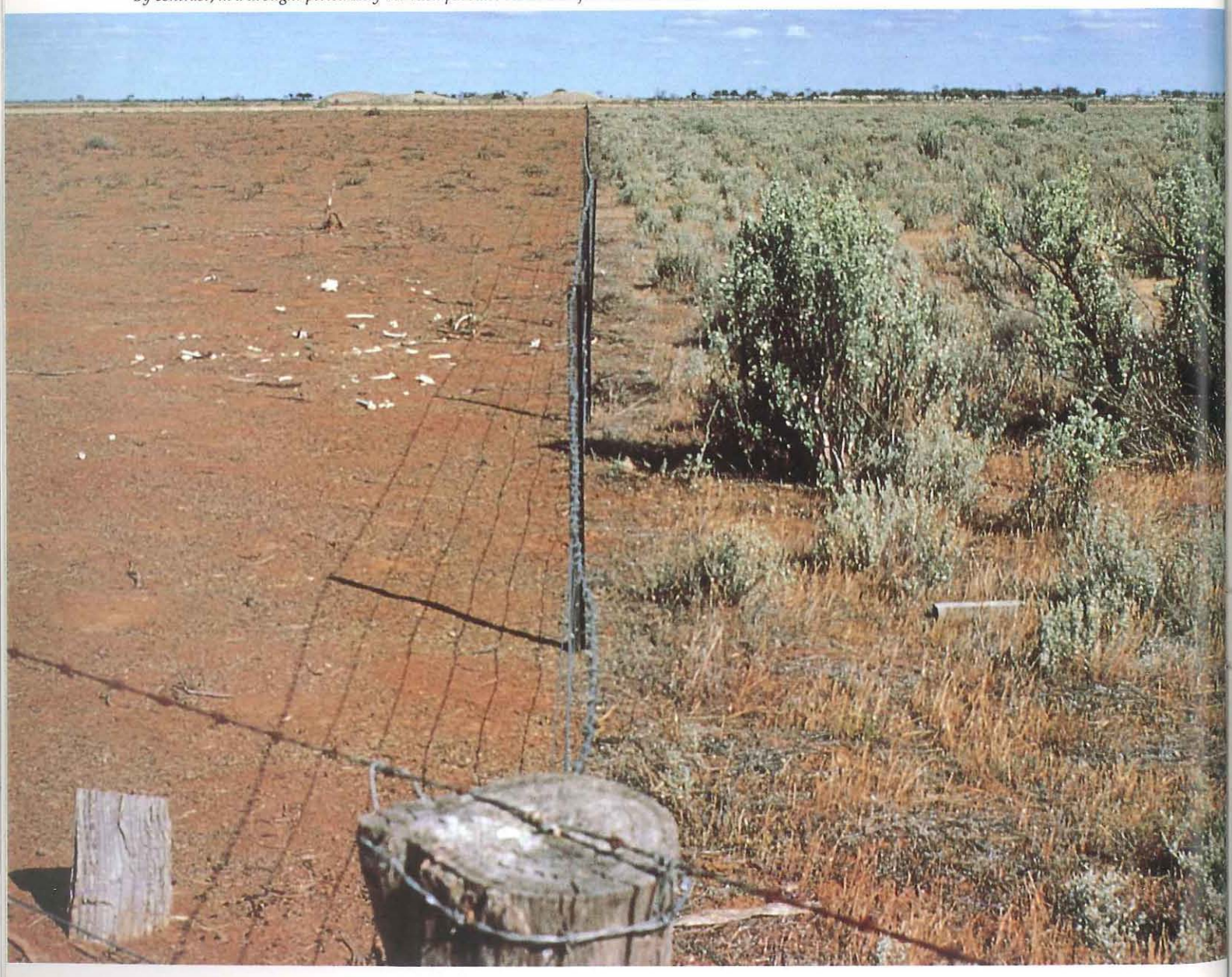


# Assistance is Available

Many forms of assistance are available to help land managers cope with the effects of drought, including the preparation stage. This assistance comprises advice on land, stock and financial management, rural counselling, and financial assistance.

These areas of assistance and their sources are listed in the following table. More details are available from the responsible agency and from the publications listed at the back of this booklet.

*By contrast, in a drought period only the bush provides reasonable feed and soil cover.*



## Table 2. Types and sources of assistance available

| Type of Service | Coverage | Source |
|---|---|---|
| Weather forecasting | Short to medium-term forecasts, drought watch service. | Bureau of Meteorology; Consultant Forecasters |
| Farm Management Decision-Support Schemes | Assistance to use available systems to predict outcomes of a range of management options. | NSW Agriculture (Ag.); Department of Conservation and Land Management (CaLM); Farm Management Consultants |
| Financial Management Advice | Budgeting, restructuring, analysis of management options, farm accounting, income smoothing options, taxation advice. | Rural Assistance Authority (RAA); Ag. Economists; CaLM Economists; Banks; Farm Management Consultants; Accountants; Ag. Farm Cheque Program; Stock and Pastoral Firms; Rural Counsellors |
| Market Information | Stock prices; fodder, agistment supply and prices; commodity prices. | Rural press; Stock and Station Agents; Ag. Economists; Rural Lands Protection Boards (RLPB) |
| Land Management Advice | Groundcover maintenance, erosion prevention and control, protection of pastures, protection of cropping lands, farm water supplies, stocking rates. | CaLM |
| Agronomic Advice | Pasture and crop management. | Ag.; CaLM; Farm Management Consultants |
| Livestock Management Advice | Husbandry, fodder conservation, feeding, diseases, stocking rates. | Ag. Livestock and Veterinary Officers; Farm Management Consultants; Private and RLPB Veterinary Officers |
| Rural Counselling | Counselling on financial and social problems. | Rural Counsellors (through Ag. or listed in Agfact M 3.4) |
| Debt Mediation | Independent assessment of financial and resource management. | Rural Debt Mediation Officers - contact through National Farmers' Federation or listed in Agfact M 3.4 |
| Pest Control | Feral animal control.<br>Native animal management.<br>Woody weed control.<br>Noxious weed control. | RLPB, Ag., CaLM.<br>National Parks and Wildlife Service<br>CaLM, Ag<br>Ag., Local Council |
| Taxation Deductions | Deductions for expenditure on water supply and cartage, fodder storage facilities, soil conservation works, fencing for land degradation control. | Accountants; Australian Taxation Office; Ag. Economists; CaLM Economists |
| Income Equalization Deposits | Scheme to encourage investment in high income years for use in low income years. | Accountants; Australian Taxation Office |
| Concessional loans | Special Conservation Scheme<br>- soil conservation<br>- stock and domestic water supply<br>Interest Subsidy/Rural Adjustment Scheme. | RAA; CaLM<br><br>RAA |
| Rebates for certain measures in Drought Declared Districts | Freight rebates (rail and road) for<br>- stock to agistment<br>- stock to further agistment<br>- fodder movements<br>- stock returning from agistment<br>- restocker movements<br>- stock to saleyards (Western Division only)<br>- water cartage | Ag.; RLPB |

# Drought Strategies for Production Zones

While the principles and strategies that have been outlined are common to most parts of NSW, the frequency and effects of drought conditions differ between regions, climatic zones and types of land use, as do the options for addressing them.

For example, in the Western Rangelands a large proportion of bare soil can be exposed, water dries up and destocking is the main option. At the other extreme, droughts on the coast tend to be "nutrition" droughts - where a fair amount of groundcover usually remains but is insufficient for normal production of, say, milk, and the main option to address this is supplementary feeding.

The following lists are guidelines for strategies applicable to the main agricultural zones. They are not recipes, since every enterprise and financial situation is different. Not only that, market conditions, the size and location of areas affected by drought, time of year etc. vary between droughts, so that the best option for one event may not be attractive in another.

**It is essential for each land manager to work out the strategy that best fits the particular set of circumstances.**

## *Western Rangelands*

These make up the western third to half of the State, where grazing of native pastures by sheep is the most common, and in most cases only, enterprise. The lack of diversity, the remoteness from fodder suppliers, and the size of operations restricts management options basically to manipulation of stock numbers.

It is a matter of adjusting stock numbers to available feed supplies, starting to remove domestic, feral and native animals as soon as there are signs of drought and progressively destocking as conditions deteriorate.

Stock would usually be sold or agisted, however feeding of a low number of selected stock may be feasible, and slaughter may be necessary if conditions are serious, if stock prices are low or if agistment is unavailable. The prior stocking rate, the availability of water, and the number of pest animals competing for feed will determine how soon the effects of drought are felt.

Feeding stock on grain in the Western Rangelands is an expensive operation unless a cheap local source is available, such as irrigation blocks or cropping areas along the eastern and southern margins. Pastoral properties are generally not equipped to handle a protracted, full hand-feeding operation. This requires bulk handling equipment for storage, feed preparation and feeding out.

Hand-feeding should be confined to small areas with a history of heavy grazing, such as holding paddocks or yards, except for very short periods (less than 3 months) especially avoiding erodible soils. Feeding should always commence before all paddock feed is depleted, so that stock are in reasonable condition to handle the diet change and pasture degradation is reduced.

Scrub feeding can be a means of sustaining stock, particularly for short periods (less than 6 months). Costs are low although labour requirements for large numbers of stock can be high. Scrub is a maintenance feed for dry adult stock only. It is not suitable for pregnant, lactating or growing animals. When feeding scrub for long periods, mineral supplements must be provided to supply phosphorus and sulphur as these elements are deficient in scrub species. Not every property has enough suitable scrub species to embark on a scrub feeding program. Scrub should be used wisely to ensure that useful scrub survives. More information is given in the NSW Agriculture Information sheet *Scrub Feeding and Supplementation.* Land managers in the Western Division require authorisation from the Department of Conservation and Land Management before pushing or lopping trees for fodder.

*Some grass butts hanging on in drought in February 1983 near Tilpa.*

*Good regeneration of grasses and herbage at the same site by March 1984.*

## Before Drought

- Maintain a cash reserve
- Monitor rainfall prospects
- Monitor feed supply, groundcover and needs for coming months
- Monitor stock market prices
- Monitor cost and availability of agistment
- Maintain a stocking rate which strikes a balance between maximising profit and conserving pastures
- Control pest animals and weeds
- Identify both genetically superior stock to be retained in drought and categories of stock for staged destocking
- Develop or set aside areas of drought-resistant pastures
- Identify land which should be destocked first
- Determine special animal husbandry needs
- Ensure water supplies are adequate
- Set dates for staged destocking if rains fail
- Store feed supplies where feasible
- Seek advice on technical matters, financial matters and sources of assistance.

## During Drought

- Monitor medium-term rainfall prospects
- Monitor feed supply and groundcover
- Commence destocking according to prepared plan
- Remove stock from erodible land types (e.g. sandy soils, powdery calcareous soils, scald-susceptible soils)
- Remove stock before grass butts are eaten into the ground or edible bushes are defoliated more than once
- Commence scrub feeding well before pasture runs out
- Maintain control of feral and native animals
- Protect water supplies
- Act to reduce stock diseases and suffering
- Minimise expenditure and manage cash flow
- Carry out emergency soil conservation measures where feasible
- Seek advice on technical matters, sources of assistance and, if required, rural counselling.

## After Drought

- Allow pastures to recover before restocking
- Compare costs of breeding back with buying stock
- Maintain feral and native animal control to prevent rebuilding of numbers and damage to new pasture growth
- Watch out for new weeds from imported fodder or stock, and for poisonous plants
- Spell paddocks used for intensive feeding
- Rehabilitate lands eroded or otherwise damaged
- Keep an eye out for germinating woody weed seedlings.

*Drought in bimble box country west of Cobar in November 1982, at the point where destocking should take place to protect soil and grass butts.*


*The same site in September 1983. Drought breaking rains in May-June have produced a profusion of cool season annual plants.*


*Following good summer rains, grasses have reappeared by March 1984.*

## *Determining Options*

*Herd-Econ, one of the decision support systems referred to earlier, was used to compare stocking options for a typical sheep property in the southern, winter rainfall part of the South Australian rangelands.*

*Three approaches were considered: no active destocking; destocking by about 20 per cent (wethers) as soon as winter rains fail; and destocking by 40 per cent (all wethers, then the oldest ewes, and then as many wether hoggets as necessary) when rains fail. Examination of all possible 10-year sequences of good, average or drought years showed that 20-40 per cent destocking would result in a better long-term economic return than no destocking. For this property, destocking by 20 per cent increased the expected 10-year cash surplus by $430,000 or 76 per cent over no destocking.*

*It was found that at least 20 per cent immediate destocking was sensible if the drought lasted only 1 year, but that 40 per cent initial destocking was more profitable if the drought lasted longer. For the 5 years following a 2-year drought, the accumulated cash surplus for no destocking was predicted to be $41,000, for 20 per cent destocking $136,000, and for 40 per cent destocking $347,000. If the drought had lasted 3 years only the last option would have produced a cash surplus.*

*The analysis showed that this general result remains valid over very wide range of market conditions for the type of property considered. Earlier work in south-western Queensland had indicated that early destocking was financially the best management option in the 1965–66 drought.*

## *Mixed Farming–Grazing and Tablelands Zones*

The mixed farming—sheep and cattle grazing zone in NSW occupies the Slopes, Riverina, nearer Western Plains, and western edges of the Tablelands. Properties may produce one or more types of crop, along with wool, cattle, some prime lambs, sheep meat and/or pigs.

The Tablelands zone is used mainly for growing wool, prime lambs and cattle, on improved and native pastures.

Properties in these zones have a lesser frequency of drought than the Western Rangelands and have more options for addressing it. Reliance on supplementary feeding is often needed even during fairly normal dry seasons due to higher stocking rates (year-round or during the growth of the crops), predominance of volunteer pasture between crops, and predominance of annuals in sown pastures. These together result in feed or nutrition gaps in summer (in the south) and winter (in central areas).

Thus the normal stocking rate, the availability of stock water and the number of native and/or feral animals competing for feed will determine how soon the effects of drought are felt.

The basic drought management strategies include:

- destocking (sale, agistment)
- feeding (stored or purchased fodder, irrigated feed, fodder trees or drought fodder crops)
- delaying and/or reducing cultivation
- changing crop rotations (delay crop phase)
- changing use of crops (grain to fodder)
- changing mix of enterprises (decrease cropping, decrease cattle relative to sheep, increase pigs etc.).

Other options, such as buying more land, changing enterprises or buying cheap stock for production feeding may also be considered.

The main differences between these two zones are the much greater ability to grow, conserve and sell fodder on one's own property in the mixed farming--grazing zone, and the cold winters which restrict feed production on the Tablelands, thereby producing regular, short, drought-like conditions.

Decisions on crop sowing or changes to rotations will depend on the condition of the paddock (whether worked up or not, in pasture or volunteer pasture), the amount of cover, the need for feed, and the risks associated with dry sowing.

Outlines of all these considerations have been given earlier and details are available in the publications listed later. Again, the choices will depend upon individual considerations, prevailing costs and prices. The economics of feeding as against selling or agisting stock, of growing and storing versus buying fodder, and of how much fodder to store need careful consideration.

Land managers who decide to hand-feed have some difficult decisions to make:

- how long will stock require feeding?
- what type of feed should be used?
- what will be the cost of the feed landed in the paddock?
- what are the capital costs of equipment which may need to be purchased?

These decisions are vital. It is easy to invest too much on the feeding, losing all equity in the stock and spending more to retain them than they are likely to cost as replacements.

These zones suffered very badly in the 1982–83 drought, with wind erosion occurring where it had rarely been seen in recent decades, followed by severe water erosion when the drought broke. The legacy of this drought will remain for many years, in the form of reduced productivity, increased need for fertiliser, slow pasture regeneration and need for resowing improved pasture. Improved pastures with no perennial grasses, and volunteer pastures succumbed fairly rapidly and stock were forced onto any remaining areas of native pastures (generally in rougher, hilly country). While these pastures performed a valuable role, continued heavy grazing has affected the native pasture species and the remaining native animal habitats. More needs to be known about management of these areas to protect their resources.

*The rocks are about all that are holding this country together near Cooma in 1982. The stock should be removed while still in reasonable condition and the pasture rested.*

## *Some Case Histories from the 1965–67 Drought*

*A grazier in the Western Division lost 2,250 old sheep and then sold the balance of his flock thus avoiding the cost of hand feeding.*

*The property was closed down for about 10 months and the owner obtained outside employment. Following the breaking of the drought he sought a loan of $13,000 to assist in restocking. As a result of the relatively early sale of stock and because outside employment covered living expenses, the owner's equity had been maintained but total debts were relatively high (for that time) at $45,000 after basic restocking had been effected. He intended to continue with his outside employment during the early stages of stock rebuilding, which it was estimated would take about 4 years to reach full carrying capacity.*

*The grazier was a very hard worker, an efficient manager and, provided no further serious setbacks occurred, it looked as though he would be able to handle his debt structure. In this case a relatively early decision to sell stock and obtain outside employment enabled the grazier to keep his level of liabilities to manageable proportions and obtain the necessary finance for a basic breeding flock to enable him to restock.*

*A property in the Western Division had a normal carrying capacity of 4,800 sheep.*

*However, early in 1965 when the drought commenced, sheep numbers had built up to 6,000. At this stage debts totalled $60,000 and the grazier decided to retain stock until rains created a market. It is almost certain that stock could have been sold at reasonable prices during the latter half of 1965 but they were retained for too long and by mid 1966 only 1,800 sheep were left. At the same time liabilities had increased to $79,000 including a drought relief loan.*

*Further evidence of lack of management ability came with a request to finance the purchase of 2,400 ewes in a situation where the property could not carry the additional stock numbers.*

*In this case a high debt level in the pre-drought period was aggravated by over-stocking.*

*This situation could well have influenced the decision to retain sheep in the hope of a seasonal break which did not eventuate. Equity and income potential were eroded to the point where recovery was hopeless.*

*Source: Lessons from the 1979–81 Drought. Society of Animal Production (1981)*

*These economic analyses do not take into account land condition and possible damage. However, reduction of stocking pressure is a critical factor in minimising land degradation, hence the destocking option is also preferable on this account.*

*For properties that are more lightly stocked, the level of destocking may be reduced or its initiation delayed. The economic projections of the strategies for these stocking regimes could be similarly calculated with Herd-Econ or other methods of analysis.*

*This country is susceptible to wind and water erosion, and to damage to pasture. Cooma, 1982*

*Heavily and lightly grazed contrasts near Orange in May 1991.*

*Pasture cover is getting below 70 per cent in this paddock near Orange in May 1991. It is time to be rested from grazing.*

*Stock restricted to a single paddock near Manildra in May 1991 while surrounding paddocks seemed to be ungrazed.*

*An overgrazed paddock (left) of annual pastures near Bathurst in April 1991 contrasts with a neighbouring paddock (right) which retains good grass cover.*

## *Drought Stories from 1965–67*

*A grazier on the Northern Tablelands obtained a loan of $32,000 in 1963 for pasture establishment and purchase of 2,500 additional sheep. Full development had not been achieved when the drought commenced but stock numbers had been increased from 15,000 sheep and 450 cattle to 17,000 sheep and 650 cattle.*

*Despite expenditure of about $40,000 on fodder, 450 head of cattle and 6,400 sheep died. Additionally 5,200 sheep were sold at give-away prices. When the drought broke total liabilities had risen from $140,000 at the beginning of the drought to $166,000 with a further $30,000 required for restocking.*

*The property recovered well with pastures re-establishing quickly. Total debts were high but the grazier still had a good equity in the venture with every indication of being able to service commitments over a term of 15 years or so.*

*In this case the drought intervening during a development period placed added strain on financial resources and the decision to retain stock rather than sell aggravated the position. Equity in the venture, however, was substantial and, with the aid of longer-term credit than was originally envisaged, the grazier appeared capable of surviving the setback.*

***A grazier on the Northern Tablelands obtained loans totalling $22,000 between 1962 and 1964 to establish pastures and purchase sheep. Pasture establishment was relatively slow and lambing percentages poorer than expected. However, steady progress was being made until the drought struck.***

*Management in this case was particularly good and the owner decided to endeavour to save his stock by travelling them along stock routes in Queensland and New South Wales. A nomadic life was followed for about 18 months and in this period shearing and lambing figures were maintained. As the property was spelled it recovered very quickly when the drought broke.*

*The overall result was that the financial position improved during the drought and further borrowings were not required. In this case an early decision enabled a good manager to save his sheep and actually improve his financial position.*

***In 1963 a loan of $15,000 was granted to a grazier on the Northern Tablelands for the erection of a building, pasture improvement and the purchase of sheep. Debts, which totalled over $50,000 after this loan was implemented and which required a very long term of repayment, were very heavy in relation to the grazier's equity in the venture. But management ability was very highly regarded and initial results on the property served to confirm this.***

*When the drought commenced there were 5,200 sheep including 3,300 ewes but pastures had not become fully established. Ample quantities of wheat could be purchased for drought feed and the grazier decided to reduce stock numbers and concentrate on the best of his ewes and young wethers, and maintain the stock retained by supplementary grain feeding till the drought broke.*

*This strategy resulted in stock losses during the drought being relatively minor and the grazier being in a position to commence a breeding up program from the retained breeding flock. But the drought lasted longer than anticipated and further borrowings to purchase grain increased total liabilities to $70,000.*

*The property recovered well from the drought but the debt level became so high that it was extremely doubtful that the income earning potential of the property would be sufficient to service all the commitments even over an extended term.*

*In this case good management minimised the effects of the drought but the pre-drought debt level was too high to cope successfully with the prolonged drought even though the standard of management was high.*

***A small grazing property in the North West was owned by a hard-working and frugal individual.***

*Pre-drought liabilities were small but the size of the property did not permit the build-up of reserves to cope with the long drought. However, the owner kept losses to a minimum by an early decision to sell off all stock at low prices rather than attempt hand-feeding.*

*Following the breaking of the drought, partial restocking of the property increased liabilities to about $18,000 and it became apparent that an increase in the income earning potential of the property was essential to enable this debt level to be serviced. Because of this the owner sought a loan of $10,000 to purchase farming plant and prepare some land for cropping. Total debts then rose to $28,000 with further funds probably being required later to complete restocking.*

*The land in question was suitable for wheat growing and the return per acre for wheat was better than the return for grazing. Budget estimates prepared indicated that the total debts of $28,000 could be handled and that funds required for restocking could be provided out of income. Further, if good seasons were experienced in the early years, repayment of all debts could be effected more quickly than was envisaged.*

*In this instance the early decision to sell stock coupled with a change in land usage, enabled this small grazier to recover from the effects of drought fairly rapidly.*

*Source: Lessons from the 1979–81 Drought. Society of Animal Production (1981)*

## *Guidelines for Drought Management in Mixed Farming–Grazing and Tablelands Zones*

### *Before Drought*

- *Maintain a cash reserve*
- *Monitor rainfall prospects*
- *Monitor groundcover, feed supply, and needs for coming months*
- *Monitor stock market prices*
- *Monitor cost and availability of agistment*
- *Monitor grain, hay and other fodder prices*
- *Continually assess mix of enterprises*
- *Stock so as to strike a balance between maximising profit and reducing damage to pastures and soils*
- *Control feral and native animals and weeds*
- *Identify genetically superior animals to be retained in drought and categories of stock for staged destocking*
- *Develop or set aside areas of drought-resistant pastures*
- *Identify land which should be destocked first*
- *Determine special animal husbandry needs*
- *Ensure water supplies are adequate*
- *Set dates for staged destocking if rains fail*
- *Identify possibilities for irrigation to produce feed or fodder*
- *Produce or purchase and store fodder supplies*
- *Assess crop rotation possibilities*
- *Use reduced tillage and retain stubbles and other groundcover on cropping paddocks, in order to retain cropping options for as long as possible*
- *Seek advice on technical matters, financial matters and sources of assistance.*

### *During Drought*

- *Monitor rainfall prospects*
- *Monitor feed supply and groundcover levels*
- *Monitor stock and fodder prices*
- *Commence destocking according to plan*
- *Remove stock from erodible land types (e.g. shallow soils, some granite soil, saline areas)*
- *Commence feeding well before pasture runs out*
- *Prevent grass butts or lucerne from being eaten into the ground*
- *Maintain control of feral animals*
- *Protect water supplies*
- *Act to reduce stock diseases and suffering*
- *Manage cash flow according to chosen strategy*
- *Keep stubble or other cover on cropping paddocks*
- *Restrict or cease stocking of cultivated paddocks*
- *Keep soil surface in cropping paddocks in a cloddy, uneven state*
- *Assess crop yield prospects*
- *Determine optimum use of already growing crops*
- *Defer further cultivation (except where required to roughen surface)*
- *Reconsider crop or pasture sowing plans*
- *Carry out emergency soil conservation measures where necessary*
- *Seek advice on technical matters, financial matters, sources of assistance and, if required, rural counselling.*

### *After Drought*

- *Allow pastures (especially native perennials) to recover before restocking*
- *Compare costs of breeding back with buying stock*
- *Maintain feral animal control to prevent rebuilding of numbers and damage to new pasture growth*
- *Control weeds resulting from imported fodder or stock*
- *Watch out for poisonous plants*
- *Spell paddocks used for intensive feeding*
- *Rehabilitate eroded or otherwise damaged lands*
- *Keep an eye out for germinating woody weed seedlings such as sifton bush.*

## *Irrigation Farming Areas*

Regardless of where they may be located, irrigation farmers may find themselves in a difficult situation in drought times. While irrigation water remains available they may operate virtually as usual and may even benefit by being able to produce fodder for drought-affected landholders and sell at higher than normal prices.

However, if water runs out and these farmers are dependent on irrigation cropping they, like dryland farmers, face crop failure and possible zero income for the year except for what can be salvaged as saleable drought fodder or agistment. Vegetable croppers will be particularly affected, although these crops are relatively short-lived. Some or all of growing crops may be able to be finished before water runs out, but the following crop would have to be deferred or omitted from the rotation. Rice or cotton crops may emerge with reduced yields if they are well advanced, or some sections may have to be sacrificed to allow adequate watering of the rest.

Orchards and vineyards could be catastrophically affected, but in most cases the plants may be kept alive by minimal watering or accumulated subsoil moisture even though the year's crop may be lost or significantly reduced.

However, major irrigation areas rarely run out of water, even though some restrictions may be applied. Irrigation from less regulated or non-regulated rivers, like the Darling above Menindee, is most at risk.

## *Drought Management Strategies for Irrigation Areas*

### *Before Drought*

- *Maximise efficiency of water use*
- *Maintain soil structural condition in order to make optimum use of the full root zone*
- *Monitor crop type options*
- *Monitor fodder availability and prices*
- *Prepare strategy for reducing water usage during periods of possible shortage*
- *Retain groundcover for erosion protection and to provide mulch*
- *Seek advice on technical matters, financial matters, and sources of assistance.*

### *During Drought*

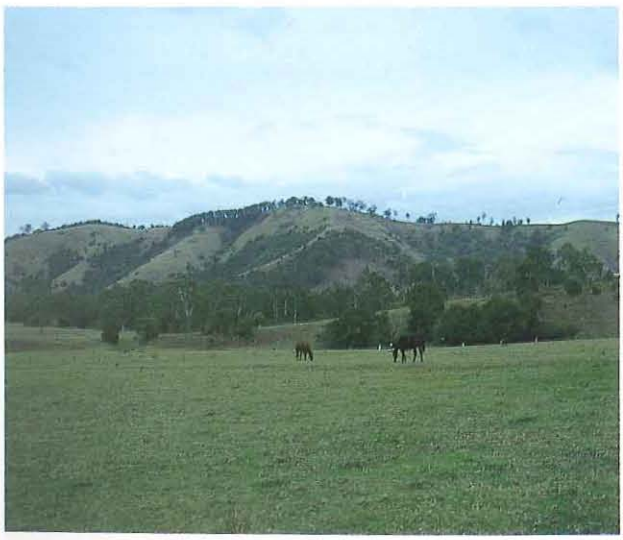
- *Monitor likely water supplies and crop requirements*
- *Determine watering priorities and possible uses of sacrificed crop*
- *Assess opportunities for fodder sales*
- *Assess opportunity for and economic benefits of providing agistment*
- *Assess opportunity for buying and fattening stock*
- *Retain groundcover if there is wind erosion hazard*
- *Determine means of securing survival of fruit trees and vines*
- *Reassess vegetable and other crop planting plans*
- *Seek advice on technical and financial matters and, if necessary, rural counselling.*

### *After Drought*

- *Determine when water supply will again be available*
- *Assess market prospects of various crops/ enterprises*
- *Assess options for planting crop with or without assured water supply*
- *Watch out for weeds introduced by stock.*

*Although cover levels in coastal areas do not fall to the levels of the west, effects of drought are felt in reduced bulk and nutritive value of pastures. Near Wauchope May 1991.*

*Cover levels and pasture quality are getting low near Candelo in 1972. (Photograph Alex Ashwood)*



*While the flats are still green, the hills, with shallower, less fertile soils, have much reduced feed value and cover. Long Flat in the Hastings Valley, May 1991.*

## *Coastal (High Rainfall) Zone*

The coastal zone is that area to the east of the Great Dividing Range supporting dairying, beef cattle production, small scale cropping and a wide range of horticultural crops. Some irrigation is carried out, and there are areas of fodder production and horse breeding.

Drought occurrence is less frequent than inland, though some areas of the far South Coast have been affected more often than normal in recent times. Rarely are the effects on soils and pasture as severe as inland.

While pastures may dry off or die, a reasonable groundcover usually remains. The problem is more a "nutritional" drought for stock, which are traditionally run at high stocking rates. However, steeper cleared ridges with shallow soils quickly show the effects of drought, particularly if overstocked, and bare ground may appear. Some loss of crop production may occur, but streams do not usually dry up and some irrigation is still possible.

Because of the low frequency, land managers tend not to prepare so well for drought as do those inland. As a result, they are often less well equipped to handle a drought when it does come. The economics of drought preparation require careful consideration, but the best options are probably to maintain a cash reserve (to buy feed), store feed and have a plan for staged destocking. The latter is less relevant to dairy cows in milk, where feeding is preferred by most operators.

In cropping and horticulture the main effects are loss of production (rather than total crop loss) and possible disruption to new plantings. However in many areas cyclones, heavy rain, winds and floods are greater hazards to cropping.

The coastal zone is also characterised by a large number of rural residential blocks, hobby farms and weekend retreats. One too many head of stock may be carried on these blocks and the need to destock or handfeed these animals is not always recognised by the owners. It is important that the owners of these blocks pay the same attention to groundcover levels and weed and pest control as do full-time farmers, and that absentee landowners make appropriate decisions for stock management during drought periods.

Because some groundcover usually remains and pastures respond vigorously to rainfall, the land degradation hazard due to drought here is much less than inland. However, there may be damage to overstocked pastures if these are not allowed to regenerate. This provides opportunities for weedy grasses such as carpet grass and parramatta grass to take hold. Areas that do become bare may be affected by water erosion when heavy rains again fall.

# Guidelines for Drought Management in the Coastal Zone

## Before Drought

- *Maintain a cash reserve*
- *Monitor feed supply and groundcover levels*
- *Monitor stock market prices*
- *Monitor cost and availability of agistment*
- *Monitor fodder prices*
- *Maintain a store of reserve fodder (dairy farms)*
- *Control rabbits (where they occur)*
- *Be prepared to destock in a timely manner*
- *Identify animals to be retained in drought and categories of stock for staged destocking*
- *Identify land which should be destocked first*
- *Be aware of stock feeding techniques and disease prevention*
- *Ensure water supplies are adequate*
- *Identify possibilities for irrigation to produce feed or fodder*
- *Assess crop rotation options*
- *Reduce cultivation of cropping paddocks to keep cropping options open*
- *Use cover crops in horticulture*
- *Seek advice on technical matters, financial matters, and sources of assistance.*

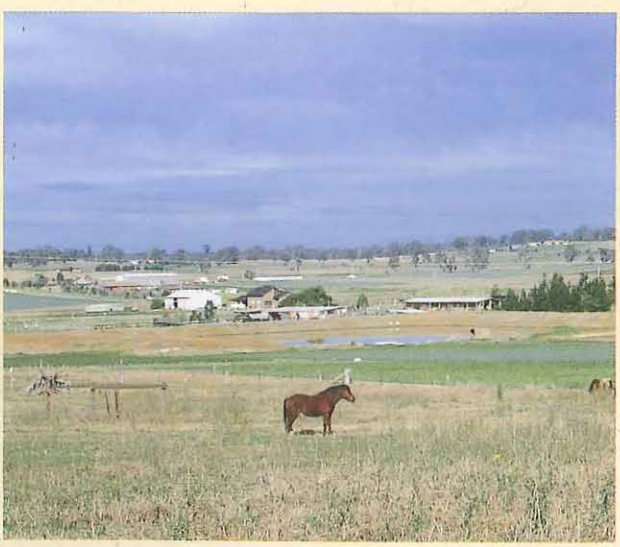
## During Drought

- *Monitor rainfall prospects*
- *Monitor feed supply and groundcover levels*
- *Monitor stock and fodder prices*
- *Commence destocking according to prepared plan*
- *Commence feeding before pasture runs out and before stock condition falls*
- *Prevent grass butts or lucerne from being eaten into the ground*
- *Act to reduce stock diseases and suffering*
- *Protect water supplies*
- *Keep cover on cropping paddocks*
- *Determine optimum use of already growing crops*
- *Reconsider crop or pasture sowing plans*
- *Make efficient use of irrigation water*
- *Assess opportunities for fodder sales*
- *Assess opportunities for providing agistment*
- *Assess opportunities for buying and fattening stock*
- *Seek advice on technical matters, financial matters, and sources of assistance.*

## After Drought

- *Assess market prospects of various crops/enterprises*
- *Allow pastures to recover before restocking*
- *Control weeds introduced with animals or fodder*
- *Resow pastures as soon as possible*
- *Sow fodder crops*
- *Rehabilitate lands which were eroded or otherwise damaged.*

*Cover crops between rows protect soil from erosion in good and bad times and build up soil organic matter and nutrients in this vineyard.*



*Attention needs to be paid to providing sufficient feed, water and soil protection in drought times on rural residential and weekend blocks.*

# Key Publications

## NSW Agriculture

- Drought preparedness and fodder conservation (Agdex 120/60)
- Drought feeding of sheep (Agfact A3.5.4)
- Drought management of beef cattle (Agfact A2.1.2)
- Drought feeding of goats (Agfact A7.5.3)
- Opportunity Lotfeeding of Beef Cattle (Agfact A2.5.2)
- Agistment guidelines (Agfact M1.6)
- Water requirements for sheep and cattle (Agfact A0.5.4)
- Disease prevention during droughts (Agdex 15/650)
- Sustaining pastures during the drought (Agdex 130/4)
- Herbicide and pesticide risk to livestock (Agdex 400/680)
- Drought and taxation concessions (Agdex 400/834)
- Drought strategies in the Western Division (Agdex 400/15)
- Scrub feeding and supplementation (Agdex 15/321)
- Health problems during drought (Agdex 15/650)
- Managing for the future (Agdex 130/027)
- Drought Relief (Agdex 027)
- Sources of professional financial advice for farmers (Agfact M3.4)
- Sources of rural finance in NSW (Agnote DRRE)
- Grazing and spelling in the dry rangelands (Agfact P1.1.3)
- Sources of financial assistance (Agnote DRRE/13)
- Obtaining farm finance (Agnote DRRE/16)
- Feeding dairy cattle during feed shortages and droughts (Agfact A1.5.8)
- Lotfeeding of lambs (Agfact A3.5.1)
- Country Guide–a directory of NSW Government services for country people.
- Feeding horses in a drought (Agfact A6.5.2)

## Department of Conservation and Land Management (incorporating Soil Conservation Service of NSW)

- Graziers' Guide Series for Management in Western NSW:
  - Saltbush Plains Country
  - Mulga Country
  - Saltbush-Bluebush Downs Country
  - Bimble Box-Pine country
  - Belah-Bluebush Country
  - Mallee Country
- Control of Wind Erosion on Sandy Soils (Soilnote No. 6/83)
- Vegetation–Key to Wind Erosion Control (Soilnote No. 5/83)
- Wind Erosion–what you can do (Soilnote No. 4/83)
- Low Risk Stocking (Rangenote No. 1)
- Soil Conservation Service Grazing Rates–what do they mean (Rangenote No. 2)
- Pasture Assessment Sites for Graziers (Rangenote No. 4)
- Stubble Assessment for Erosion Control (brochure)

## NSW Rural Assistance Authority

- Rural Assistance Measures Currently Available (brochure, August 1991)

## Western Lands Commission (now Department of Conservation and Land Management)

- Drought Management in the Western Division (2pp) (guidelines and regulations)

## Australian Society of Animal Production

- Lessons from the 1979–81 Drought

# Where To Get Advice

| | | | |
|---|---|---|---|
| Department of Conservation and Land Management | G.P.O. Box 39<br>Sydney, NSW 2001<br>Telephone (02) 228 6111 | or | District Offices,<br>(listed in telephone books) |
| NSW Agriculture | Locked Bag 21<br>Orange, NSW 2800<br>Telephone (063) 616 100 | or | District Offices,<br>(listed in telephone books) |
| NSW Rural Assistance Authority | G.P.O. Box 4051<br>Sydney, NSW 2001<br>Telephone (02) 266 3222 | or | Head Office<br>1 Oxford St,<br>Sydney, NSW 2000<br>Telephone (02) 266 3222 |
| Rural Land Protection Boards | Local offices,<br>(listed in telephone books) | | |
| Australian Association of Agricultural Consultants | P.O. Box 1877<br>Canberra City,<br>ACT 2601 | | |
| Agricultural Consultants | Listed in local telephone directories under "Farm & Agricultural Advisory Services". | | |
| Rural Debt Mediators | Senior Economist,<br>National Farmers' Federation<br>Telephone (06) 273 3855, | or | Australian Bankers' Association<br>Telephone (03) 654 5422 |
| Rural Counsellors | Contact NSW Rural Assistance Authority | | |
| Banks | Rural advisory sections | | |

*Graphic designer: George Biagioni*