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Sustainability in Queensland Agriculture: The Role of Land Care in Securing the Future.

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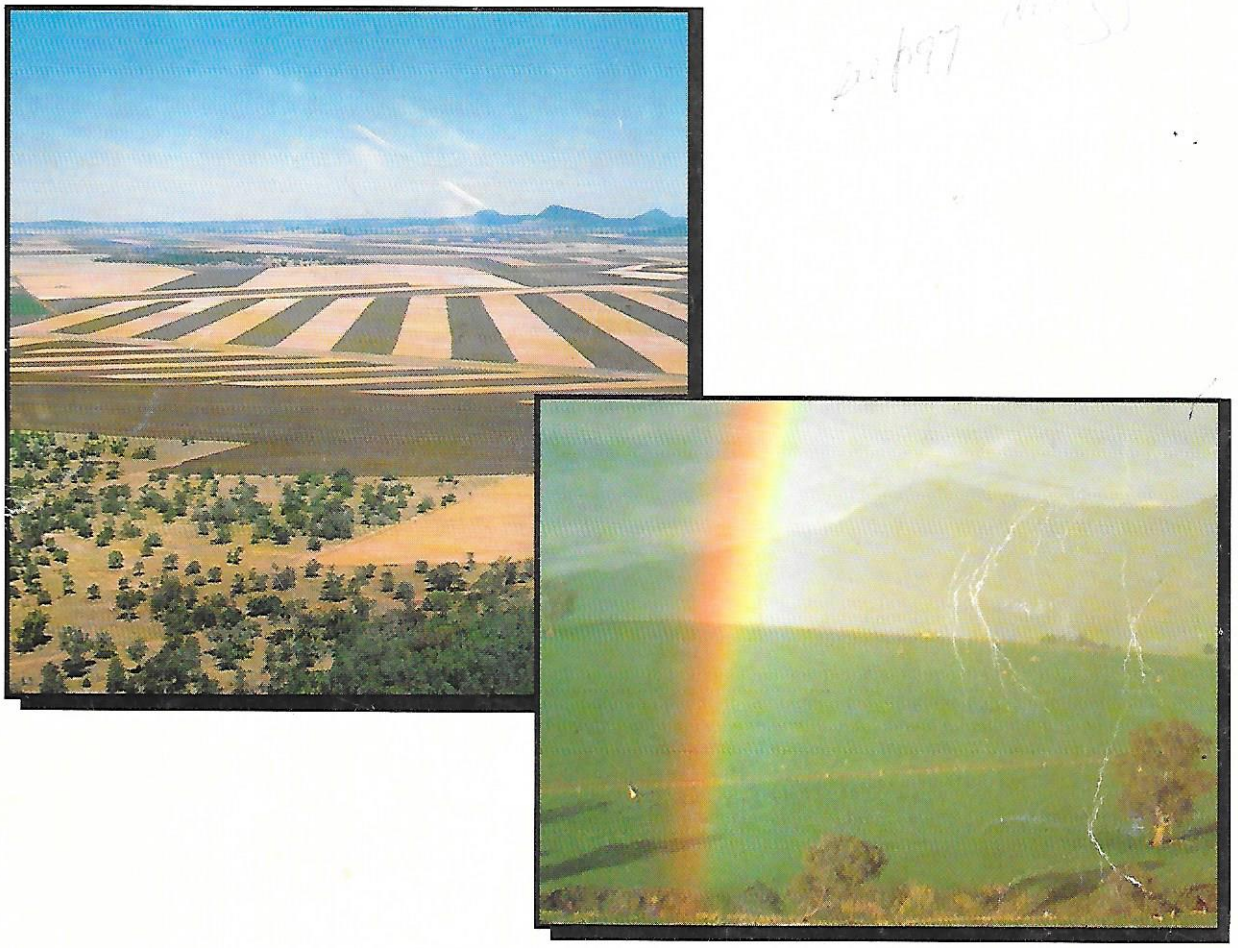
Dr Geoff Edwards
President
04 8850 5887

LAND CARE

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE



Sustainability in Queensland Agriculture

The role of land care in securing the future

SYMPOSIUM PROCEEDINGS

Bardon Professional Centre, Brisbane. 20 October, 1989

AIAS OCC. PUBL. NO. 44 June 1990

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SUSTAINABILITY IN QUEENSLAND AGRICULTURE

THE ROLE OF LAND CARE IN SECURING THE FUTURE

PROCEEDINGS OF THE LAND CARE SYMPOSIUM, BRISBANE 20 OCTOBER 1989

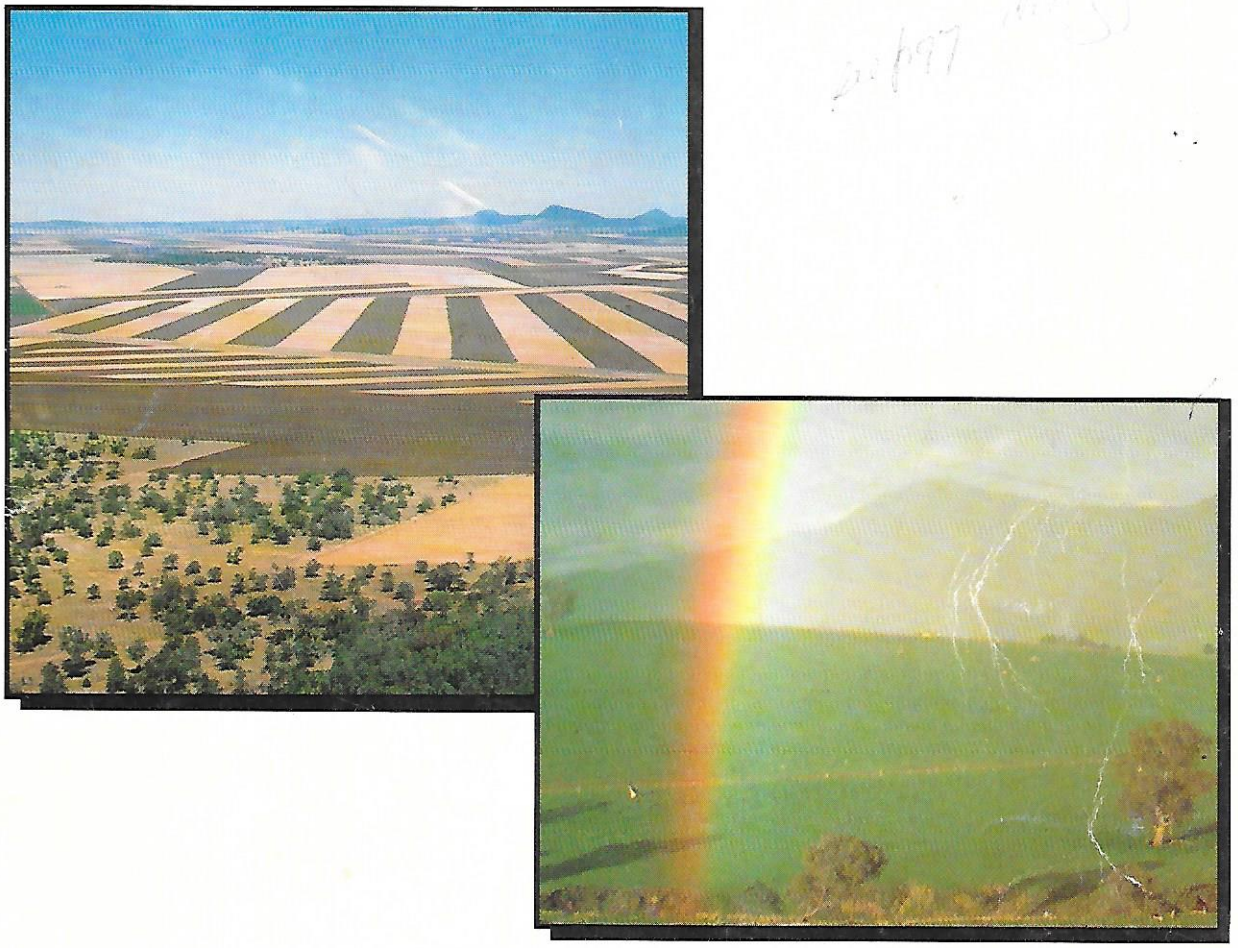
(Arranged by the Australian Institute of Agricultural Science, Queensland Branch and the Australian Soil Science Society, Inc., Queensland Branch).

Editors: F P C Blamey and W M Strong

AIAS OCCASIONAL PUBLICATION NO. 44, 1990

LAND CARE

THE AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE



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FOREWORD

All agricultural production makes use in some way of the land. Production of animals and crops brings about change due to increased exposure of the land, especially the soil surface, to both natural risk and through the harvest and export of soil-derived nutrients. In the majority of production systems the natural vegetation is partially or completely removed, to be replaced by introduced plants. A great deal of experience is required to learn how to manage a system based on "foreign" plants and a major disturbance of the environment.

The concept of sustainable agriculture implies an equilibrium between the loss and replenishment of plant nutrients, and also protection through reduction of exposure against direct loss of soil. It also implies stability or improvement in the soil physical properties that influence water infiltration and movement, and root growth.

Most primary producers have a long term interest in the wellbeing of their land but a great deal to learn about how to achieve sustainability. At the farm level in Queensland we have only a few decades of experience to draw from in developing sustainable management. The Landcare concept seeks to heighten awareness and develop a sense of urgency about the need to arrest the degradation of our land resources. It seeks to speed up the learning phase in devising a sustainable system for every type of land use. It makes use of the combined experience, and motivation for improvement, of the majority of primary producers in a given area. This pooling of wisdom is stimulated and made possible by an injection of money from the whole community via the agency of Government.

This Symposium was arranged to present the broad issues involved in landcare to agricultural scientists, producer leaders, politicians, and concerned members of the Queensland community.

The Australian Institute of Agricultural Science and the Australian Soil Science Society both have a vital interest in the future of agriculture in this country. We eagerly took the opportunity to present the proceedings of a symposium that makes an important contribution to the development of Landcare groups.

M A FOALE
PRESIDENT
AUSTRALIAN INSTITUTE OF AGRICULTURAL SCIENCE
(QUEENSLAND BRANCH)

R C BRUCE
PRESIDENT
AUSTRALIAN SOIL SCIENCE SOCIETY, INC
(QUEENSLAND BRANCH)

CONTENTS

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OPENING REMARKS - THE URGENCY OF LAND CARE AND CONSERVATION FOR QUEENSLAND'S FUTURE

D A McKECHNIE[1]

SUMMARY

Agriculture has been approached as an extractive industry for 150 years, but now even the best soils are deteriorating rapidly. While erosion damage is being arrested with appropriate constructions the loss of nutrients and soil structure associated with excessive pressure of production is only now widely recognised.

Co-operation between the State and Federal governments, under urgent pressure from industry leaders, has seen rapid expansion of the Landcare infrastructure in Queensland. I hope that this movement will not be hampered by party politics, top heavy bureaucratic structures or lack of a sustained flow of funds.

A good deal more information is needed in both arable and grazing forms of land use to halt degeneration and restore the soil to a sustainable level of productivity. This will be achievable if the whole community provides a level of support that provides economic benefit to the land holder in undertaking land care.

Chairman, Ladies and Gentlemen

Thank you for the opportunity to officially open this symposium. My congratulations to all concerned within the Australian Institute of Agricultural Science and the Australian Soil Science Society Inc., Queensland Branches, for organising this event.

Land Care and conservation issues are certainly to the fore in the minds of most Australians today.

Agriculture has been an extractive industry in Queensland for about 150 years. It was thought that many of our soils would sustain unlimited farming. Now, however, it is realised that even the deep black soils of the world famous Darling Downs are unable to sustain continual cultivation.

Soil erosion by water was recognised as a problem many years ago and the Queensland Department of Primary Industry and many hundreds of land-holders

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[1] General President, Queensland Graingrowers' Association, Toowoomba; and President of the Queensland Farmers' Federation.

in Queensland have an excellent record in developing water control measures to save our soils - notably by the construction of contour banks and associated waterways. Of recent years, with the development of the brigalow and associated areas for the cultivation of crops, the problem of rapid deterioration in essential nutrients, the rapid breakdown in soil structure and increased water and wind erosion has pulled farmers up in their tracks.

In over forty districts throughout the State, farmer and community concern has been such that Land Care Committees have been established. In late 1988, it was recognised by rural industry organisations that it was necessary for the State Government to take action to encourage and sustain the momentum, that had developed at the grass roots producer level, for the establishment of Land Care Committees.

Accordingly, rural leaders (Messrs. Douglas, Drysdale, Soper and myself) entered into discussions with the Premier and the Minister for Primary Industry to seek the necessary Government support.

Their support requested was readily given and it is now history that the Queensland Department of Primary Industry was charged with the responsibility of co-ordinating the land care movement in Queensland. Also we realised that without local co-ordination it would have been difficult for the Federal Government to direct Federal monies into Queensland in a meaningful way.

Most producers welcome the land care committee structure. However, worries are starting to surface. I know of <u>one</u> case in south-east Queensland where Party Politics has entered the arena. There are in-effect two committees trying to achieve the same ends with one claiming that because of its Party Political allegiance, it will receive most of the assistance.

As far as possible Party Politics will have to be kept out of land care if we as a nation are to be successful in eventually arriving at a sustainable form of agriculture.

There is a <u>second</u> worry, and that is concern by producers that the multitude of committees and Government Departments becoming involved in the land care "push" will develop into a costly bureaucratic nightmare. This must be avoided.

The <u>third</u> worry is how to find the finance and give the necessary encouragement to land holders to undertake the necessary development work and agricultural practices to allow sustainable agriculture to evolve under the guidance of the land care committees and the agricultural extension organisations. Sensible taxation incentives would seem to be an excellent way to achieve this rather than high handed/draconian legislation which has been suggested by some people.

My organisation is keen to see a Chair of land care or a Centre of Excellence in land care set up at the University College of Southern Queensland in Toowoomba. It would assist in basic research and development directed at long term land care and sustainable agriculture. It would also, we feel, assist in training extension officers and land care committee members in the development and extension of a multitude of land care issues. It would strive for a degree of excellence in its courses for graduates.

There has been a tremendous assimilation of knowledge in recent years about how to work towards sustainable agriculture in Queensland. However, much more knowledge must be gained and the knowledge already to hand must be

disseminated and accepted over a very wide area of land and over a much larger number of land holders.

Contouring or strip cropping is now accepted. Pasture rotations and the need for trees is starting to be accepted. No till/minimum till practices have been slow to be accepted. This year however it is obvious that the practice has tremendous benefits in reduced costs and in achieving higher yield. The Mines Department and miners are now addressing land care issues.

Information about the correct placement of watering facilities, fences and shade clumps to minimise land degregation has been slow to be accepted. We are now facing the price of over-grazing of much of our grazing land. We are fast developing acceptable guidelines for the establishment of intensive livestock enterprises. We need to develop policies and practises to stop urban and hobby-farm encroachment over our valuable agricultural land in many areas.

In all of this it will be the individual land-holder who must be the major player. Without his/her co-operation, the whole land care program will falter. The land care issue will need to be packaged and presented in away that shows clear economic benefit or it will not succeed.

In your deliberations today, I appeal to you to keep this important point in mind as you strive to find the answers to how we will arrive at sustainable agriculture in Queensland. I wish you well in your deliberations. You have my personal support and I have very much pleasure in declaring this symposium officially open.

SOIL RESOURCES FOR SUSTAINABLE AGRICULTURE: A QUEENSLAND PERSPECTIVE

R J COVENTRY AND J WILLIAMS[1]

SUMMARY

Geology, and to a lesser extent climate, have been the dominant controls over soil formation in Queensland. Hence the major geological and climatic trends within the state are briefly noted. The age of the soils is discussed, and the nature of the soil-forming processes is explored. The rates of weathering and pedological processes are vastly slower than both natural and accelerated rates of soil erosion. These differences suggest that our agricultural lands cannot continue to sustain their present high soil losses. By adopting any critical value for 'tolerable' soil losses, we obscure the fact that many of our agricultural practices are steadily destroying the soil that is to all intents and purposes a non-renewable resource. There is a responsibility on all who own and use the land to realise that the existing soil is all that is available to present and future generations. Management practices must be developed that take into account the age and fragility of our soil resources.

SOIL RESOURCES: THE GEOLOGICAL AND CLIMATIC FRAMEWORK

All agricultural enterprises in Australia are literally rooted in the diverse soils of a large land mass. The diversity of the soils reflects both the variety of environmental niches in which the soils have formed and the history of weathering under a range of distinctly different climatic regimes. In Queensland, these range from the arid deserts of the southwest of the state to the tropical rainforests of the northeast.

Not only does the climate vary across the state, but so also do the underlying rocks from which the soils have formed. The terrains of Precambrian basement rocks of the Mount Isa, Georgetown, and Coen Inliers (Fig. 1a) are among the oldest rocks of Australia forming the central craton, or 'core' of the continent. They are at least as old as 1100 million years and may be as much as 1865 million years old. Somewhat younger rocks of Palaeozoic age (600 - 230 million years old), constituting the Tasman Orogenic Zone in the geologically complex eastern part of the state (Fig. 1a), have been extensively intruded by granitic rocks, strongly folded and faulted, and are now exposed in the eroded fold mountain belts of the Eastern Uplands (Fig. 1b). These rocks are themselves overlain by the relatively little disturbed, almost flat-lying rocks in the sedimentary basins of Late Palaeozoic and Mesozoic (230 - 65 million years old) age that outcrop over the Interior Lowlands of Queensland (Figs 1a & 1b). The geology of broad regions of the state is obscured by younger Cainozoic (less than 65 million years old) sedimentary and volcanic rocks, deep weathering profiles, and thick soil mantles.

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There is limited diversity within each of the major geological terrains. This is largely a result of the overall geological history of the continent. The old, Precambrian rocks of the craton were the source area for many of the younger, Palaeozoic sediments of the Tasman Geosyncline. Thick sequences (>20 000 m) of these sediments were deposited in seas marginal to the craton, were lithified, uplifted, folded, and 'welded' onto the Precambrian craton. With the passing of time, these rocks in turn were eroded and provided much of the source materials for even younger sedimentary rocks. As a result, the major geological terrains of eastern Queensland tend to maintain a certain homogeneity from north to south (Fig. 1a), and tend to become progressively younger towards the east.

This explains why the geological variability between these major geological regions tends to be much greater along transects from the coast to the inland, than between tropical and temperate latitudes within a terrain (Fig. 1a). The pattern is reinforced by the distribution of the younger geological basins, particularly the Great Artesian Basin, that overlie the older Precambrian craton and the Palaeozoic rocks of the Tasman Geosyncline (Fig. 1).

Geology, and to a lesser extent climate, have dominated over the roles of topography and vegetation as the major soil-forming factors. Large tracts of land are underlain by relatively uniform rock types and have developed repetitive patterns of soil landscapes. The agricultural potential of the soils is quite tightly circumscribed by the underlying geology and prevailing climate.

As a result, the poorer soils tend to be underlain by rocks with lower contents of weatherable primary minerals, or lie in the harsher climatic zones. As a general rule, the more fertile soils tend to be the younger soils on alluvial floodplains that receive regular, flood-borne additions of organic matter and relatively unaltered sediments. The mineral grains break down with time and provide many of the essential nutrients for plant growth.

Many of the older soils of Queensland have developed under climatic regimes vastly different from those of the present. The primary rock-forming minerals have been weathered over long periods of time and the nutrients leached from the soil profile. In such soils, the mineralogical source of some of the important plant nutrients may have been irretrievably lost. Plant growth will be severely inhibited without careful soil management and added inputs of fertilizers. This condition is exacerbated if the original parent rocks have low contents of weatherable minerals, or if they are enriched in materials toxic to plant growth such as salts or heavy metals.

SOIL FORMING PROCESSES

1. Nature of the Processes

It has been pointed out previously by Simonson (1959) that all soils are the result of the action of four major processes: additions of material to the soil profile (e.g. deposition of transported sediments at the soil surface or nitrogen fixed by legumes); losses from the profile (e.g. soil erosion products, or nutrients leached from the soil); transformations of

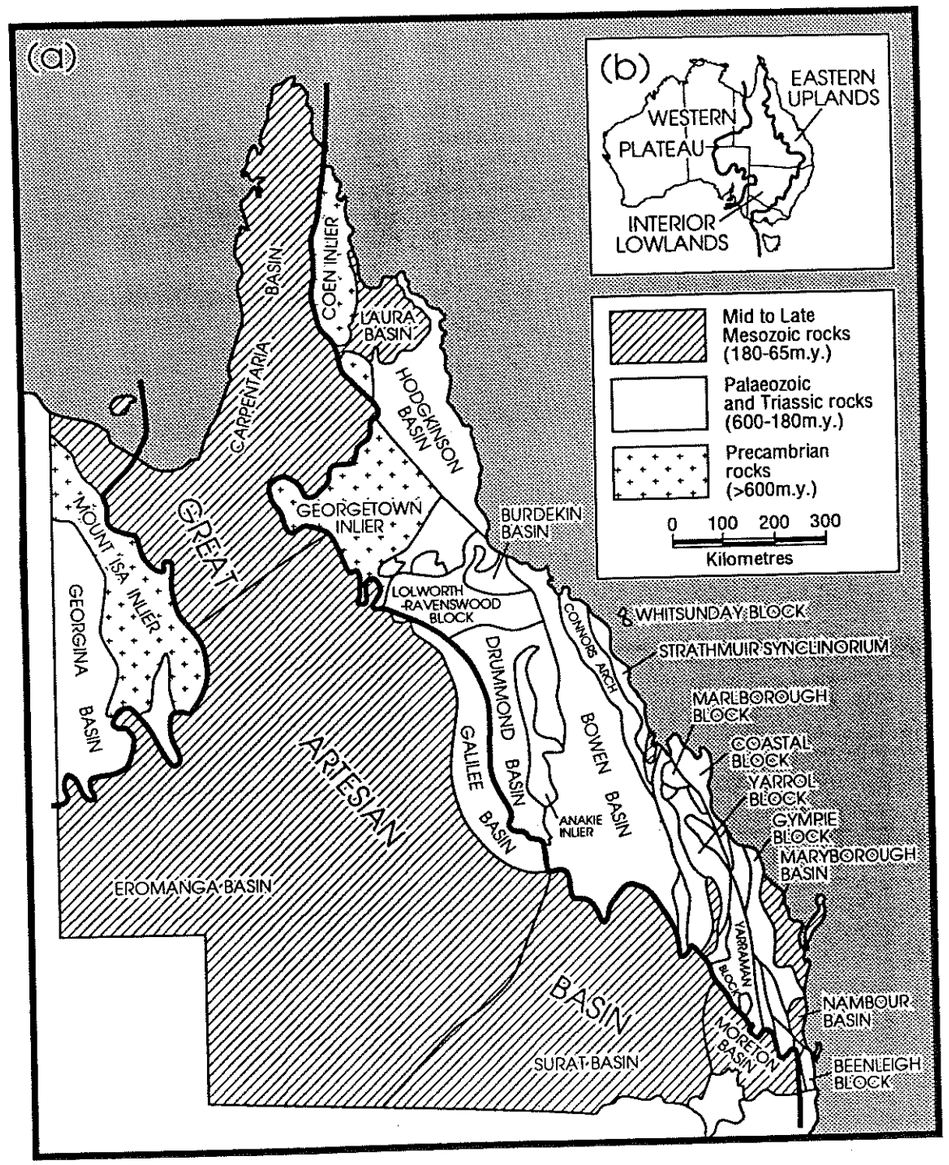

Figure 1. The geological and physiographic framework of Queensland.
(a) The distributions of the oldest (Precambrian) rocks, the Palaeozoic rocks of the Tasman Geosyncline and of the Georgina Basin, and of the extensive Mesozoic sedimentary basins are shown. The boundaries between major geological terrains and the three major physiographic regions are located; the more extensive geological units are named. Source: Day et al. (1983).

(b) The major physiographic regions of Australia. Source: Jennings & Mabbutt (1977).

soil materials within the profile (e.g. weathering of primary rock-forming minerals to clays or the breakdown of soil organic matter); and translocations of materials within the profile (e.g. the movement of colloids to form B horizons or the concentration of iron oxides into mottles or nodules in the soil).

Some soil-forming processes are rapid, and may operate on a seasonal or annual time-scale. These include processes driven by changes in soil moisture regimes, or in soil organic matter accumulation and decomposition. Other processes are much slower and include the physical and chemical aspects of mineral weathering, clay mineral formation and alteration, and the development of soil fabrics from rock fabrics. The net result of the operation of all these processes, operating over widely different time-scales, is the development of soil horizons, and the separation of the horizons into distinctive sequences in different soils.

2. Rates of Soil Formation

The rates at which pedological processes operate to form a differentiated soil profile can be deduced from studies of sequences of alluvial terraces and related landforms whose ages are known. Sequences of this kind have been studied by various workers in the temperate zone of southeastern Australia, and have been dated by various methods, notably by the radiocarbon method. There are some overall patterns that can be discerned in the soils of various ages. Throughout the region, consistent stages of soil profile development have been recognized (Walker & Coventry 1976; Walker 1989), with increasing age and elevation of the soils and associated landforms above the present stream beds (Fig. 2).

The stratic stage of soil profile development is evident in low alluvial benches consisting of stratified sediments that are found within the channels of contemporary streams. These materials have undergone very little pedogenesis, and consist of virtually unaltered sediments. Somewhat older river floodplains, whose fertility is maintained by sediment deposition from regular floods, have yielded dates of up to 1000 years old. They carry weakly differentiated soils of the cumulic stage of soil profile differentiation that generally have uniform (in the sense of Northcote, 1979) texture profiles. Low alluvial terraces that receive minimal inputs of fresh sediment from infrequent flooding are of the order of 1 000 - 10 000 years old. They carry both uniform and gradational texture soil profiles of the low-contrast solum stage with clearly differentiated A horizons and minimally developed B horizons. Higher alluvial terraces that are rarely flooded have yielded dates of 10 000 - 30 000 years, and carry texture contrast soils. These soils of the high-contrast stage have clearly differentiated A, B, and C horizons, evidence of pronounced weathering, and strong clay illuviation. The highest and oldest terraces are considerably higher than any known flood heights and are too old to date by radiocarbon techniques; they may well be older than 100 000 years. The duplex soils of the extended subsolum stage have strongly differentiated A and B horizons, and many display C horizons in which pseudogley features (van Dijk, 1969) are prominent.

The various stages of soil profile differentiation have been related to an absolute time scale by Walker & Coventry (1976) whose main results are summarised in Fig. 3. These data suggest that it takes between 100 and 1000 years for an A horizon to form in alluvium, and at least 1000 years

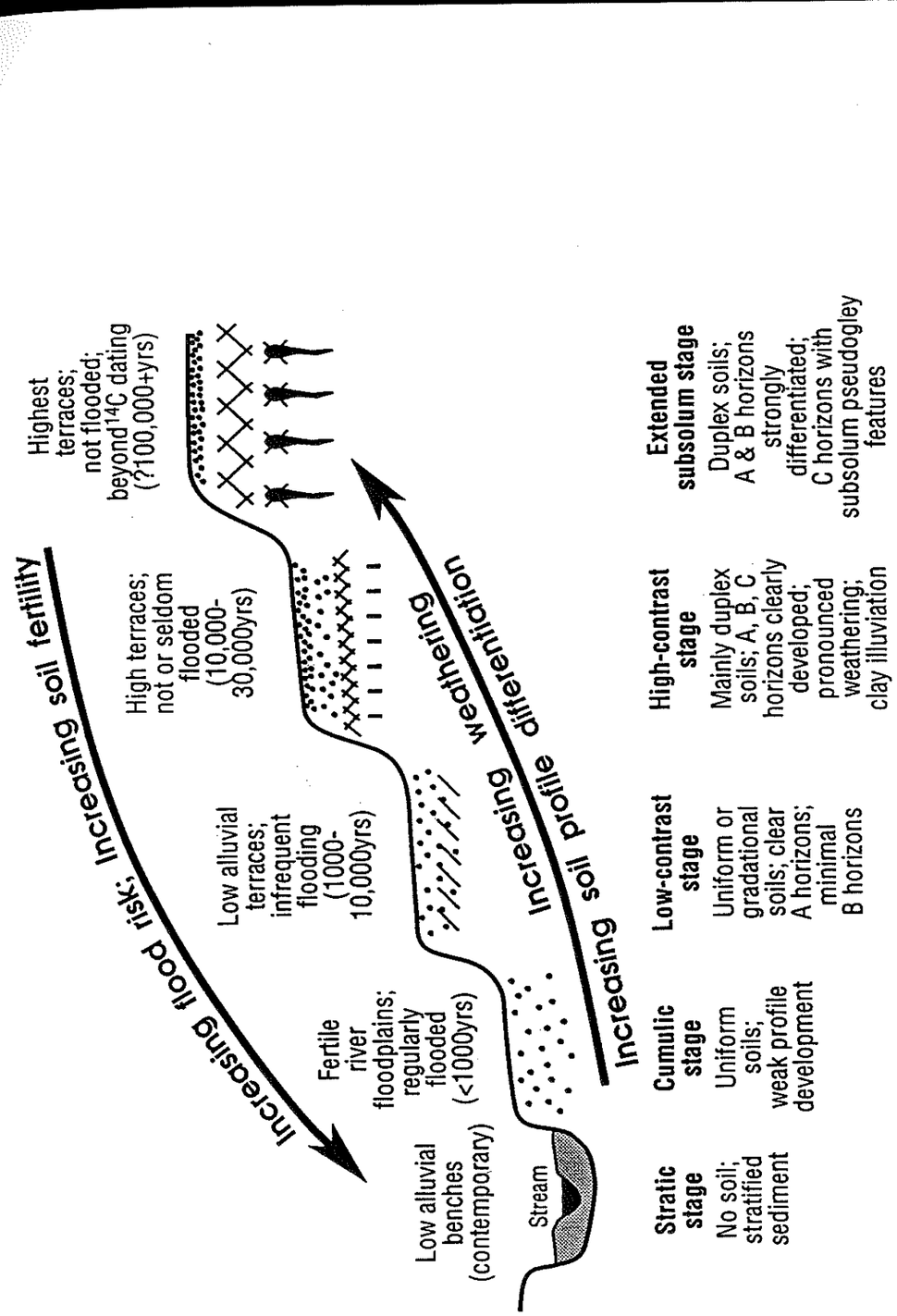

Figure 2. Generalised patterns of soil profile development stages in dated terrace sequences in southeastern Australia. Sources: Walker & Coventry (1976) and Walker (1989).

for a B horizon to begin to develop; the full expression of the B horizon, and the onset of subsolum developments, may well require the order of 10,000 years of weathering.

Clearly, the amount of time required for weathering and soil-forming processes to convert stratified alluvial sediments into coherent, differentiated soil profiles is considerable. As Beckmann & Coventry (1987) have suggested, rates of soil profile development far exceed human life-spans and are best estimated in terms of thousands, or tens of thousands of years.

3. Age of Soils

It may be helpful to consider a tree-growth analogy when trying to assimilate the significance of rates of soil formation measured in terms of millenia. If we assume a rate of growth of a hypothetical tree at 1 mm/year, then it would have grown the order of 60-80 mm in a human's lifetime. The same slowly growing tree would be 1.99 m high if it had been planted at the time of Christ. Had it been planted 100 000 years ago when the soil profiles of the high-contrast stage were beginning to form, it would now be 100 m tall! In North Queensland, however, there are soils that are overlain by basalt flows that have been dated by the potassium/argon method at 2.3 million years (Coventry 1979) and at various ages up to 5.9 million years (Coventry et al. 1985). The soils must be older than the associated, overlying lava flows. Yet, if that slowly growing hypothetical tree had been planted at the times of those volcanic eruptions, it would now be 2.3 km or up to 5.9 km tall, respectively!

Many of the soils of Australia are old. They are, undoubtedly, the products of soil-forming processes that have operated over long periods of time. Similarly, it can be concluded that rates of soil formation have been quite slow in certain parts of the continent.

RATES OF SOIL EROSION

If soils of such great age are to sustain agricultural enterprises into the future, they must be managed in such a way that the processses of soil erosion do not proceed at rates that exceed the rates of soil formation.

1. Natural and Accelerated Soil Erosion

There are few parts of Queensland where long-term, geological rates of erosion have been established. One such area is in the vicinity of Hughenden, in the catchment of the upper Flinders River. By relating depths of post-basaltic stream incision to ages of volcanic eruptions in this area, Stephenson & Coventry (1986) and Coventry & Stephenson (in press) were able to demonstrate long-term rates of stream downcutting at between 13 mm/1000 years and 45 mm/1000 years, with an overall mean, from 35 sites, of 22.2 mm/1000 years (or 22.2 m/million years).

On the other hand, however, these slow rates for natural (or 'geological')

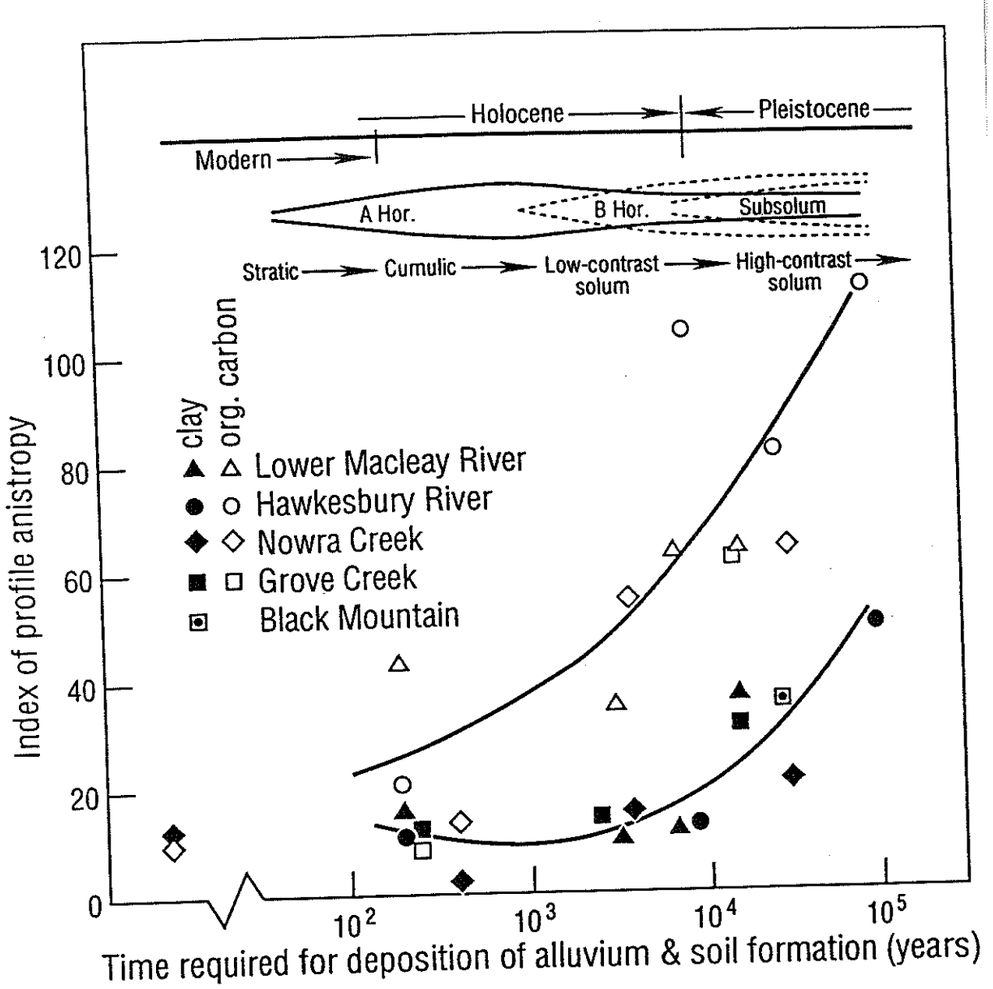

Figure 3. Relationships between the age of the soil and the degree of differentiation of the profile which is represented by indices of profile anisotropy. These indices (the coefficient of variation of a soil property down the profile expressed as a percentage of the mean) indicate, as a single value, the variation down each soil profile in both mineral components (clay) and biotic components (organic carbon) within a soil profile. Master horizon development is also indicated for soils of alluvial landscapes in southeastern Australia. Source: Walker and Coventry (1976)

erosion are far outstripped by measured rates of soil loss from lands that are undergoing accelerated rates of erosion caused by human activities. Mullins (1986) has recorded soil erosion losses following high intensity storm events over the cultivated lands of both the Darling Downs and in sugar cane lands as high as 450 tonnes/ha (equivalent to 47 600 mm/1000 years). These erosion losses are some 2000 times greater than the natural rate of stream incision estimated by Coventry et al. (1985), and thereby emphasise the differences between natural and accelerated erosion rates in various parts of Queensland.

There are insufficient data available to allow us to determine how these measured rates of natural or accelerated soil erosion compare with currently active rates of soil formation. It is not unreasonable to suggest as a general principle that slow rates of soil formation are far outstripped by rates of soil erosion in most, if not all areas of Queensland. It must be kept in mind, however, that quantitative data are virtually non-existent!

2. 'Tolerable' Soil Losses

Attempts have been made to define 'tolerable' soil loss levels for particular parts of the world that will allow productive land uses to continue without destroying the soil resource. One such approach that has been widely endorsed is that of Pimentel et al. (1976). The key to their approach is that:

> "Under ideal soil management conditions soil may be formed at a rate of 1 inch in 30 years, and under natural conditions at a rate of 1 inch in 300 to 1000 years."

The 'ideal rate' of soil formation of 1 inch in 30 years (or 847 mm/1000 years - 8 tonnes/ha/year - 12 tons/acre/year) is still 10 - 33 times greater than that suggested by Pimentel et al. (1976) to prevail under natural conditions. Nevertheless, the 'ideal rate' of Pimentel et al. (1976) has been widely adopted in the wheat lands of Queensland and New South Wales as a limit to the rate of soil loss that may be tolerated with no serious effect on the sustainability of the agricultural enterprise. Soil losses of such a magnitude are sufficiently insignificant to be just noticeable in the paddock (Mullins 1986).

On the other hand, however, the annual soil erosion losses from cultivation land in northern and southeastern Queensland discussed above still grossly exceed even the ideal rate of soil formation suggested by Pimentel et al. (1976). Sheet, rill, and gully erosion all contribute to the serious soil loss problems that affect 82% of the cropping lands of Queensland (Begbie & Sullivan 1986). The soil is being removed at rates that are much, much faster than it can be 'reformed' by natural weathering and soil-forming processes. Our agricultural lands cannot sustain such high soil losses.

This concept of 'tolerable' soil loss arose in the young prairie landscapes of North America that, Beckmann & Coventry (1987) have argued, relate to soils and soil-forming conditions vastly different from those of Queensland. The relevance of such data to Australian environments must be questioned. 'Tolerable' soil loss figures derived from studies outside

Australia should be used only with great care in the Australian context!

SOIL RESOURCES AND SUSTAINABLE AGRICULTURE

Edwards (1988) has argued strongly from measured soil erosion losses in New South Wales that the concept of a tolerable soil loss cannot be supported under Australian conditions. He has suggested that, "It may be appropriate to adopt a figure that will limit the decline in productivity resulting from erosion to a minimum value. Sufficient data are not yet available to estimate the magnitude of that value whose determination depends, not only on an estimation of erosion rates under various management practices but also, on the quantification of the link between erosion and yield decline" (Edwards, 1988, p. 140).

As Beckmann & Coventry (1987) pointed out, all estimates of 'tolerable' soil losses obscure the essential fact that many of our Australian agricultural practices are steadily destroying the soil. We are, in effect, mining a non-renewable resource - and the mine has a limited life span.

The productivity of our soil resources is threatened by a variety of natural agencies, many of which are exacerbated by inappropriate management strategies. Perhaps the most widespread and devastating is soil erosion. Dryland cropping areas of the Darling Downs and Central Queensland have undergone localised severe sheet and gully erosion, often affecting the best agricultural soils of the region. Surface instability as a result of reduced ground cover in overgrazed areas of the rangelands of the semiarid and arid zones has the same devastating effect. Similarly, the sugar cane lands of humid coastal North Queensland yield massive sediment loads following storm rains. No lands are safe from the on-going, insidious effects of soil erosion.

Plant nutrients are lost from the soil system in solution and in the solid phase with the eroded soil materials. These nutrient losses are hard to quantify, but recent work in the upper Burdekin River catchment suggests that 10kg/ha/annum of nitrogen and 1 kg/ha/annum of phosphorus are lost annually from grazing lands under native pastures (Hicks, 1989). To replace these nutrients as added fertilizer would cost the order of $90 million each year (Gardener et al. 1989).

The fate of the soil nutrients that are lost from soil profiles is not accurately known. It is clear, however, that the river systems of coastal Queensland have the capability of discharging a significant sediment and nutrient load into the waters of the Great Barrier Reef. The survival of one of the world's great heritage areas may ultimately depend, then, on how effectively we can manage the various soils of the river catchments. That management has to address not only the sustainability of agricultural production, but also the long term stability of the whole ecosystem.

New methods to combat soil erosion and other forms of land degradation are continually being developed. Minimum tillage, stubble and mulch management, and sugar cane trash retention methods are being increasingly and effectively adopted in various areas of the state.

Beef cattle producers are prepared to consider new ways to avoid the

problems of overgrazing - even to the point of carrying less cattle on their properties in order to produce more beef of better quality. "Less mouths but more kilograms!" is a strong and vital message of the Dalrymple Land Care Committee to the grazing community of the Charters Towers area. The invasion of woody weeds such as rubber vine and chinee apple into pastures is another threat to the sustainability of the present grazing industry, particularly in areas where the cost of chemical control is more than the land is worth.

One of the big problems demanding the on-going attention of agricultural scientists is to address the issue of land clearing and timber management, particularly in North Queensland where extensive tracts of open eucalypt woodland still survive. The short-term benefits of increased pasture production after clearing are evident. What is not being considered currently are the long-term environmental hazards, such as the risk of soil salinization and soil structure decline. With many of the soils of the region containing measurable salt contents, there is an urgent need to develop risk prediction models for use at a variety of management scales from part of a paddock, to a hillslope, to the whole property, and to the entire catchment. Equally important, is the need to educate landholders of the possible long-term consequences of their present actions.

But these are not merely regional problems. The inevitable and calamitous consequences of continued land degradation surround us. Queensland agriculture can be sustained into the future only if management practices are developed with an understanding of the fragility of our non-renewable soil resources.

CONCLUSIONS

Many of the soils of Australia are old, and rates of soil formation are very slow. Soils cannot be "reformed" from their erosional remnants within hundreds of human life-spans. The existing soil is ALL that is available to present and future generations. It is incumbent upon us, then, to make all landholders and other users of the land aware that our soil resource is old and fragile, and must be managed accordingly.

Soils are like people; they demand careful management just as families do. In our families, we treat young and boisterous children very differently from the way we deal with our grandmother! Yet many soil and land management practices overlook a similar, inherent fragility of our soils - a fragility induced by the age and depauperate nature of the soil resource.

The need to look after Mother Earth is a growing message of the times in which we live. But we must pay her the respect appropriate to her age and fragility. In the 1990's the major task confronting the agricultural scientists of Australia is to find better ways to care for Grandmother Earth!

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STRIKING A BALANCE IN AGRICULTURE BETWEEN PRODUCTIVITY AND EXPOSURE TO RISK

K J COUGHLAN AND D M FREEBAIRN[1]

SUMMARY

The essence of good land management in the semi-arid tropics is the management of water. In an environment where water is commonly limiting, better use of rainfall through land management will lead to higher profitability as well as a more sustainable form of land tenure. This paper presents an approach for studying soil management based on a combination of local adaptive research, process studies and computer stimulation techniques. It is shown that a number of options are available for reducing some of the risks of production while at the same time improving short term profitability and long term sustainability. The apparent interactions between processes, some of which maybe in conflict in terms of production goals, can be better understood by studying the relative importance of these processes in the context of long term weather sequences using a computer stimulation of the system.

INTRODUCTION

Land use is of necessity a balance between use and abuse. The question is; how to manage the land for maximum economic return with minimal degradation of soil and water resources over the long run.

Risks to production and land can be reduced by:

1 using the land within its capabilities (not always easy to define and related to climate and available technology);

2 development of acceptable and sustainable land management systems; and

3 control of changed hydrology (due to agriculture).

The main risk to both production and soil degradation is due to climatic variability (largely rainfall). Yield variability of wheat in Queensland is due to high variability of rainfall, being higher than most other agricultural areas in the world (Russell, 1980). Also, low chemical and physical fertility of soils as well as pests and diseases increase the risks of production, the difficulties in management and the risks of degradation. Long term production is threatened by soil erosion resulting from high intensity rainfall and management practices which result in bare soil. Soil erosion rates measured from land under poor management range from > 100 t $ha^{-1}y^{-1}$ on steep canelands in north Queensland (Sallaway, 1979) to 50 t. $ha^{-1}y^{-1}$ on the eastern Darling Downs (Freebairn and Wockner, 1986). Structural degradation of soils manifest as compact zones within the soil profile and/or surface crusting have been observed over much of the cropping lands (McGarry pers. comm., Dalal and Mayer, 1986).

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The aim of land management research is to minimise risks. Our philosophy is therefore:

1 To develop systems which maximise utilisation of rainfall by reducing runoff and evaporation for different climate and crop combinations;

2 Avoid or minimise *in situ* soil chemical and physical degradation; and

3 When runoff is unavoidable, to control water using traditional soil conservation structures.

Reduced erosion and *in situ* degradation will both reduce landscape degradation while increasing yield potential and thus profitability.

We believe research has made and will continue to make significant improvements in development of farming systems which are both conservative and more profitable. Agriculture must respond to new technology to maintain profit margins in a world market economy, and research is the source of this technology.

We do not subscribe to the theory that enough is known and that it is only a matter of development, adaption and extension. To implement conservation tillage practices, for example, requires knowledge of why a practice works, and to what extent it works (not just that it works sometimes!). For example; In conservation cropping, how much soil cover is needed to reduce erosion to a target level? What damage is done to soil structure by strategic cultivation in 'minimum till' situations? What happens when no stubble is available?

Research on land management and runoff control makes its best contribution to sustainable production in two ways. Firstly, a contribution is made through development of 'regional' practices research (e.g. how to plant into stubble, nitrogen balance of pasture and crop systems, changes in soil structure due to management and pasture and crop rotation, effects of controlled traffic on soil properties and yield, etc.). These studies are often site or soil specific. Secondly, technology which allows integration of environmental factors and physical processes in a framework such that probabilistic estimates of outcomes can be determined (i.e. simulation models). Examples of the above two approaches follow.

REGIONAL PRACTICES

Measurement of hydrology and erosion

Runoff and soil movement monitored at a site provide specific information on the impact of fallow management on soil degradation (Figure 1). The presence of stubble cover on the minimum tillage catchment reduces runoff to a small extent, but reduced erosion to one third of the value from bare fallow. Pastures provide permanent cover, and result in minimal runoff and erosion. This result is site and season specific, and cannot be simply transferred to other conditions.

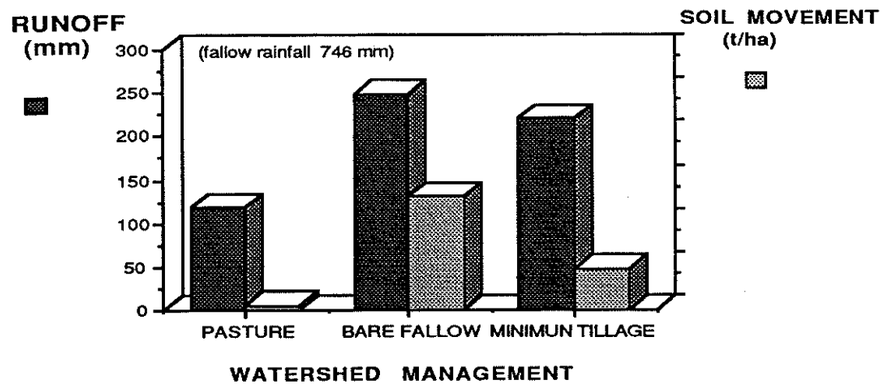


Figure 1. Runoff and soil movement for 1987/88 measured from 1 ha contour bay catchments at Greenmount, southeast Queensland, on a Black earth with a 6% slope.

Assessment of tillage practices for yield

Replicated experiments are traditionally used to determine the differences between tillage practices. Typically these experiments have compared tillage practices with and without stubble retention and may include rates of nitrogen (N) fertiliser application. Selected results for two treatments on such a trial near Billa Billa are presented in Figure 2.

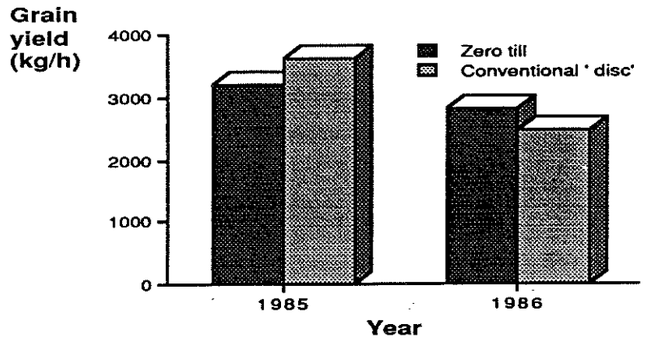


Figure 2. Wheat yield from two tillage treatments at Billa Billa in 1985 (wet growing season) and 1986 (dry growing season). (Source B. Radford and G. Thomas).

The variable yield from these two tillage treatments in two seasons is somewhat typical of tillage experiments across the world, reflecting the many interactions between climate, soil physical and chemical conditions and plant

N availability was not limiting. Thus, the zero till treatment produced a higher yield than conventional 'disc' cultivation due to better water storage in the previous fallow. The challenging question a farmer might ask after seeing these data is, which years results apply to me? Such questions do not have an absolute answer but can be presented as a probability distribution of results if a model incorporating the relevant processes and the climate data are used.

Modification of planting equipment for more flexible crop management

Timely planting is an important aspect of winter crop management in Queensland due to the narrow time window between frost risk at anthesis and the adverse effect of high evaporative demand around anthesis (Woodruff, 1986). The low probability of receiving planting rainfall within several weeks of optimum planting time results in many crops being planted later than desired with anthesis occurring during a period of high evaporative demand with resultant yield decline. Presswheels attached to planters have been shown to improve crop establishment and also increase the duration after rainfall when 'successful' crop establishment can be obtained (Radford and Nielsen, 1983). Figure 3 shows the results of planting wheat into what was considered by both farmers and scientists to be a 'too dry' situation. With the use of presswheels, a narrow tine and a sweep to push dry soil aside, crop establishment was changed from an unsuccessful 20% using a 'conventional' planter to 70% in a 'seedbed' which had not received useful planting rainfall for 6 weeks. Such a result, while dependent on soil type and current weather conditions, has been shown to have universality for most crop and soil types.

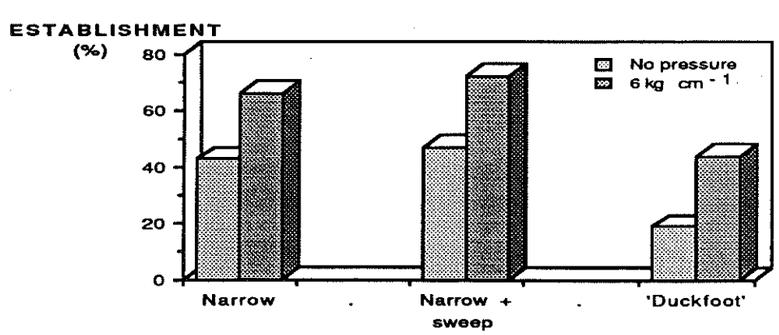


Figure 3. Effect of presswheel pressure and opener type on wheat establishment in a 'dry' seedbed - Wallumbilla brown clay.

Surface configuration and stubble cover to improve infiltration

Stubble cover has been shown to improve infiltration of high energy rainfall into Vertisols on the Darling Downs (Freebairn and Boughton, 1985). In drier environments or drought years, the amount of crop residue available for soil cover may be insufficient to reduce surface crusting and runoff. If cover is not present, infiltration is low, water storage is reduced and subsequent yields are poor. Thus, a vicious cycle of poor production is established.

Recently the use of equipment which produces pits on the soil surface to store excess rainfall and allow infiltration has been developed (e.g. Conservation King). Some types of this equipment require a 'fine' tilth to function effectively and also require stubble to be incorporated into the soil. The question arises, what is the interaction between roughness elements and stubble? Using a single intensity (28 mm h^{-1}) 'storm' of simulated rainfall (43 mm), the relative role of cover and roughness was demonstrated (Figure 4) (S. Glanville pers. comm.). Results from this simple test indicate that stubble is as equally effective as surface pitting alone, but in the presence of stubble, pitting may provide a management option for runoff control. Once again, the results from this experiment are rainfall type and soil specific, and require further analysis before general recommendations can be made.

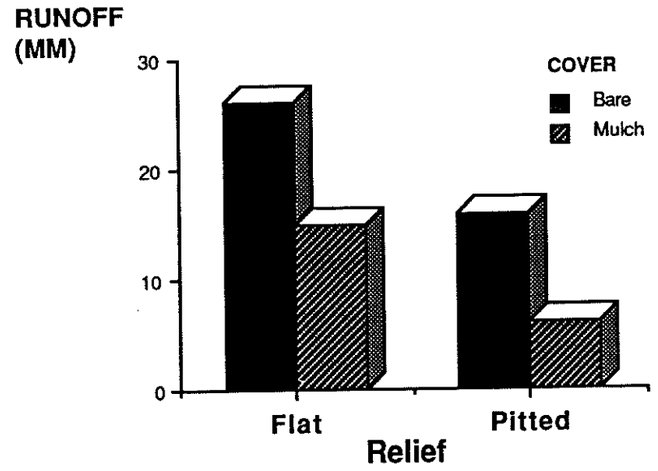


Figure 4 Runoff from 43 mm of simulated rainfall (28 mm h^{-1}) for flat and pitted soil with and without stubble cover. (Source S. Glanville)

SIMULATION MODELS FOR PROBABILISTIC ANALYSIS

Models allow us to answer questions that are either too complex (too many qualifications) or are not intuitively obvious. A model has been developed to simulated soil hydrology, erosion and crop yield. This model call PERFECT (Production, Erosion, Runoff Function for Evaluating Conservation Techniques) is able to examine crop rotations and is sensitive to fallow management (Littleboy et. al., 1989). A simplistic representation of some components of the model is shown in Figure 5.

The model can predict the hydrology and yield outcome from a sequence of crops and fallows where management and crop type can be compared. Several examples of the application of models to provide answers to both research and application problems are presented.

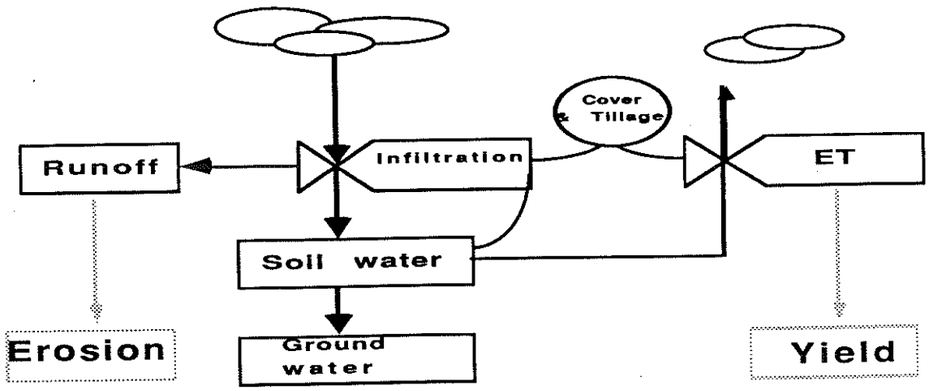


Figure 5 Simple representation of a water balance model.

Predicting the outcome of tillage experiments from year to year depending on seasonal conditions

Data in Figure 2 show that different tillage treatments may produce differing rank yields depending on what is the limiting factor in each season. Table 1 shows the median runoff, soil loss and yield of three stubble management practices predicted using 87 years of daily rainfall data as an input to the PERFECT model. A probability distribution curve would fully describe the runoff, soil loss and wheat yield and thus decisions on management can be made on the basis of those data. In this case, the retention of stubble as a mulch reduces runoff and erosion while increasing yield. Such a form of management is both more sustainable and profitable in both the short and longer term.

Table 1: Median predicted runoff, soil loss and wheat yield for three stubble management practices for the period 1898-1985 using the PERFECT model - eastern Darling Downs.

Stubble Management	Runoff (mm)	Soil Loss (t ha $^{-1}$)	Wheat Yield (t ha $^{-1}$)
Bare Fallow (Burnt)	49	34	2.01
Disc Tillage	45	22	2.17
Sweep Tillage (Mulch)	35	13	2.24

Extrapolation of results to new environments

It is difficult to test new practices on all soil types and locations. With the aid of a physically based model whose parameters can be independently measured or estimated, it is possible to estimate, in the absence of experimental data, the outcome of a cropping system in a location where only climate data and soil properties are known. For example, runoff and soil water were able to be predicted in the cental highlands of Queensland using

soil infiltration data from the Darling Downs (D.M. Silburn and M. Littleboy, pers. comm.).

Determining the representatives of short duration experiments

Our view of the world is biased by the relatively short range of our experience or memory. Models allow us to extrapolate through time as in the previous experiment but also allow us to see where our experience fits in with a longer term perspective. For example, what relation does soil loss from a short duration of experimentation (Figure 6) have to the longer term average? In the case of soil loss measured at Greenmount, the 11 year mean over the experimental period was slightly higher (51 t ha^{-1} y^{-1}) than the estimated mean soil loss (39 t ha^{-1} y^{-1}). However, if the four years 1984-1987 were the only years when soil loss was measured, mean annual soil loss would be 12 t ha^{-1} y^{-1}, close to the 'acceptable' level proposed by the USDA. By carrying out a simulation analysis, the length of expensive field experimentation may be reduced when a model is shown to adequately predict the relevant processes.

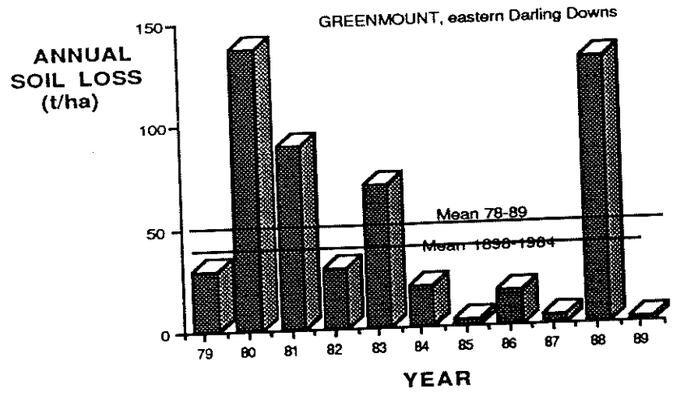


Figure 6 Annual soil loss measured at Greenmount on the eastern Darling Downs. Means for the period 1978-89 (measured) and 1898 -1984 (predicted) are also marked.

Predicting the net result of counteracting effects of conservation tillage

Yield

Yellow spot (*Pyrenothera triticii*) is foliar disease of wheat whose spores survive over summer on stubble from the previous wheat crop. One solution to reducing the chance of yield loss from this disease is removal of stubble by burning or cultivation. The absence of stubble may increase runoff and erosion thus threatening both the short and long term yield potential. The question is - what to do if a farmer can not grow another crop in rotation or cannot wait for genetic protection from the disease? Currently we are not able to provide a probabilistic assessment of the relative risks of water stress and disease on yield.

Infiltration

Figure 4 showed the difference in runoff from four surface conditions under simulated rainfall. A number of questions arise from this study. How long will the pits retain storage capacity? How many times during a storm with variable intensity will pits fill and empty? When pits fill, will the subsequent cascading create more erosion damage? These questions can only be answered (in a reasonable time) using simulation models which use mathematical representations of infiltration and soil subsidence as well as input of rainfall intensity.

Effects of land capability on productivity

Land capability is a function of both climate and soil properties. Figure 7 demonstrates that either soil or climate may be limiting crop production. In the drier cropping areas (e.g. Maranoa), climate is more commonly limiting yield of wheat, with only a small increase in yield potential for soils with plant available water content (PAWC) greater than 150 mm. Climate becomes limiting for soils with PAWC greater than 200 mm on the eastern Darling Downs. One deduction from the data in Figure 7 is that the so-called poorer or lighter textured soils in the Maranoa have a similar productive capacity to clay soils which have greater PAWC - the reason being that the higher water capacity is rarely used while the lighter textured soils can make better use of small falls of rain.

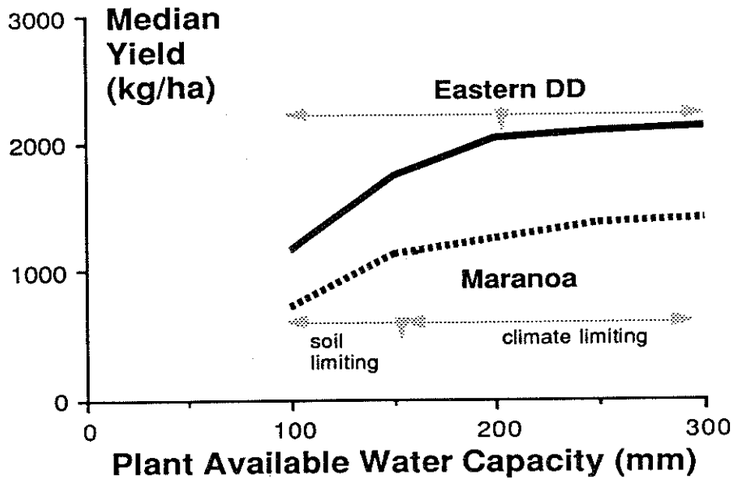


Figure 7 Influence of soil plant available water capacity (PAWC) on median wheat yield on the eastern Darling Downs and on the Maranoa. Data estimated using the PERFECT model

Effect of erosion of productivity

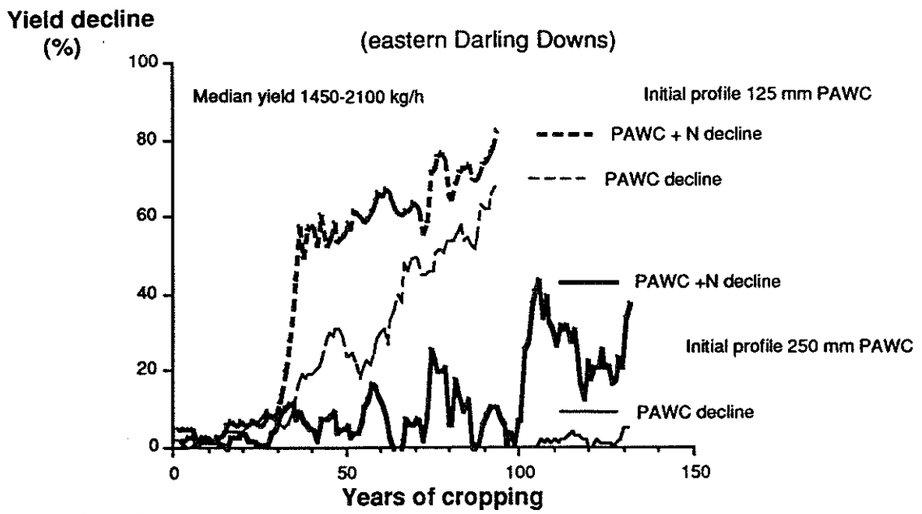
While it is a widely held opinion that soil erosion results in a loss of productivity, little information is available on the degree to which erosion reduces yields and profitability. Such information has been difficult to obtain because erosion is a slow and sporadic process, and its effects are often masked by climatic variability and technology.

The PERFECT model was used in two modes to estimate erosion effects on yield; (i) through loss of soil depth and PAWC, and (ii) through loss of both PAWC and N. Data in Figure 8 shows that shallow soils (PAWC 125 mm) in both the Maranoa area and the eastern Darling Downs suffer from large yield declines with erosion, and that the decline in yield increases rapidly after 10-20 years. Deeper soils (PAWC 250 mm) do not show yield declines greater than 10% for up to 100 years. Yield declines are slower in the Maranoa because erosion rates are lower, and yield are more often climate limiting rather than soil limiting (Figure 7). With the addition of fertiliser N, deep soils on the eastern Darling Downs can sustain yields for at least 130 years. This analysis does not consider off-site effects of erosion or *in situ* degradation of soil structure which may reduce the infiltration capacity.

DEVELOPMENT OF CONSERVATIVE LAND MANAGEMENT

Soil conservation has evolved considerably in the last 50 years. Initially contour banks were used to control gully erosion. Later contour banks were supported by conservation tillage methods which involved the retention of crop residues.

Currently, a 'model' of sustainable farming might include not only contour banks designed with a parallel layout and conservation tillage, but also elements such as storage and reuse of runoff, crop rotations which maximise use of soil water when available (flexible crop rotations) and cropping systems which utilise legumes (fertility maintenance). The necessary complexity of such a system requires careful economic analysis of proposed changes and higher levels of management. An example of a simple farm system involving contour banks, stubble mulching and storage of runoff water for later use as supplementary irrigation is compared with a system which practices 'black fallow' with no soil conservation structures to carry off 'excess' rainfall (Table 2). Mean yields can be increased by 12.5% while sediment loss from the catchment is reduced to 0.5 t ha^{-1} y^{-1}. Such a system has much to offer the farmer and society.



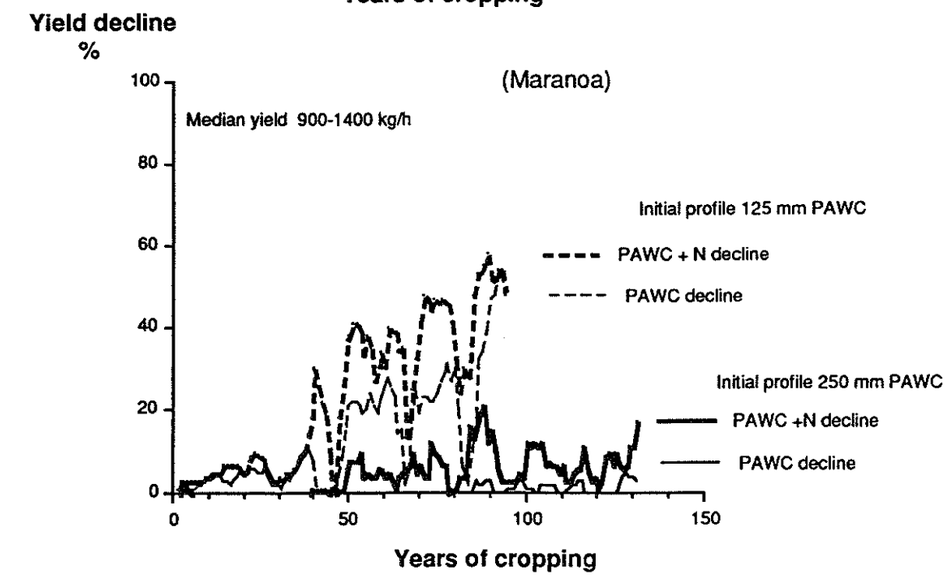


Figure 8. Effect of erosion on wheat yield on the eastern Darling Downs and the Maranoa. Erosion affects yield by reducing PAWC (solid line) and PAWC + N (broken line). Yield is simulated for two soil depths - 125 and 250 mm PAWC.

Table 2: Influence of stubble management, contour banks and use of runoff water collected in a farm dam for supplementary irrigition on runoff, soil loss and yield, eastern Darling Downs (Freebairn et. al., 1986)

		Wheat, Bare Fallow	Wheat, Stubble Mulch Contour Banks Dam + Supp. Irrigation
Runoff	mm	54	21
Sediment Loss	t ha^{-1}	37	0.5
Wheat Yield	t ha^{-1}	2.8	3.2

CONCLUSIONS

We believe that with the continuing cost squeeze on agriculture, economic aspects of soil management are becoming increasing important in the context of farm and catchment management.

The essence of good land management in our unpredictable climate is the management of water. In an environment where water is commonly limiting, better use of rainfall through land management will lead to higher profitability as well as a more sustainable form of land tenure.

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ALLOCATING RESPONSIBILITIES FOR SOIL CONSERVATION: ANALYSIS OF A COMPLEX NETWORK

R E RICKSON[1] AND D F BURCH[2]

SUMMARY

Conventional agriculture is not sustainable. Changes, some of which are already emerging, are needed to make it so. It is vital to understand the relation between the range of people and organizations who have a stake in future land management.

Voluntary acceptance by the farmer of new practices is basic to successful change. Any role of government must be seen as an action in the collective interest, free of political or private gain.

Whereas a farmer recognises a general problem of erosion or degradation he often does not identify any hazard on his own farm. He will support community action, but resile from dealing with his own problem. The solution lies more with education and enhanced perception than with legislation.

INTRODUCTION

It is generally recognized that soil erosion and land degradation in general pose serious threats to sustaining modern agriculture. Furthermore, we know that the problem cannot be solved by the invention and implementation of new technology. Indeed, the rapid diffusion of technologies and practices associated with capital intensive farming are fundamental causes of modern land degradation. Agricultural technologies ranging from hybrid seeds to new and better pesticides, herbicides and fertilizers gave the false assurance that the land would last without care and that production could grow unabated by land care. As chemical fertilizers were substituted for soil as a medium for plant growth, there was the logical conclusion that we indeed had a substitute for soil. Researchers and farmers are now discovering the falsity of these beliefs, noting that crop yields are seriously affected by soil loss and that fertilizers cannot, in the long run, substitute for soil.

We also know that fundamental changes in agricultural practice are necessary and, fortunately, some are emerging: e.g., farming systems relying on minimum tillage, organic farming and integrated pest management. There are several different views on conventional agriculture, but most agree that it is not sustainable unless we recognize the need for continual care and vigilance. There are no quick, easy and simple technical 'fixes'. The best definition of environmental management is that by Caldwell (1971:xiii). It is "...the control of human action in relation to the environment". He adds (1971:xiii):

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> "It is not the environment that is managed, but rather people. Environmental change or protection is the primary object (but the secondary effect) of this action. We change or protect the environment through directing or constraining the behavior of people. Principal among the formal social arrangements and processes through which human behavior is controlled are those called government and public administration."

We argue that a range of different people, organizations and institutions are involved with land management. A principal point of our paper is that understanding the relationships between these parties is a more important question than those which relate to how much soil conservation will cost, or 'who will pay'?

Large national and international agribusiness corporations promoting contract farming are also important to land management.

Agribusiness goals, policy and actions encourage capital intensive farming. Does this influence encourage farmer investment of time, personal energy and money into soil conservation practices and technologies? Or, are agribusiness corporations interested only in short-term maximization of production and profits. How interested parties respond to land degradation, how they define their responsibilities and others, how they evaluate government laws and policies are basic questions in land management. A large research literature has emerged dealing with these questions.

We discuss basic issues and present data on farmer responses to questions of responsibility including cost and the government's regulatory roles. We discuss also the emerging role of agribusiness. Data are derived from two projects funded by Australian Research Grants Scheme, the National Soil Conservation Program and the Australian Research Council.

Our concern is primarily with (1) farmer responses to land degradation, (2) their acceptance of responsibilities for conservation, acceptance and perceptions of the proper role of government and perceived obligations of others and, of course, how the two are related. Finally, farmer responses have to be considered in the context of a system where some argue that farmer autonomy and influence is declining.

FARMER RESPONSES

Soil conditions, land degradation generally, presents the farmer with a complicated and ambiguous set of stimuli. Research shows that farmers have great difficulty detecting many types of erosion, particularly in its early stages. For a variety of reaons, farmers are strongly motivated to underestimate erosion occurring on their own land (Rickson et al. 1987). Furthermore, technologies and practices have, in the past, been adopted by farmers when they promised short-term payoffs in crop yields and income. Technologies, such as fertilizers, could be easily added to existing farm practices, crop yields would increase, and fundamental changes in farm management practices were unnecessary. On the other hand, 'preventive' technologies, which include the most effective conservation technologies and

practices, are characterized by long term payoffs and some (minium tillage, for instance) require strategic changes by farmers in how they manage their land.

There are additional pressures on farmers to change via education campaigns by private associations or government action in the form of law, policy or agency regulation. Increasing demands for regulation and laws to force farmers to protect soil challenges very deep conceptions of agrarian fundamentalism in Australia that 'the rural life is the best life', that 'farmers are the backbone of the nation' and the proprietory rights of land owners - that they have the ultimate right to do what they wish with their land. Despite these sentiments, regulation of farm land use is becoming a reality. The general community and many farm groups reject notions that encouraging voluntary adoption of soil conservation measures by farmers through education and persuasion is the only acceptable way.

Governments, of course, are reluctant to enforce environmental law, and soil conservation law, in particular. Voluntary compliance, the voluntary acceptance by farmers that soil conservation is necessary, is a fundamental premise of educational campaigns aimed at farmers. However, the model is now being actively challenged as governments are encouraged to actively enforce environmental law. Bradsen and Fowler (1987:129), for example, compare land-use policy with regulations in other areas of law and policy recognizing that

> ...'problems confronting urban-industrial communities could not be dealt with adequately through the traditional channels of the common law. Hence, regulation has been accepted as necessary for the public or common good, at least by most sections of the community'.

RESPONSIBILITY AND REGULATION

In this section we attempt to specify the nature of incentives and regulations farmers support and the role of government they are most likely to legitimise as governments attempt to deal with the problem of soil erosion.

Environmental management or regulation, including general land management, is primarily a government responsibility and it principally involves the administration or control of how farmers use their land. A direct and affirmative role for government and public administration is therefore implied. However much this is needed, the effectiveness of law and policy depend upon farmers and the general community recognizing a need and legitimising government to act in the collective rather than private economic or political interest.

Law or regulations can improve environmental quality, only through administering or controlling how farmers use the soil (cf. Fisher, 1980). Farmers have strong views about agricultural land, rural life, government's role in land-use planning and their proprietory rights as landholders (Bates, 1987; Bultena et al., 1981, 1982; Craig and Philips, 1983; McDonald and Rickson, 1987). These views are variously based in traditional agrarian beliefs, values and economic self-interest in the use and marketing of land by proprietors. Priorietory rights are central to rural beliefs and these beliefs, predispose farmers against extensive government control in land-use.

Farmer perceptions of soil erosion as a problem is important in understanding farmers' responses to erosion or, in some instances, a lack of response. Government has a primary responsibility in soil erosion control in its development and enforcement of soil conservation law. Government agencies present farmers with certain types of incentives to encourage them to voluntarily adopt appropriate soil conservation measures and assume both a regulatory and educational role. Grabosky and Braithwaite (1986) argue that business and environmental law and policy in Australia is generally rather 'gently' enforced. If Bradsen (1987) is correct that modern soil conservation law is largely unenforceable or at least has not been enforced, then agency policy, regulations and incentives 'in the absence of enforceable law' are crucial (Fisher,1980).

The development of effective legal and educational programs to deal with land degradation and soil erosion in particular, require that (1) land owners (farmers in this case) accept land degradation as a problem for which they have some responsibility and (2) that they legitimise the right of government authorities to actively enforce the law. The two are not the same. The establishment of regulations or making laws to deal with a problem such as pollution or land degradation is a process quite different from enforcement of regulations (Rickson, 1977). In order for a law to be effective, at least in its ability to regulate behavior through policy, most people must accept the law and the administrative or regulatory policy as legitimate. Law and policy cannot effectively change behaviors which are damaging the environment unless these conditions are met. This is particularly the case when we deal with a situation in which 'normal', 'acceptable' behavior is that which must change if the problem is to be solved.

There are a number of basic questions associated with farmer responses to soil erosion. One is the extent to which farmers recognize that soil erosion and, more generally, land degradation or conversion of farm land to other uses is a problem. Educational programs are most effective at this stage, that of creating awareness about a problem. Knowledge of a problem is a complex process in that farmers are knowledgeable of general erosion problems, but are reluctant to admit they have a problem on their own farms (Rickson et al. 1987).

This finding is consistent with other studies and suggests that farmers have great difficulty see soil erosion on their own land even though they readily accept that soil conservation is a serious state, regional and perhaps community problem. This allows the curious conception that farmers support action at the community level or the state level but are reluctant to accept that they should engage in action to reduce erosion on their own properties. Therefore, there is sufficient evidence to suggest that farmer acceptance of soil conservation regulation at the general level is not particularly correlated with either recognition of damage on one's farm or voluntary commitment of the farmer to dealing with soil erosion on their farm.

Such perceptions may echo official approaches to the issue of soil erosion. Bradsen (1987) argues that soil conservation Acts are oriented toward obvious damage and not long-term insidious degradation which constitutes the main problem. Furthermore, he says that when the Acts were drafted they left soil conservation very largely optional, hence there was no need to consider more carefully what it meant.

Voluntary schemes should be able to come under the umbrella of Acts. But, in practice, "voluntary" schemes tend to be most successful when obvious damage has occurred and the soil conservation authorities have taken the initiative.

Earle (1987:412) found that "...in the 1970s and 1980s, the motivation of farmers to implement soil conservation measures appeared to be dependent on whether or not there had been a recent erosion event". Regional newspapers tended to emphasize major erosion events.

It is clear that legislation in the Australian states and at the federal level has the presumption that the farmer is responsible for soil conservation. However, as pointed out by Bradsen (1986:120), soil conservation has a number of different facets: research into land capability, planning and co-ordination on a regional or catchment basis, sound land-use management and, ultimately, enforcement. There is the further assumption that soil conservation is optional, not obligatory. Farmers are faced with a number of conflicting demands and pressures. We would expect that because of the nature of erosion, interest in protecting the soil might vary from year to year. It is the responsibility of government to keep soil erosion on the public agenda and not the individual farmer or farmers as a community.

1. Farmer attitudes to regulation:

Farmers are ambivalent about government regulation (Rickson et al., 1988; McDonald and Rickson, 1987). McDonald and Rickson (1987) report data from a study of Australian farmers' attitudes to land-use problems and land-use planning (Rickson and Neumann,1986); water shortages, farmland conversion to urban and suburban uses and soil erosion on farms were ranked as the top three problems facing farmers. However, their data showed contradictory statements or beliefs by farmers as to their individual rights as 'property owners' and their 'social responsibilities' as land stewards. For example, only 27% of farmers agreed to a statement that public goals of rural land conservation should be given higher priority than the wishes of individual land-owners. However, 88% agreed that "there should be regulations prohibiting the conversion of high quality agricultural land to other purposes".

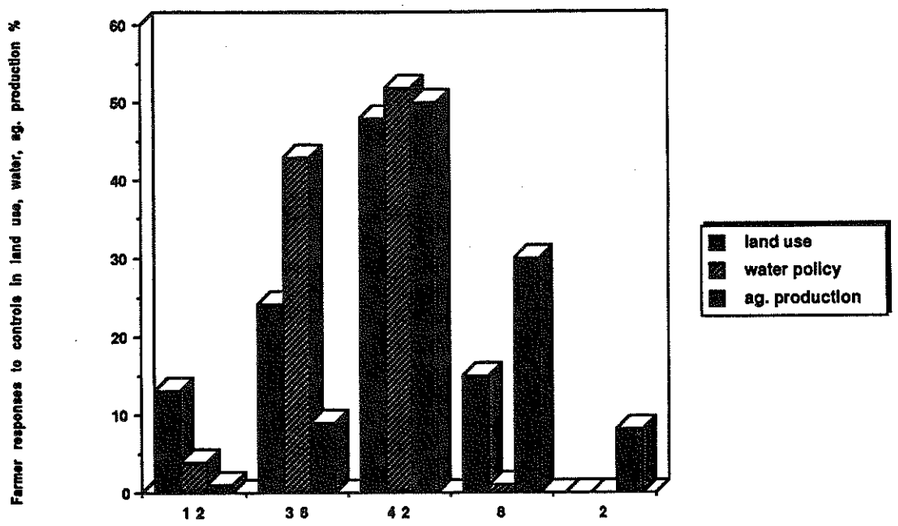
As indicated in the previous section, it is important that farmers accept the fact that laws associated with soil conservation must be enforced. Two aspects we look at are: (1) farmer support for government action and type of action supported; (2) farmer responses to DPI proposals or farm plans to deal with erosion on their properties.

Our questions were formed from an examination of the relevant research literature, extensive contact with farmers about the issue, newspaper coverage of soil erosion as a problem (statewide and regional newspapers and the 'rural press' in general) and conversations with relevant professionals in the Queensland Department of Primary Industries and other agencies. We found as Earle (1987) did in his study that the main policy option suggested was education or making people aware of the problem. State-wide newspapers stressed regulation whereas regional newspapers and the rural press stressed monetary incentives. In our pre-tests, farmers spoke mostly of educational programs and incentives and were generally against government taking a hard line and aggressively enforcing soil conservation law. The attitudes of professionals varied from a 'realistic' view, as they put it, that soil conservation law could not be enforced to the position that if authorities did not take a hard line then soil erosion would continue to be a serious problem. Farmers and non-farmers generally concede that government should have an active role, but are ambivalent about enforcement.

2. Farmers' attitudes to the role of government:

Farmers were asked: 'How much influence does the government have in the following areas?' The areas listed were soil conservation, land-use planning, preventing water pollution and off-site damage from soil erosion and a general question on amount of influence in agricultural production. They were asked to respond on the basis of government having 'far too little government control', 'too little government control', 'about the right amount', 'too much government control', and 'far too much government control' (Figure 1).

Figure 1: Farmer responses: "How much control does government have?"



In summary 48% of farmers say that government has either 'far too little', or 'too little' control in the area of soil conservation. Forty-two percent say that government has 'about the right amount of control'. At the other end of the scale, 8% of farmers respond that government has too much control; only 2% say that government has 'far too much control'. It is clear that farmers legitimise an active role by government in the area of soil conservation.

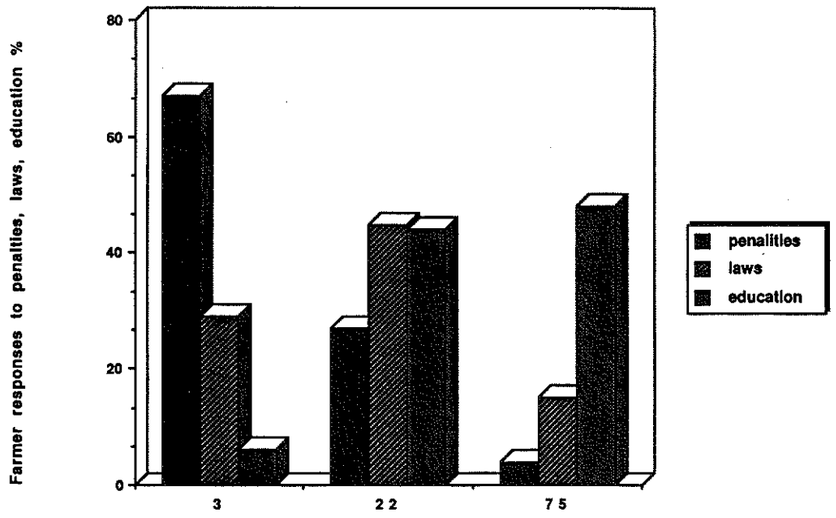
There is no evidence of ambivalence here by farmers in support of government control regarding soil conservation, land-use planning or controlling off-site damage and water pollution from farm soil erosion. The question on regulation or control of agricultural production provides an interesting comparison as farmers are obviously distinguishing between government influence over farmers' decisions about land-use and land degradation and ability to control or influence agricultural production.

Only about 2% of farmers say that there is 'far too much government control' regarding farmers' decisions about soil conservation. However, at this level, about 10% of farmers say this about government regulation of agricultural production (Figure 1). While about 35% say that government has 'too much control'. Farmers are clearly differentiating governments' role in decisions about land-use planning and land-degradation from decisions that farmers must make about their farm's production.

3. Farmers attitudes to policy instruments by government:

It is one thing to support government influence on a general basis, it is quite another to support or legitimise specific policy means or instruments which government might use to encourage or 'force' farmers to use appropriate soil conservation measures.
Figure 2 refers to policy instruments, economic incentives and penalties. The alternatives for farmer response are three: very unacceptable, acceptable and very acceptable. As might be anticipated, farmers support the use of incentives (75% say very acceptable), more than penalties. However, they are much more receptive to legal regulations than they are to economic penalties. About 60% are in favor of legal regulations while only about 31% are in favor of economic penalties. With respect to the latter, only 4% say that economic penalties are very acceptable. Education is, as would be expected, seen as a general and most acceptable solution to dealing with soil conservation problems.

Figure 2: Farmer responses to incentives, penalties, laws, education in erosion control



Farmers in this study are responding similarly to Darling Downs farmers studied by Earle et al. (1981:211). In that study, farmers were asked to give their opinion as to what would be most effective in controlling soil erosion, e.g., the choices ranged from 'more laws', 'more education', 'less laws', 'less education' or a 'combination of' those above. Most farmers in their study (52%) said 'more laws and more education' was necessary. About 48% preferred education to law.

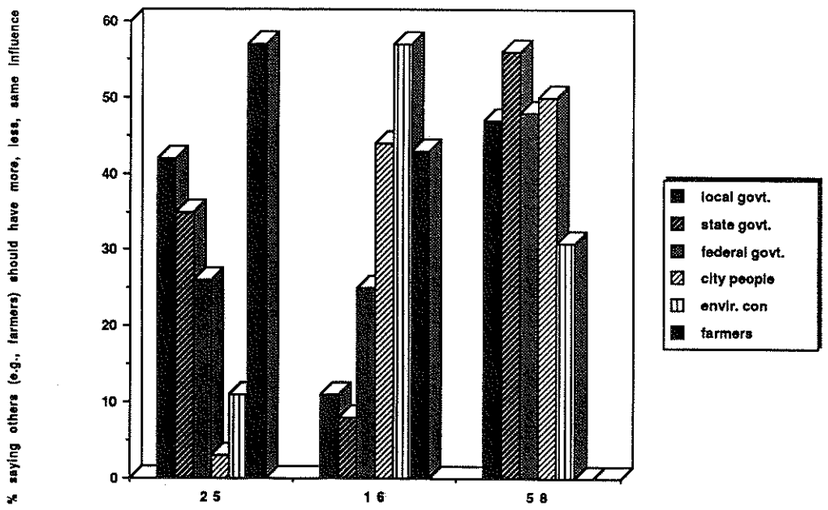
In general, farmers are opting for the status quo when they support incentives more than penalties or laws, education more than either. Penalties in particular are seen as 'unacceptable'. Farmers legitimise government action, but they do so quite specifically and they legitimise education over more direct action. Clearly, although farmers are in favour of government control, they are more conservative regarding the use of policy instruments and

subscribe to a voluntary model of farmer adoption of soil conservation measures depending upon education as a principal incentive.

4. Who should have influence? farmers, scientists, local, state, federal government, city people, environmentalists:

Figure 3 shows that 57% of farmers think that they should have more influence than they have now, 43% feel that farmers should have the same amount of influence they have now and none say that farmers should have less influence. Farmers here specify government influence. Forty-five percent say that local government should have more influence than now, 38% attribute this amount of influence to state government and about 30% say that the federal government should have more influence than it now has.

Figure 3: Farmer responses: How much influence should various groups have in soil conservation?



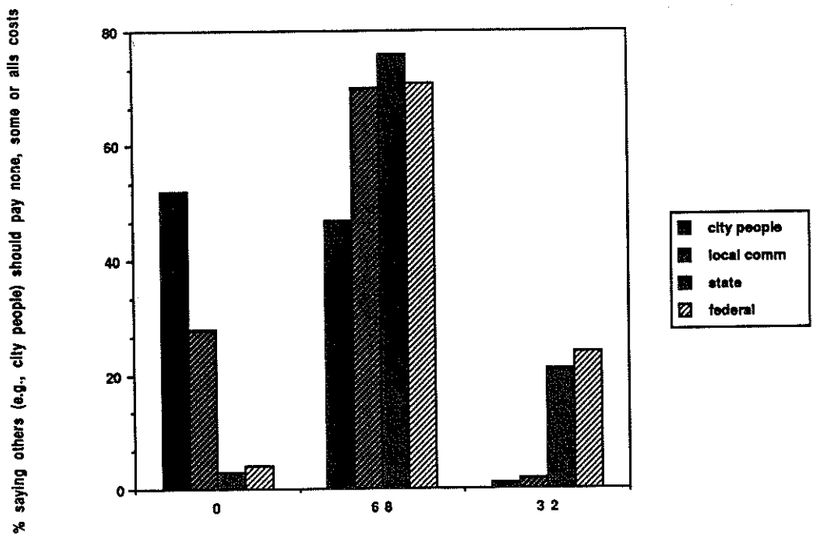
The other three groups (scientists, city people and environmental conservations) are accorded less power than they now have by farmers. For example, 25% of the sample say that scientists should have more influence than they now have, but only 2% say that city people should have more influence and about 10% think that conservationists should have more influence. However, the majority of farmers want each of these groups to have less power than they now have. Sixty-percent want scientists to have less influence than now, city people should have less influence than they have now and 30% of farmers say environmentalists should have less influence than now.

In general, farmers prefer that they have more influence than others with most farmers saying that all other groups listed should have less. Interestingly, environmental conservations are given more support than the other groups with respect to having the same influence they now have. Moreover, about 34% of farmers say this group should have less influence while 50% say this about local government, 58% say state government should have less influence and about 50% say the federal government should have less influence.

5. Farmer Attitudes to Costs:

Farmers were asked two questions associated with the costs of soil erosion control. The first asked farmers who they thought should pay the costs of erosion control: city people, local community (local authorities), state government, the commonwealth government, farmers. Farmers were asked to respond in terms of how much each group should contribute to costs, for example, should farmers or city people pay 'none of the costs', 'some of the costs', 'most or all' of the costs, 'all of the costs'. Figure 4 below illustrates the farmers responses to this question. Contrasting with common conceptions, farmers are willing to pay a substantial share of the costs of erosion control. The second question to farmers was 'In order to solve soil erosion problems how much tax are you willing to pay?'

Figure 4: Farmer responses: Who should pay for soil conservation: farmers or others?



Questions about taxes have to be carefully interpreted as respondents can act negatively to the term 'tax' itself and lose sight of the issue. Farmers' vary in their willingness to pay more tax (Table 1). Farmers were asked: "In order to solve soil erosion how much more tax are you willing to pay?" The responses ranged from "none" to "$300" or more. The responses are rather evenly balanced with only 29% saying that they would not want to pay any more taxes. Twenty-three percent are willing to pay $100-300 or more. Thirteen percent would be willing to pay $300 or more to help solve soil erosion problems. It is clear with these responses that many farmers are willing to support soil erosion programs by paying more taxes. Earle et al. (1981) found that farmers were generally willing to pay more taxes to deal with soil erosion, but underestimated the willingness of city people to pay more.

Table 1. Farmers' willingness to pay tax for soil erosion control.

	%
None	29
$10 more	23
$25-50$ more	25
$100-300 more	23

Responses to questions such as the above on the responsibility of farmers, and to questions about government regulation in the area of soil conservation are narrowly focused and do not take account of the changing structure of agriculture. We have argued (Burch, Rickson and Thiel, 1990) that the agricultural sector is currently undergoing a significant structural change which is not only undermining farmer autonomy and independence, but is also subtly shifting the locus of decision-making over agricultural practices away from the farmer. For example, processes of vertical integration in terms of supply of inputs such as fertilizer and pesticide, production and marketing, imply increased corporate control of the agricultural system. Lawrence 1987:132), in his book, has commented on this in the Australian context:

> "...simple commodity producers are, in fact, virtually totally reliant upon the up-stream agribusiness firms which purchase their output (the farmer's independence therefore being something of a myth).."

The increased integration of the farm family into the industrial economy through such corporate strategies as contract farming. "In this way the family farmer can be linked to the industrial economy without the necessity of formal ties between corporation and the farmer" (Lawrence 1987:132). While the farmer may appear to bear total responsibility for land management, there is a clear indication of corporate responsibility, not only for land use decisions but also for implementing conservation strategies.

The social and environmental impacts of contract farming is currently the subject of a major research programme sponsored by the Australian Research Council (Burch and Rickson 1989). Contract farming raises many issues which will impinge on policies for land management and soil conservation. While we have, in policy terms, so far have been focussing on the individual farmers, researchers into soil conservation have failed to take account of the changing structure of agricultural production which has direct influence on farmer decision-making and implies increased corporate power over farmer decisions. As we argue, this change has significant implications for land conservation as agribusiness corporations have growing influence and direct power in commodity production and thereby substantially influence decisions associated with land and water conservation, and chemical use.

FARMER DECISIONS AND CONTRACT FARMING

For much of the period since the beginning of commercial agriculture, the market was the place where the farmer and the buyer of agricultural produce met to transact their business. Under this system, farmers made decisions based on their own judgement and experience, and market signals concerning which crops should be grown or livestock reared, in what quantities, and where the produce or livestock should be marketed. In recent years, however, a system of contract farming has emerged, especially in vegetables but also in

areas such as poultry, eggs, fruits, and livestock.

This system, as described above, is based on an agreement between two parties (in the case of vegetable production, the farmer and the processing company engaged in the canning or freezing of produce) which, in simple terms, requires the farmer to plant a specified crop over an agreed acreage, to follow cultivation practices laid down by the processor, for harvesting at an agreed date. In return, the farmer is paid a guaranteed price based on the quality and volume of output.

The contract farming system has been widely adopted in developed and less-developed countries, because of the advantages which the system is said to offer when compared to traditional arrangements. Such benefits include:

(1) Greater certainty and predictability to the farming community, which avoids the 'boom and bust' syndrome associated with traditional farming systems;

(2) A greater knowledge and utilization of the latest technical advances, introduced to the farmer by the processing companies;

(3) A guaranteed source of supply to the processing companies, which enables them to contemplate a scale of production and a level of capital investment in transport, processing and packaging technologies which would not have been possible under the old system.

(4) Guaranteed supplies of produce by the supermarkets which are the main retail outlets of this system of production;

(5) Year round supplies to the consumer of vegetables which might have been previously been seasonal, at prices which are more or less constant; and the provision of a wider choice of vegetables, which are bred and harvested under optimal conditions to a high level of quality.

While the system has brought substantial benefits to the farmer, it also results in a loss of autonomy and independence which may, in the longer term, involve the producer in significant monetary and social costs.

Over the longer term, a contracted farmer may be subject to a process of 'de-skilling', increasingly dependent for inputs and 'know-how' upon the processing company. This dependence will be reinforced by the fact that once the farmer has entered into the contractual relationship, it is extremely difficult for him or her (but not the processor) to move out of the relationship. For example, vegetable varieties chosen by the processor for their suitability for processing, storing, etc., are seldom suitable for sale in the open market. As a consequence, in the event of some dispute, the farmer cannot decide to seek alternative outlets for his/her produce, while in the longer term it would take much time and money for the farmer to re-orient his or her production program away from the processing companies.

In short, the contractor/farmer relationship is one in which the distribution of power between the producer and the processor has shifted towards the latter. Thiel (1985) found that on numerous occasions, processors have either re-negotiated prices downwards, or offered delayed payment terms, both which have disadvantaged the farmer. Burch et al. (1990) found in their pilot study of contract farming that sudden changes in the terms of contracts was a basic

concern of farmers and an indicator of a lack of power by farmers to control contract implementation.

Davis (1980:141) equates contract farming with industrial piece-work. He notes that: 'Contract farming is agricultural piece-work, founded upon relations of production that are contractually established between non-farm capitalist firms and 'independent' agricultural producers'. Contract farming is distinguished from corporate farming by Davis (1980:141) in the following way:

> 'When a non-farm firm owns all of the on-farm resources and controls all the on-farm decision-making, this type of vertical integration is referred to as 'ownership integration', or corporate farming. In contrast, when a non-farm firm has title to only a portion of the on-farm resources and shares decision-making power with the farm owner, this type of vertical integration is referred to as 'contractual integration', or contract farming'.

Nevertheless, whatever the extent and form of integration, the ultimate goal is much the same. As a spokesman for the U.S. Tenneco Corporation put it in 1970, 'Our goal in agriculture is integration from the seedling to the supermarket' (Thiel, 1985). It can be assumed that similar factors are operating in the Australian context.

A major consequence of contract farming is the separation of ownership and farmer decisions about use of land and water resources. All forms of contract farming allow the non-farm firm some degree of direct control over farm management and production (Lawrence, 1987; Davis,1980; Roy,1972).

For example, the heavy use of chemicals as a technique of quality control, combined with a tendency for producers to 'over-insure' by applying chemicals at all levels higher than officially advised, can lead to the existence of potentially damaging chemical residues in crops. If lending institutions provide farm credit only when the farmer formally agrees to the use of pesticides (Nelson and Murray,1967), pest control is no longer the farmer's exclusive responsibility. Possible 'over-use' of ground and surface water for irrigation to ensure that crops are delivered on time at a particular quality may lead to increased soil salinity, erosion and 'off-site' pollution.

Short-term 'over-use' of resources is a form of temporary security to farmers, lending institutions, and corporate partners, in the case of contract farming. Schnaiberg (1980) sees this process as part of a 'treadmill of production' where partners are dependent upon increasing levels of production growth and incomes. Attention, over time, is more and more focussed on short-term growth and incomes at the expense of social and environmental impacts (cf. Goldschmidt, 1978).

Other wider environmental problems-the creation of a monoculture, the narrowing of the genetic base of agricultural production as processors hasten the introduction of hybrid plant varieties bred to display the characteristics they seek, the increased threat of disease and crop losses-are all possible outcomes of the contract farming system which pose serious questions about its long-term effects (Myers, 1985).

All of these points raise important questions about where responsibility for land management should lie. We have all tended to assume that, as the primary user, the farmer should be main focus when we decide by law and policy who

should have responsibility and to whom should policies be targeted. Our work suggests that we need to reconsider these assumptions based as they are on assumptions about the autonomy of farmers and the idea that land owners have ultimate power over land and water use on their properties. Agribusiness interests have more and more control over farm decisions through contract farming systems. Research on land and water conservation therefore needs to consider agribusiness goals and policies and how they affect the use of vital land and water resources.

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LAND CARE IN QUEENSLAND

BY D.K. BEGBIE[1]

SUMMARY

By mid October 1989, 47 land care committees had formed or were forming in Queensland. Nine committees had been formally appointed under the Soil Conservation Act 1986.

The formation of land care committees has been strongly supported by the major industry organisations, local authorities and the Queensland Government. Assistance mechanisms available through the State Government include technical advice, financial support, insurance cover, information dissemination and co-ordination of activities.

Land care committee activities vary widely across the State. Issues such as weed pests, timber control and pasture management dominate the activities planned by committees in the extensive grazing areas. Property planning, conservation tillage and specific techniques for erosion control are the focus of attention in the cropping and sugar-cane areas. Issues such as salinity, landslip and shade/shelter for stock are also being addressed with tree planting projects.

The challenge ahead now is to provide appropriate support to allow the committees to develop their sense of ownership and responsibility for practical solutions and to encourage them to achieve their land care goals.

INTRODUCTION

Land care has been alive and well in Queensland for a number of years. However, over the last 18 months there has been a rapid expansion in the formation of land care committees and groups.

Forty-seven rural communities had formed or were forming their own land care committees by mid October 1989. Committees covered a broad area from Charleville in the south-west to Beaudesert in the south-east and Charters Towers and Atherton in the north of the State. Much of the intensively cropped area of the state had been covered and interest had blossomed in the extensive grazing areas of western and north-western Queensland.

This paper provides a brief overview of the history of land care group formation in Queensland and discusses the activities of the committees and support available to them from the Queensland government. It also raises some issues relevant to the continued successful operation of land care groups into the 1990s.

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IMPLEMENTING LAND CARE IN QUEENSLAND

1. What is land care?

Land care is all about rural communities taking an active and leading role in promoting better land management in their local areas. It means landholder involvement, leadership, responsibility and initiative in planning and undertaking activities to achieve local land care goals.

The land care committee and group is simply a means of drawing together interested and committed individuals to enable land care objectives to be met.

Land care committees in Queensland are encouraged to have at least 60 per cent of their members representing primary producers in the area. Other members represent local authorities and state government departments and groups or individuals who take a special interest in land care activities.

Land care is more than solving soil erosion and land degradation issues. It provides a means of promoting sound land use and management to prevent land degradation problems occurring. It can encourage landholders to look to the future and adopt practices that are sustainable in the longer term.

2. A brief history

Six advisory group committees were formed in the mid 1970s and early 1980s in the areas of soil erosion hazard - four on the Darling Downs and two in the sugar-cane lands of the Burnett region. These committees were formed by the State Government to provide advice on the implementation of the soil conservation programs in those areas and to provide local input and leadership in the co-ordination of activities.

These committees were disbanded in 1986 after changes to the Soil Conservation Act but were encouraged to sponsor the formation of local, activity-oriented, landholder-based groups. They did this by holding a series of public meetings, resulting in the formation of land care committees in 1987 for seven local authority areas on the Darling Downs and for the Kolan and Isis Shire Council areas in the Burnett. Subsequently, another three land care committees have formed to date on the Darling Downs covering shires originally included in the previous advisory group committees.

In 1981 the Lockyer Watershed Management Committee formed in the Lockyer Valley to develop a community based, self help catchment project as a Bicentennial project. This group successfully established a number of smaller sub-groups in local sub-catchments, each tackling issues specific to each area.

In 1984, the Inglewood Shire Council established a Bicentennial Land Management Committee. This committee prepared a book on land management and presented it to all landholders in Inglewood Shire. The bicentennial committee formed into a land care committee on the completion of its tasks in 1988.

By about 1987, landholders in the Charleville and Goondiwindi areas had formed local landholder based committees with the major topics of interest being kangaroo cull numbers and rural nature conservation. Both committees have broadened their interests to include a wide range of land care issues.

About this time, the establishment of land care committees started to be strongly advocated by producer organisations, notably the Cattlemen's Union. By the end of 1988, support for the formation of land care committees was forthcoming from all the major producer organisations and the Queensland Government.

From the core of nine committees established by the advisory group committees, the two Bicentennial committees and two rural nature conservation committees, approximately 30 land care committees had formed by mid 1989. The numbers have expanded rapidly since then to total 47 by mid October 1989.

Landholders in a number of other locations right across the State have also indicated an interest in forming land care committees. By the end of 1989, there may be as many as 60 active land care committees in Queensland.

3. Government support for land care

The State Government's Land Care Strategy for Queensland was launched on 1 August 1989. The strategy contained four key elements, namely:

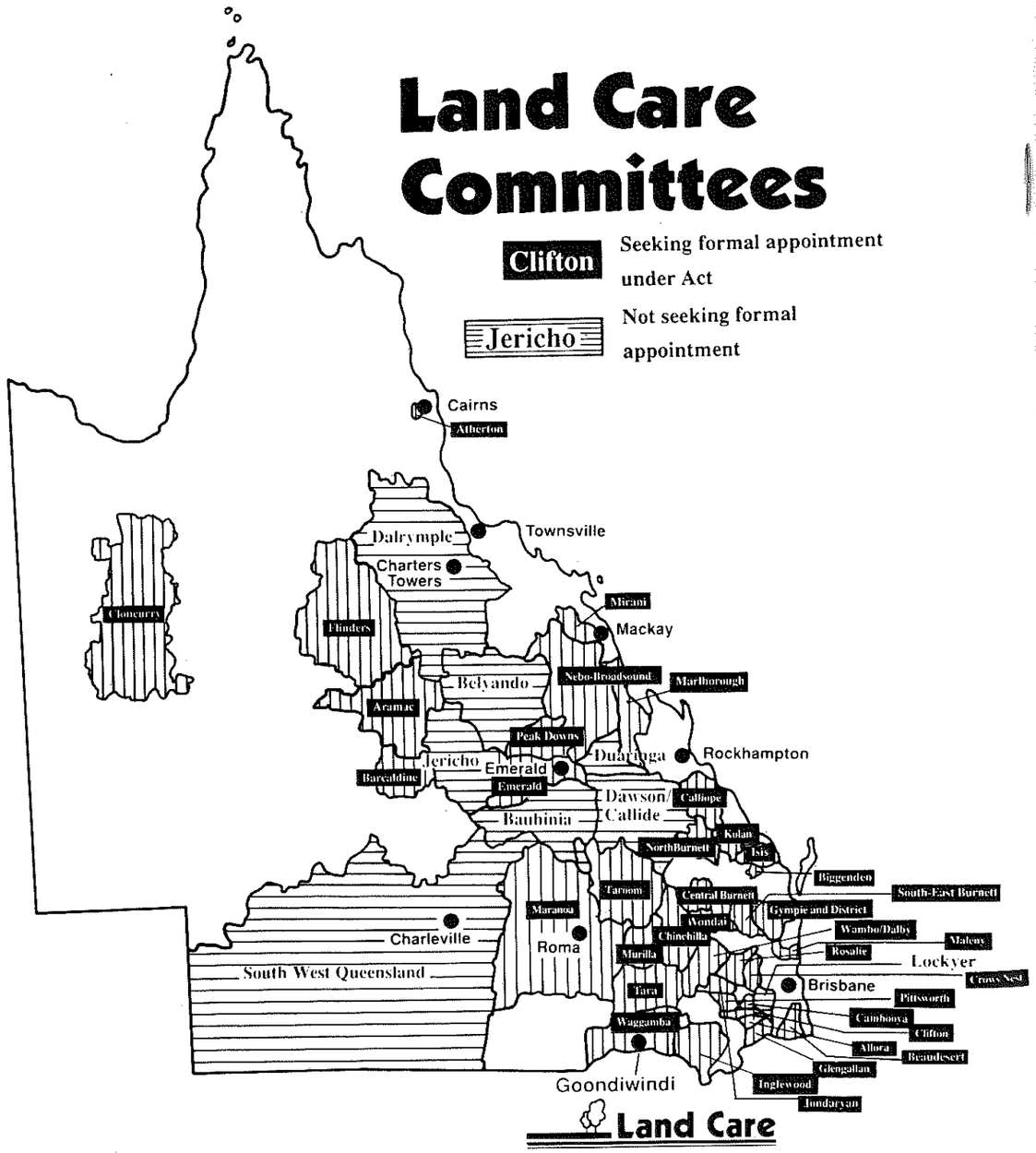
- establishment of a **Ministerial Task Force** comprised of the Ministers having responsibility for all government departments with an interest in land management;
- appointment of **Departmental Land Care Liaison Officers** within each government department with responsibilities that influence land use and management;
- support for the formation of **District Land Care Committees** through a range of initiatives; and
- encouragement for individuals and groups of landholders to implement **Land Care Activities** on their properties.

Local technical support and assistance is being provided to land care committees by officers of the Queensland Department of Primary Industries (QDPI) and other government departments. In addition, the QDPI is providing assistance with the formation and operation of land care committees through a range of initiatives.

The formation and operation of district land care committees is co-ordinated by a State Co-ordinator of Land Care Committees within the DPI.

Four regional land care facilitators have been appointed, with funds obtained under the National Soil Conservation Program (NSCP), to provide direct support in the formation and operation of land care committees. These officers will take an active role in encouraging and assisting committees to achieve their land care objectives.

A $250 establishment grant is available to assist in the formation of a land care committee. This help covers the cost of holding a public meeting, preparing a constitution and other initial costs incurred in establishing the committee.



A $100 operating grant is available each year to each committee appointed under the Soil Conservation Act. This help covers costs incurred in day-to-day operations, such as postage, photocopying, typing notices and minutes of meetings and other similar items.

Public liability insurance for land care committees and personal accident insurance for committee members and other voluntary workers involved in committee activities is available to all committees seeking appointment under the Soil Conservation Act. The public liability policy provides cover for the committee and individuals on the committee for up to $5,000,000. The personal accident insurance policy provides $100,000 death cover and provides for the loss of hands, limbs, sight, etc.

A land care committee newsletter is being published to provide the opportunity for committees to find out what other committees are doing and to promote their own activities within the community. Model constitutions for land care committees have been produced to provide a starting point for committees to develop their own preferred method of operating.

A series of 14 training modules for land care committees and the technical staff working with the committees has been developed by Dr Shankariah Chamala, University of Queensland and Mr Peter Mortiss, QDPI, in a joint project funded by NSCP. These modules will provide valuable information to assist committees achieve their objectives.

4. Activities of land care committees

Land care committee activities vary widely across the State. In grazing areas, committees are interested in issues such as appropriate methods of timber clearing and regrowth control, the spread of weed pests such as parthenium and prickly acacia and pasture establishment and rejuvenation.

The Dalrymple Land Care Committee, at Charters Towers in North Queensland, has held two field days to date. The first promoted the adoption of ponded pastures to increase animal productivity per beast allowing for a more rapid turnoff of stock, thereby lifting productivity without increasing stocking rates.

The second field day run by the Dalrymple committee provided a forum for graziers to assess eucalypt timber clearing and regrowth control strategies. The Inglewood committee has also held two successful field days examining different strategies for timber clearing and regrowth control.

Landholders at Richmond in the north-west of the State recently organised a field day to promote the control of prickly acacia (*Acacia nolotica*). The Aramac and Jericho Land Care Committees are planning activities to promote the control of rubber vine (*Cryptostegia grandiflora*). Both prickly acacia and rubber vine are introduced plants that have spread rapidly in recent years and now pose a major threat to the productive Mitchell grass pastures and river frontage country in western and north-western Queensland.

In cropping and mixed crop-grazing areas, committees are promoting activities such as property planning, conservation tillage and other techniques to control soil erosion. Self-help planning workshops with local groups of landholders are being actively promoted by a number of committees. The Glengallan Land Care Committee, at Warwick on the Darling Downs in south-east

Queensland, is planning to modify a chisel plough to make it suitable for one-pass planting operations in the soils in their local area.

In the sugar-cane areas, management practices for planting and ratooning cane after green cane harvesting are being demonstrated and promoted by land care committees. Landholders are also showing a keen interest in property planning activities.

In areas right across the State, committees have taken an active interest in rural nature conservation and issues such as salinity and landslip. Tree planting projects are already under way and are being planned to demonstrate effective techniques to control salinity and landslip problems.

This year, 13 land care committees submitted applications for funding for 19 projects under the Community Landcare Support Sub-program of the National Soil Conservation Program (NSCP). These projects sought contributions of $178,000 from the NSCP in 1989-90. Activities planned for funding include setting up demonstration sites, plant identification manuals, monitoring sites and trials, property planning and tree planting.

5. The challenge ahead

For many land care committees, the honeymoon period is over. The easy part is forming the committee, then the hard work starts. However, the committees can take some steps in the formation stage that will greatly enhance the probability that they will perform well when the action phase is reached.

Before the committee forms, time must be spent evaluating the need for the committee to exist and the level of support that is needed for the committee to be a success. Landholders must be able to identify the land management issues that are of concern to them and also believe that a land care committee is a viable means of addressing those issues.

The degree of support for land care must be assessed. This can be gauged from the response to public meetings, previous field days, etc., and by having a good understanding of beliefs and attitudes about land care issues held by the landholders in the area.

The committee needs to undertake immediate action to let landholders in the area know what is being planned and to seek their support. The existence of other committees that could take on the role of promoting land care must also be considered. There is little point in forming a new committee when an existing one can adequately handle the tasks.

Very early in the life of the committee, a clear perception of the land care issues confronting landholders must be gained. A number of techniques involving individuals and groups can be used to achieve this. The technique chosen for a particular group should provide the maximum opportunity for the new committee to set clear goals and objectives and to clearly establish its purpose. What is the mission of the committee, what role should it play to meet its objectives?

When a clear idea of mission, goals and roles is obtained, the committee is then in a position to plan activities that can address the priority issues it has identified. The committee must always keep in mind that to be successful it must address issues recognised as being important by landholders in the area. It must undertake activities that are seen to be relevant.

6. The importance of committee identity

The committee also needs to establish its own identity and legitimacy if it is to be successful. This can be done by planning activities that are of interest to landholders and that have a good chance of achieving a positive response. Early activities of committees should therefore be kept simple, relevant and address appropriate issues.

Some committees have tried to take on activities designed to involve everyone in the area covered by the land care group. This is usually done in an effort to establish the identify and credentials of the committee. If such activities are well planned, promoted and attended, they can adequately serve the purpose for the committee. In reality, such activities are hard to organise and run the risk of not being seen to be relevant to many landholders.

New committees may be better advised to plan a number of smaller events that are relevant to smaller groups of landholders in a number of different locations. With a couple of successes to build on, the committees will be in a better position to tackle the broader issues that involve everyone.

Adequate publicity for events and promotion of the committee or group is an essential ingredient for success. Publicity should be seen to be coming from the group itself, not from, for example, the government representative on the committee.

Each committee will need to monitor its own activities and evaluate whether or not it is effectively meeting its goals and expectation. On-going action learning will enable the committee to adjust its strategies and goals to ensure its activities remain relevant to the landholders in the area.

At all costs, the committees must develop their ownership of the issues and solutions. This can be done by maximising involvement and input by the landholders and the local rural community. Government, commercial businesses and any other institutions offering support to land care committees must be sensitive to the needs of the committees so that their sense of self-direction and self-reliance is not diminished.

This provides a quandary for those in supportive roles - what is not enough input, support and leadership to one committee can be seen as too much direction and interference to another. People providing support to land care committees must be able to recognise the appropriate level of support to offer and realise that this will alter with the stage of development of each group.

CONCLUSION

Land care has captured the attention and imagination of landholders right across Queensland. Groups of landholders have already identified their main land management issues, set goals and objectives and planned activities to achieve their goals. Assistance and support is being provided by the Queensland Government for the formation and operation of committees with technical input and advice from local Departmental officers. The scene has been set for district land care committees in Queensland to make major advances in the promotion and adoption of better land management.

CARE AND CONCERN FOR GRAZING LANDS:

HIGH EXPECTATIONS AND HARD REALITY

A.J. PRESSLAND

SUMMARY

Until the late 1960s cattle numbers in Queensland were reasonably static. The market problems in the 1970s led to a massive increase in the state's herd, which reached a total in excess of 11 million in 1976. Fortunately, the 1970s were years of above average rainfall and pasture production was sufficient to provide for this increase. However, since the beginning of the 1980s, rainfall has returned to lesser, more normal amounts with the attendant debilitating effects on the pasture.

Drought is common in Queensland, and since 1981 has been a dominant feature of the weather in many areas of the state. This has been the case in the Dalrymple Shire based on Charters Towers where the combination of high stock numbers and low summer rainfall put tremendous pressure on the soil and pasture resource.

Cattlemen in the Shire became increasingly concerned for the welfare not only of their stock but also their pastures. This concern was supported by biological data being collected by the Department of Primary Industries which demonstrated the impact of cattle on the pasture and on surface runoff water and soil loss. It also indicated that people's expectations of productivity from their land may be higher than that which could be realistically obtained.

A Land Care Committee was formed as an initiative of local cattlemen to address these problems. This paper shows how a well focused Land Care group can have a major impact in a short time. The processes involved in this success are briefly highlighted for the benefit of others. Land Care groups are suggested as the conduit by which public perceptions of rural resource management, and of the rural community may be modified.

INTRODUCTION

The grazing industry contributes significantly to the gross rural production (GRP) of Queensland. In 1988/89 this contribution was 43% of GRP or $1 888M. In 1987/88 most of this (c.$1 480M) was produced from native pastures (Figure 1); and $1 191M was as a result of cattle products and $477M from sheep products. It is vitally important for the future of this state that the level of pastoral production is kept high. This can only be achieved if the natural resource upon which the pastoral industry depends is maintained. However, the basic resources of soil and pasture are at risk because attitudes towards them are not always commensurate with environmental health.

1. People's expectations

The most common reason for deteriorating conditions of overgrazing lands has less to do with our unpredictable environment, than with the expectations: grazier expectations of the potential for animal production are much higher than the reality indicates. Expectations vary between producers and are a reflection of their attitudes to risk, uncertainty in markets and future weather conditions, and financial situation.

The consequences of these expectations include overgrazing; excessive and inappropriate timber treatment; saltation; invasion by woody weeds; and soil erosion. When these consequences are combined with the increasing use of dietary supplements, a change in animal type (for example, sheep to goats; *Bos taurus* to *B. indicus* cattle), and an increase in - or at least improvement in fodder and water availability to - kangaroos, there is the potential for disastrous degradation.

2. Weather or Not?

Much of the blame for these higher-than-realistic expectations can be laid at producers' attitudes to future weather prospects. We tend to fondly remember the good years but quickly put aside the bad years as abnormal. Yet the rainfall and drought statistics tell a different story. For example, in south-western Queensland the shires of Paroo and Murweh were drought declared for 70% and 55% respectively of the time between 1964 and 1984 (Pressland 1984, Pritchard and Mills 1986). Further, Charleville received less than its mean annual rainfall in almost two thirds of the years between 1880 and 1980. In fact, for most centres in Australia, rainfall is less than the arithmetic mean in the majority of years (Anon 1977). Surely, this is not 'abnormal'.

THE DALRYMPLE EXPERIENCE

I now want to take a particular area of Queensland to look, at the interaction between rainfall variability and amount, pasture and animal production, and pasture and soil stability. I have selected the Dalrymple Shire in North Queensland based on Charters Towers because I am presently involved with a study which addresses aspects of the interaction between cattle management and landscape stability in that district. However, my comments would be relevant to many areas of pastoral Queensland.

1. Rainfall

As for south-western Queensland, drought is a major feature of the environment of Dalrymple Shire (Figure 2). For example, between January 1986 and January 1988, 110 931 head of cattle were moved to agistment and 41 294 were sold as a result of widespread droughts. While this was an exceptionally dry period, Figure 3 indicates that for the months September to March, in excess of 40% of the years 1964 to 1984, were officially declared droughted.

2. Stock Numbers

It is enlightening to compare the actual stocking rates (calculated from the data obtained from the Australian Bureau of Statistics) with that which computer simulation modelling indicates to be safe (Pressland and McKeon 1990). This comparison (Figure 5) shows that between 1945 and 1963 there was good agreement between the two for Dalrymple Shire. However, due mainly to the export beef price collapse in 1974-6; but also to the changeover from *Bos taurus* to *B. indicus* cattle, the use of supplements and the effect of Townsville stylo (*Stylosanthes humilis*); cattle members doubled between 1964 and 1979 from 300 000 to 600 000 head. Until the mid 1970s these cattle could be supported by the existing forage because of above average rainfall and pasture production. However, the gap between the actual stocking rate and the simulated safe stocking rate widened from 1976 until the present in response to lower growing season rainfall (Figure 4).

3. Effects on Pasture and Soil

Maintaining excessive numbers of stock on pastures leads to changes in both pasture and soil surface condition. These changes are most pronounced on infertile soils in an environment of low and variable rainfall.

Changes in pasture composition, yield, basal area and projected foliage cover (PFC); and changes in runoff and soil movement were followed between 1985 and 1989 at two sites near Charters Towers. Site 1 was dominated by spear grass and *Bothriochloa bladhii*; Site 2 was dominated by Indian couch, a species which is rapidly replacing spear grass in manly coastal and sub-coastal areas of north Queensland (Gardner *et al.* 1989).

At Site 1, spear grass has fluctuated widely with season, but is still the dominant grass (Table 1). On the other hand, the contribution that gold beard grass makes to the pasture has increased particularly under grazing, while that of kangaroo grass has declined.

At Site 2, the contribution of spear grass has declined irrespective of grazing while Indian couch has increased under grazing over the period. Yield, basal and area PFC have all been higher at both sites in the absence of grazing.

It is indisputable that some changes in pasture have occurred due to grazing by domestic - and native - livestock. What do these changes mean in terms of landscape stability and animal production?

Where changes occur which affect the proportion of edible forage, or its quality, there is likely to be a reduction in animal production. The increase in inedible woody weeds in western grazing lands has led to a significant reduction in carrying capacity and therefore profitability (Mills *et al.* 1989). On the other hand, the author has some information which suggests, at least for more coastal areas, that a change from spear grass dominance to Indian couch dominance has little effect on carrying capacity, probably because the two grasses are quite palatable. Nevertheless, the increase in grazing pressure since 1964 has been a major reason for the demise of the tussocked spear grass and its replacement with the stononiferous Indian couch, Further, the 'soft' nature of Indian couch makes it potentially susceptible

to grazing pressure above those presently employed.

Whilst the change in species composition in some areas of the Dalrymple Shire from spear grass to Indian couch may not have had much effect on carrying capacity, there is evidence that it had a favourable effect on conserving soil, particularly during drought and at conservative grazing pressure. Over the two wet seasons 1986/87 and 1987/88 soil movement under grazing was similar at Site 1 (spear grass) and Site 2 (Indian couch) (Table 2). In the absence of stock there was a six fold difference in favour of the Indian couch. Thus, at lighter grazing pressure than those in force at Site 2, a reduction in soil movement could be expected. This constrasts with Site 1 where exclosure had little effect on soil movement.

Grazing also has an effect on the amount of runoff recorded. Often, runoff from grazed areas was an order of magnitude greater than that from areas where livestock was excluded. On one site for example, a storm of about 40mm produced runoff at a rate of up to 120 l/min on grazed areas compared with 45 l/min when livestock were excluded (Myles *et al*. 1988).

So, where does all this leave the cattlemen, and what effect has it had on his attitudes to pasture and stock management.

THE POSITION OF THE GRAZIER

The cattlemen in the Dalrymple Shire became aware that detrimental changes were occurring on their land due to the combined effects of drought (Figures 2, 3 and 4) and management (Figure 5). Extensive areas of bare ground were obvious from Townsville to Hughenden and The Lynd to Mt Douglas (Bob Shepherd, personal communication). But what could be done? Many of the factors which were resulting in these changes - markets, weather, interest rates - were out of their control (Table 3). Others - property improvement, animal husbandry, for example - are under their complete control. Whilst the finite natural resources can not be influenced by graziers, the condition of those resources are affected by decisions made by management.

A group of cattlemen under the leadership of Mr Roger Landsberg organised a Form at Charters Towers in June 1988 to highlight the problem of land degradation in the Dalrymple Shire. About 150 people attended and listened to talks from both technical experts and experimental landholders. The Dalrymple Land Care Committee (DLCC) was formed at this meeting, and comprised landholders and a member of the QDPI as secretary.

1. Establishment of DLCC Aims

The DLCC met on six occasions between June and December 1988. Three of those meetings were associated with field trips to experimental sites of QDPI and CSIRO and to commercial cattle properties. The main business of the early meetings was to establish aims and objectives for the committee and to address the issues of individual needs. This process was fostered by Dr Richard Moneypenny from the James Cook University of North Queensland who acted as the facilitator. He used group processes including brainstorming to elicit answers to the questions 'What should the committee do' and 'How should it be done'. The presence of the staff from the QDPI, CSIRO, and the Environment and Conservation Department aided in this process as they were familiar with the techniques. The cattlemen quickly caught on and were the major initiators of ideas as the 'government men' only contributed when the pace slowed.

What did the DLCC think important and how did it tackle its aims? The responses are showed in Table 4. Their perceptions of productivity were related to pasture improvement (costs, effectiveness); rainfall infiltration into the soil; soil loss; balance between trees and pasture; increasing numbers of shrubs and woody weeds; stocking rates; size of property; cattle management; and herd size, structure and quality. Maintenance of landscape stability was important, and was felt to be related to pasture condition and property size.

Attitude towards risk - particularly with respect to markets, finances and weather - and towards sub-division into smaller paddocks was seen to have an important influence on management style. The Committee also saw that the maintenance of its own credibility in terms of its objectives and actions was most important. From the individual producer's viewpoint, preservation of the land base which is the foundation of their livelihood, and the maintenance of their viability were paramount. Producers saw that many of the biological problems they were encountering could really only be addressed in the political area: they needed to lobby strongly to influence policy particularly as it related to taxes, and land lease and tenure.

The committee addressed the question 'How are we going to give the producer the answers he wants' (R.G. Landsberg, Personal Communication). Following quite extensive discussion as a result of the aspects mentioned earlier, it set three aims:

* to create an awareness of the level of land degradation in the Dalrymple Shire;

* legislation by government to enforce changes in management; and
* research directed towards the relationship between the state of the pasture and the condition of the cattle.

Education was seen as the immediate need. Accordingly the committee organised a program of field trips to highlight practical ways of changing management to foster land care. Some of these trips were to research sites of QDPI and CSIRO; others were to commercial cattle properties. In addition, major field days were help where up to 150 producers attended. The committee also fostered the production of TV film clips to advertise and demonstrate meaningful techniques of property development aimed at conserving the natural resources in concert with maintaining - and in fact improving - viability.

The committee has been active in political lobbying. It prepared a submission to The Parliamentary Committee of Enquiry into Land Degradation in Australia (October 1988) and has hosted visits by influential federal politicians including the Minister for Science and Technology and the Minister for Primary Industry and Energy. It lobbied successfully to have a Land Degradation Unit within the QDPI established at Charters Towers.

Further, it has attracted a large grant from the Dalrymple Shire Council to help fund its activities and has applied for funds through the National Soil Conservation Program to assist with resourcing pastures in degraded areas.

The DLCC has been successful because there was a real, recognised problem in the area. Local landholders wanted to do something to overcome the problem, and the DLCC has actively pursued its aims through ACTION, and it has plans for the future!

CONCLUSION

Concern for grazing lands has become widespread in the Australian community. The public has been quite outspoken in denigrating the approach of graziers to property development. Criticism is easy: it is much easier to destroy than to build, particularly when not all the facts which allow a balanced judgement are available. It is undisputable that Australia needs its pastoral industry (Figure 1). What is in dispute is the management of our resources - at the individual property level - needed to sustain it.

Management is the nucleus around which soil and pasture condition, and animal production resolve. Poor management leads to deteriorating pasture condition, loss of natural vegetation, increased risk of soil erosion and the development of salinity.

High expectations by the grazing community for production from a fragile, variable and sometimes unstable resource are often unrealistic. Also perceptions of the general public, including those well-meaning souls who advocate that all timber or woody species treatment and all herbicide use, should be banned, need to be changed before an ecologically sound basis for future development of Queensland's pastoral industry can be achieved.

To engender a land care ethos most emphasis needs to be placed upon influencing grazier attitudes towards dealing with our variable environment. Grazier attitudes to various management options; e.g. number of stock; more stock do not necessarily mean more money. Attitudes about animal death; to feed or allow animals to fend for themselves; to feed sell, or agist during dry periods, should be addressed. The question of economic viability v land care considerations also impacts on the decision making process. Graziers and their organisations need to recognise the rights of people outside their industry to question practices considered essential by industry. For their part, the general public, concerned for Australia's resources, needs to recognise that Australia needs rural industry, and that individual farmers need to maintain their competitive edge at a time when off-farm pressures (market, interest rates, weather) are making this increasingly difficult.

The potential impact of land care committees for achieving changes in attitudes is considerable. The experience of the Dalrymple Land Care Committee shows it can be effective. Government has recognised this in its approach to funding land care projects development by local committees through the National Soil Conservation Program. Care for Queensland's grazing lands is assured while industry, supported by government initiatives, is involved.

'One today is worth two tomorrows' (Benjamin Franklin) and 'Rejoice in hope; patient in tribulation' (Romans 12:12) are both quotes that epitomise the nature of rural production.

ACKNOWLEDGEMENTS

Whilst the views expressed in this discussion have been developed over a long period of interaction with producers and scientists, any errors of logic or interpretation are mine. The data presented in Tables 1 and 2 are from a project funded through the National Soil Conservation Program. Mr D.J. Myles and Mr P.D. Fleming assisted with this work.

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TABLE 1. Change in pasture parameters at two sites near Charters Towers[1]

	1985		1986		1987		1988	
SITE 1								
Botanical Composition (%)	G[2]	E	G	E	G	E	G	E
spear grass[3]	-	-	29	32	2	3	48	53
golden beard grass	-	-	8	11	15	22	17	13
Kangaroo grass	-	-	10	12	3	6	0	3
Yield (kg/ha)	1250	1380	475	1420	<10	<10	870	1660
Basal area[4](%)	2.8	3.4	1.5	3.3	0.8	1.5	1.5	2.0
Projected foliage cover[5] (%)	35	42	27	54	<5	15	34	54
SITE 2								
Botanical Composition (%)								
spear grass	-[6]	-	17	25	0	0	4	10
Indian blue grass	-	-	63	66	30	30	75	67
Yield (kg/ha)	450	590	<10	960	<10	<10	570	1250
Basal area (%)	2.6	5.2	2.6	2.9	0.9	2.9	2.3	2.4
Project foliage cover	39	46	24	50	<5	10	38	54

1 Unpublished data, A.J. Pressland, D.J. Myles, P.D. Fleming

2 G - grazed; E - no domestic livestock.

3 spear grass - Heteropogon contortus; golden beard grass - Chrysopogon fallax; kangaroo grass - Bothriochloa pertusa.

4 Basal area (%) - proportion of soil surface covered by the growing point of the plant.

5 Projected foliage cover (%) - proportion of soil surface covered by standing, intact plant material.

6 No data

TABLE 2. Total soil movement over the 1986/87 and 1987/88 wet seasons under different pastures in response to cattle grazing[1]

	Rainfall (mm)	Soil Movement (kg/m)[2] G	E
SITE 1 (spear grass)	270	4.85	4.76
SITE 2 (Indian couch)	265	4.51	0.79

1 Unpublished data of A.J. Pressland, D.J. Myles, P.D. Fleming.

2 Unit is the dry weight of soil collected per metre length of a trough placed with the upper edges at ground level, normal to the direction of the slope.

TABLE 3. Factors that graziers can and cannot influence.

FACTORS WHICH GRAZIERS CAN INFLUENCE

.. CONDITION OF NATURAL RESOURCES - SOILS
- VEGETATION

.. STOCKING RATES

.. PROPERTY IMPROVEMENTS - WATERING POINTS
- FENCING
- YARDS

.. TYPE OF ENTERPRISE

.. DIVERSIFICATION

.. RESOURCE INPUTS - PHYSICAL
- FINANCIAL?

.. PRESSURE GROUPS - ENVIRONMENTAL
- CONSUMERS (LONG TERM)

.. ANIMAL HUSBANDRY.

FACTORS WHICH GRAZIERS CANNOT INFLUENCE

.. MARKETS

.. WEATHER

.. NATURAL RESOURCES - SOIL TYPES
- VEGETATION
- TOPOGRAPHY

.. INTEREST RATES

.. PRESSURE FROM CREDITORS

.. CONSUMER DEMAND AND PREFERENCE (SHORT TERM)

TABLE 4. Dalrymple Land Care Committee's perception of important aspects relating to its aims and objectives.

WHAT DID THE DLCC THINK IMPORTANT??

.. PRODUCTIVITY

.. STABILITY

.. MANAGEMENT STYLE

.. COMMITTEE CREDIBILITY

.. PRESERVATION OF LAND BASE

.. VIABILITY

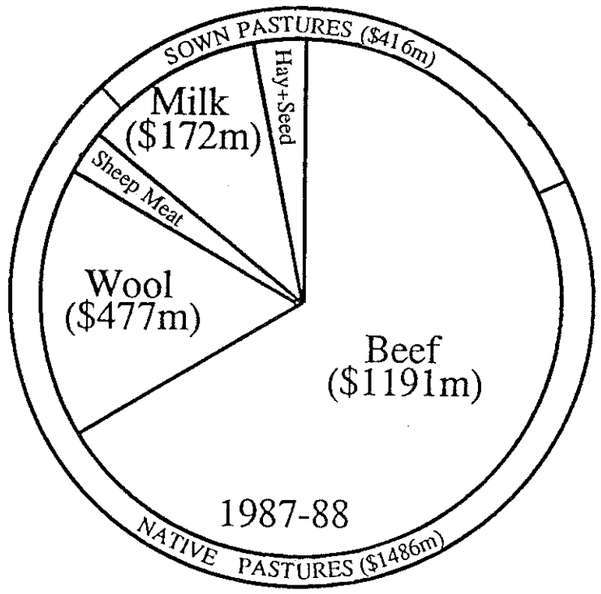
.. SOCIAL FABRIC

.. POLITICAL CLOUT - LOBBY.

HOW DID THE DLCC TACKLE ITS AIMS??

.. EDUCATION

- LAND MANAGERS
- TOWN PEOPLE
- SELF EVALUATION
- FIELD DAYS
- FORUMS
- COMPETITIONS
- TRIPS TO 'GOOD THINGS'
- RESEARCH SITES
- COMMERCIAL ENTERPRISES



TOTAL VALUE

1985-86 $1285m
1986-87 $1656m
1987-88 $1902m

FIGURE 1. A recent example (1987/88) of the annual value of pastoral production in Queensland.

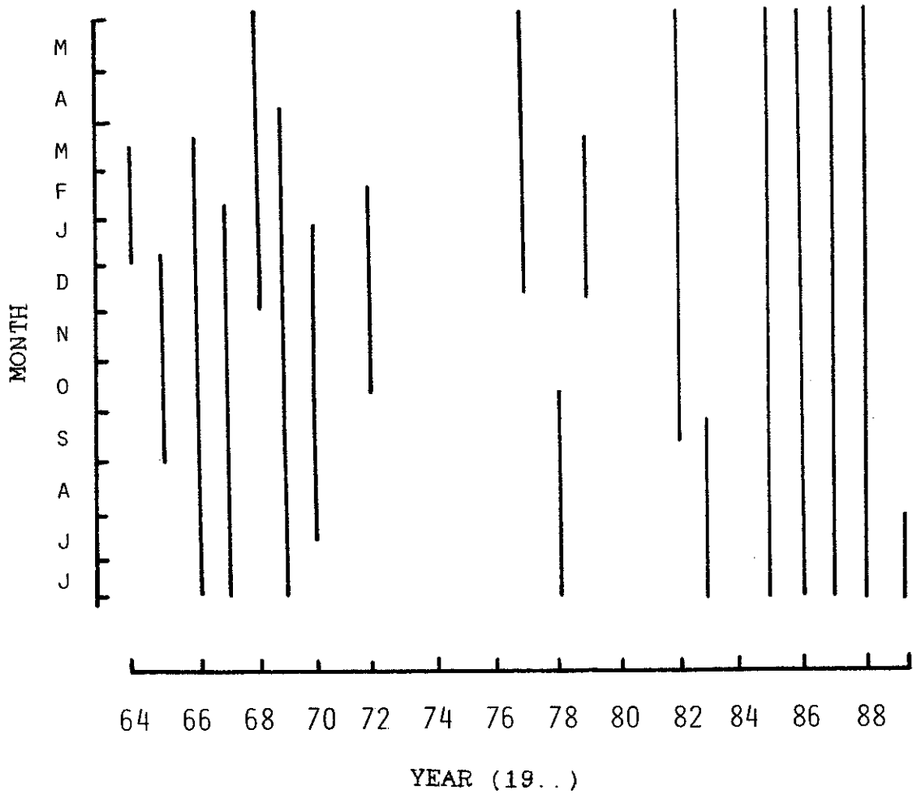


FIGURE 2. The duration and timing of drought declarations in the Dalrymple Shire, Queensland, 1964 to 1988.

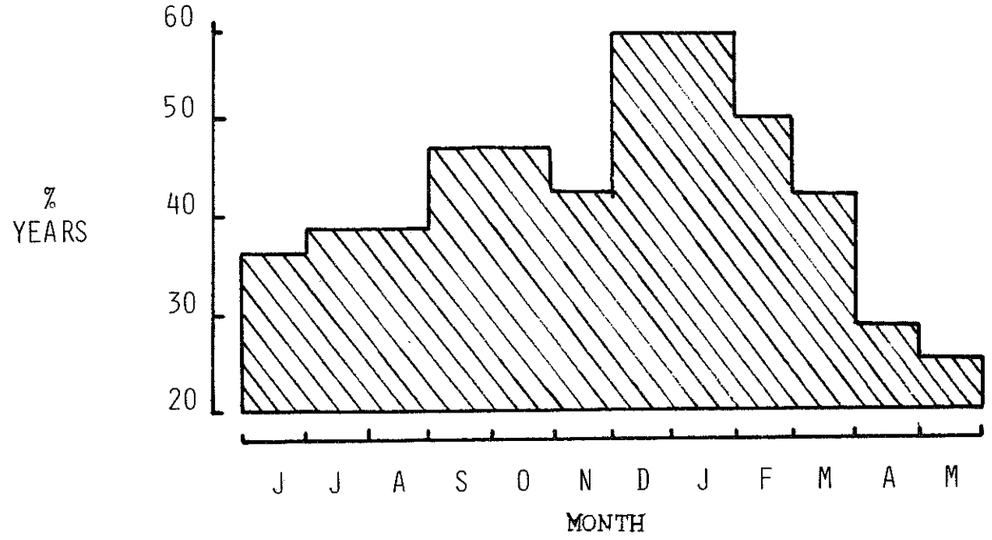


FIGURE 3. Proportion of years at Charters Towers, in the period 1964 to 1988, in which individual months were included in a drought-declared period.

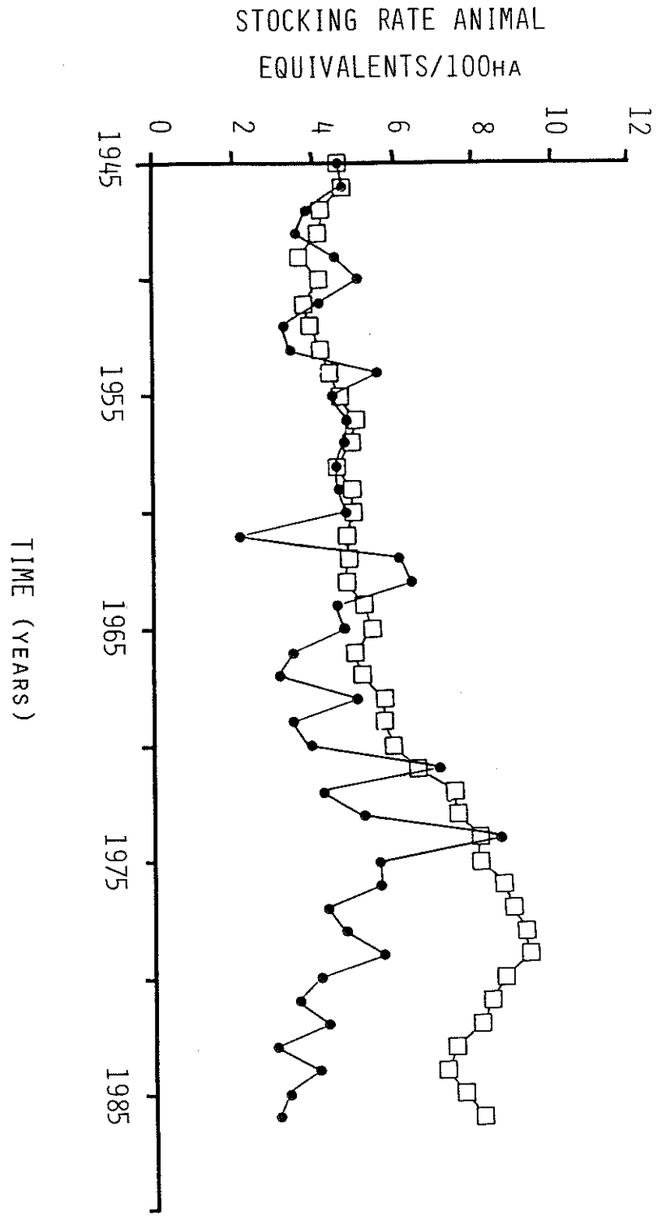


FIGURE 4. Five year moving average of summer and winter rainfall at Charters Towers 1982-1989, superimposed on the general mean for the whole period.

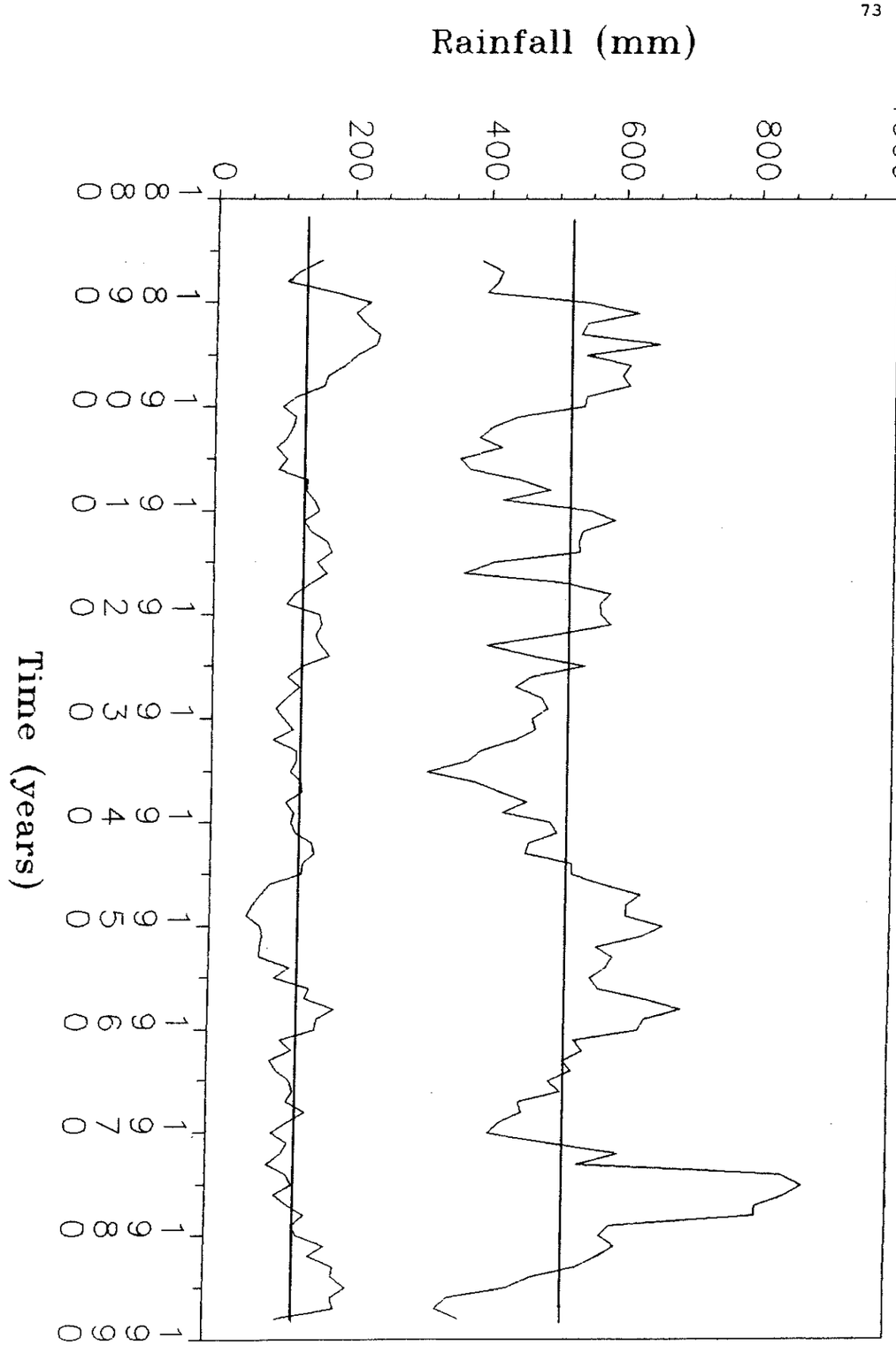


FIGURE 5. Comparison of potential stocking rate ( ) and actual stocking rate (+) in the Dalrymple Shire 1945-1986. Potential Stocking Rate is calculated using computer simulation.

THE LANDSCAPE PERSPECTIVE OF THE PRIMARY PRODUCER - 1

J G DOUGLAS[1]

SUMMARY

Landcare, which at best means people voluntarily adopting management that preserves and rebuilds the land resource is a major development in land management in Australia.

The stimulus to form the Mount Abundance Landcare Group grew from a concerted program to control Parthenium weed. The landholders recognised that the longer term problems of soil erosion, declining productivity of pastures, feral and native animals, and salinity required sustained effort. Whereas the extent of the concerned community was in this case clear, there is a vast area of Australia where the producers are too "thinly spread" to engage in group action.

While informed people have sounded warnings for a decade, the upsurge of interest and its translation into action has all taken place within the last two years. Eighty-five percent of producers will eventually change their management to improve and sustain productivity while sadly fifteen percent currently don't care about the issue. Such rugged individualists may finally be persuaded when the majority in their community have shown the outstanding result that can be achieved.

INTRODUCTION

I have been asked to speak today on Landcare from the perspective of the primary producer.

It would not be very constructive merely to give you my views of landcare, which are strong and positive. Rather, I will give you some appreciation of how the landholders out there in the Australian bush view landcare.

WHAT IS LANDCARE?

Landcare, like beauty, is in the eye of the beholder. The common factors are land and the people who manage it. The variable factors are numerous: soil type; rainfall patterns; topography; agricultural practices; and pastoral practices. These variables make the imposition of regulation to prevent land

[1] Mount Abundance Landcare Group, P O Box 320, Roma, Queensland, 4455.

degradation a huge undertaking. In any case the imposition of regulation should only be a last resort. The name of the game is to positively encourage individual landholders to embrace management practices for sustainable agriculture.

The landcare movement, as evidenced in Queensland, is one of the most significant developments in the history of land management in this country.

Landcare groups are being formed at a rapid rate but are still in an early development stage. There are now 47 landcare groups and the number rises every month.

FORMATION OF A LANDCARE GROUP

Let me give you an example of the development of one such group with which I have been closely associated - The Maranoa Landcare Group.

It was formed by an open meeting of about 50 landholders in Roma in mid 1988. It covers a large area across four shires with varying topography and production cattle, grain and wool.

The group has sought to define the major problems in its area and to promote better land management. Lately attention is being concentrated on particular problems such as gully erosion and devising projects which would demonstrate solutions. Property planning is high on the list for attention and a pilot project is being developed with Queensland Department of Primary Industry's assistance on three representative properties.

1. The Mount Abundance Landcare Group

An interesting progression has been the formation of a smaller local group - The Mt Abundance Landcare Group - under the umbrella of the Maranoa Group. I will outline the formation and aims of this group because I believe it is where landcare will go eventually if the movement succeeds.

Like most success stories in bringing landholders together, the Mt Abundance group was born out of adversity. A troublesome parthenium weed outbreak brough the landholders together for concerted action. But a knowledge of the aims of landcare inspired these people to take their concerted action further than controlling a noxious weed.

Consequently a meeting was held on a property where all the adjoining landholders in a valley area (28) attended. Under the quidance of the Q.D.P.I. landcare facilitator they defined their major problems in order of importance.

These were -

1 immediate - parthenium

2 soil erosion

3 decline in pastures caused by high stocking rate

4 feral and native animals

5 salinity.

Significantly this group - comprising all the landholders in a given area, agreed to meet on a week day once every three months. The meeting would be on one of the properties where management would be discussed - warts and all, after an inspection. As the problems present themselves technical information will be sought from Q.D.P.I. and relevant sources. Production and development information will be exchanged and soil and water conservation techniques discussed.

There we have an example of the near-perfect landcare group in its formative stage - with all landholders in an area involved.

2. Impediments to Landcare Groups

On the other end of the scale let me tell you that there is a huge area of Queensland - and of Australia - where a landcare group like this would not work. In the more remote areas comprising nearly half the State of Queensland people simply don't come together for group action. The distances are too great - the communities indistinct. These people may be reached through property planning requirements by the Q.D.P.I. extension service has not reached such properties in any significant way. They have been self reliant for generations.

But people even in remote areas are now taking stock of their management and development practices. There is an awareness that our land, in many places is in decline. There is a gathering resolve through individual and group action to do it better.

WHAT STARTED THE LANDCARE MOVEMENT?

All of this happened pretty suddenly. Informed people like Dr Brian Roberts have been sounding warnings for a decade and until recently these fell largely on deaf ears. It first had to be publicly stated by primary producers themselves that "our land is deteriorating" before there could be any major response like there is now. At the same time it had to be publicly stated that the solution is in the hands of primary producers themselves, helped by the best advice from Government and academic sources.

This was recognised and done by the Cattlemen's Union in late 1987 and early 1988. But that is another story.

Let me take you back to the most important part of the landcare equation -the landholder.

As one who had been president of a major grassroots producer organisation and travelled and attended meetings constantly for three years I claim some knowledge of producer opinion.

REACTION TO THE IDEA OF LANDCARE

I would split landholder attitude towards landcare into three categories -

1 Nobody tells me what to do (15%)

2 It is a good idea but does it mean me? (70%)

3 Landcare is necessary and I am practicing it now (15%)

Category 1 -

The first category comprises people who don't want to be told, don't plan ahead, or don't care. It is a problem and probably covers 10% to 15% or primary producers.

We must remember that this country was developed with great individual effort. People survived through hard work and self reliance in the face of a harsh climate and a fluctuating market price for primary products. That same self reliance is now somewhat of a barrier to people coming together into group schemes.

These rugged individualists in the "nobody tells me what to do" category will prove very difficult to regulate. The answer lies in two approaches -

First, have the landcare groups so effective that they are supported by a majority in any given community. This will provide sufficient social impetus to encourage most to join.

Second, provide incentives through taxations or soft loans which are linked to landcare action; in other words across compliance. The Federal Government should take this into consideration in its current "Review of Taxation Arrangements relating to Prevention and Treatment of Land Degradation".

Category 2 -

Category 2 people are those who are aware of landcare but unsure of their own involvement. I suggest that this is the great bulk of primary producers - perhaps 70% of them.

Their current awareness is causing them to give more forethought to day-to-day land management decisions and development planning, with the effect on their land in mind. But they have yet to join the landcare groups or to embrace the landcare ethic, as it relates to management, in an ongoing way.

The people in this category are fragile in their resolve. They will be influenced by economic pressure, by peer pressure and by green movement pressure. They will judge the effectiveness of landcare groups critically before joining them.

The sensitivity of these people is such that the formative years of landcare

in Australia will be vital. If a political dogfight erupts, if the green movement becomes outlandish in its demand for regulation, if the landcare groups fail to meet local expectations, the movement, now started, will struggle to survive. On the other hand, if bi-partisan political support continues, if the greenies adopt a practical supportive approach also and if the landcare groups really get to grips with better land management - then I expect major support from this large gorup. But it will take the addition of personal incentives, such as taxation relief and soft loans, to really lock them in to landcare in a significant and ongoing way.

Category 3 -

The third category - in their own way - are practicing exponents of landcare. Their land is in continuing good shape and they constantly search for better methods to keep it that way. They have probably sacrificed some short term gain to achieve long term benefit.

They may be quiet achievers and not about to shout their message from the rooftops. Their management practices and soil conservation techniques have been refined for their particular localities. They need exposure to other producers in their communities. This should be one of the primary functions of the landcare groups.

Chairman, I think that is how primary producers generally see landcare in its formative stages.

PERSONAL PERSPECTIVE ON THE FUTURE

Now I have some personal thoughts for you -

Landcare will be a progression. Landcare groups will ultimately become the most important focal groups in Australian agriculture. They can build knowledge and awareness of the best local sustainable management practices and at the same time be an extension point for the latest technical information on production and marketing.

The key to individual action lies in whole-property planning. This will be the major growth area for agricultural science.

A progression of landcare which I forsee would be along these lines.

- Establishment of active landcare committees to define the problems and seek solutions in their local situation.
- Strong back up for these groups from the relevant government departments.
- Federal incentives designed to encourage individual participation in landcare groups and landcare practices.
- An acceptance of landcare groups and active participation by most landholders.

- Taxation incentives and soft loans, designed to encourage soil conservation practices sooner rather than later.

- A phased introduction of incentives linked to whole-property planning. This would follow an announcement from the Government (with all-party support) of the intention to make whole-property planning a requirement for tax incentive eligibility. This key move would then initiate the education process necessary for property planners to be put in place.

The whole progression would take place over a decade, "The Decade of Landcare". At the end of it, Australia would have an integrated system funded and directed by the Federal Government, controlled by the States and implemented by landholders themselves with the best local knowledge available.

If we succeed Australian agriculture will be on a much sounder footing than at present. We will be repairing the damage which has already occurred to large tracts of land; preventing damage to huge areas and maintaining or improving production at the same time.

That is my perspective of Landcare. It is an exciting prospect and one in which you, the agricultural scientists of Queensland will have a major part to play.

THE LAND CARE PERSPECTIVE OF THE PRIMARY PRODUCER

ROD PETERSEN[1]

INTRODUCTION

No matter which way we look at the role of land care in substantiable agriculture the primary producer has perhaps the most important role of all for he is the front line troop who implements actual land management practices. Many practices in the past and in too many cases still are detrimental to the environment. So if the message we are preaching doesn't reach the farmer in the bush, we have failed.

Some practices over the years have been quite damaging. Some of the best land in my area has been lost after 80 to 100 years of agriculture. If we don't change now what will generations inherit in two hundred years.

Thankfully though, I believe that land degrading practices are now in the minority; 75% of cultivated land in my area is protected by contour banks or by some other soil conservation method. Unfortunately land holders on the remaining 25% will be those most difficult to convince that soil conservation is in their best interests.

WHAT IS TO BE DONE?

So what can the primary producer do? In my case I am a grain producer in the Killarney-Tannymorel area approximately 30 kilometres east of Warwick.

The area receives a 700 mm (28 inch) average rainfall but this can vary quite markedly. Because of its position in the western foothills of the Great Dividing Range, average summer temperature is generally lower and humidity often higher than more western areas. These factors influence the choice of dryland summer crops. Maize, soybeans, sunflowers and sorghum can be grown while in winter, barley, wheat or chick pea are grown.

I farm about 400 ha (1000 acres) including land owned jointly with my father as well as leased land. The various blocks I farm are spread over about 11 km (7 miles). My machinery therefore must be transported over public roads which is inconvenient and time consuming.

Soils are based on fine grained sandstones which supported a scrub or forest vegetation, and basaltic clay which supported forest also. Slopes are in the range of 2 to 6%, all protected by broad or narrow-based contour banks.

Following the establishment of a QDPI fallow management demonstration area in 1983 I have put a lot of time and effort into experimenting with various combinations of reduced and zero till as well as the necessary machinery modifications. My ultimate aim is to increase returns and reduce erosion risk by retaining as much stubble on the surface as possible. The use of

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[1] Glengallon Shire Land Care Committee, Killarney, Queensland

herbicides to control weeds is an integral part of my program and it goes without saying that not everything I have tried has been successful.

CROP MANAGEMENT OPTIONS

I do not operate a set crop rotational program. I prefer instead to crop as the opportunity arises. In other words, when establishing a crop I always attempt to leave the door open to be able to establish another crop directly after harvest if subsoil moisture is sufficient.

So my cropping program is a mixture of both short (6 month) fallow or opportunity cropping. I will deal with these separately.

The method I employ for a six month fallow does not follow a set pattern.

Usually for a winter crop fallow (fallow in summer) I would do a couple of early workings with a blade plough or chisel plough fitted with sweeps and rod weeder. I would follow later in the season with the herbicides to control weeds.

For a summer crop fallow (fallow in winter) I would normally control weeds with herbicides early in the season, roundup or atrazine depending on the proposed crop. Later in the fallow period I would normally cultivate once or twice to give some surface roughness before summer storms and to apply nitrogen fertilizer prior to sowing.

I have found that in a zero till fallow the soil surface crumbles to a very fine state and on sloping country this promotes runoff.

Following the very wet and boggy summer harvest this year I cultivated to eradicate problem wheel marks but this wasn't such a good idea. It hasn't rained since tillage to destroy the large clods. A reduced till fallow would have been a better proposition.

PROGRAM FOR OPPORTUNITY CROPPING

My program depends heavily on opportunity cropping, my philosophy being that, if sufficient moisture is in the soil upon harvesting a crop, there is little to be gained by fallowing for a further 6 months, unless it is needed to break a weed cycle. But with the right choice of crops a weed cycle can often be broken with successive opportunity crops anyway.

All my opportunity cropping is conducted strictly with zero till. In the short time available for planting I have found that if the soil is cultivated once it usually has to be cultivated three times to obtain the required soil tilth. This wastes valuable time and moisture so I find it cheaper and more reliable in the long run to use a knockdown herbicide after harvest and then plant at a convenient time. This may be immediately following the header.

Summer opportunity crops of maize or soybeans are established directly into barley or chickpea stubble. A couple of knockdown herbicide treatments would usually be used before sowing. Some fertilizer nitrogen is applied at

planting and if necessary more is sidedressed at a later stage.

SOYBEAN being a legume plays an important role in opportunity cropping. At planting I apply inoculum with the in-furrow spray equipment which is also used for applying insecticide in other crops. For weed control in-crop I may use "Claytons Cleaners" i.e. shielded sprayers. I have set them up to apply Roundup[1] or Sprayseed[1] between rows and Fusilade[1] on the row to control grassy weeds.

Winter opportunity crops of chickpea or barley are established directly into maize or soybean stubble.

	84 SUMMER	85 WINTER	85 SUMMER	86 WINTER	86 SUMMER	87 WINTER	87 SUMMER	88 WINTER	88 SUMMER
1	MAIZE		SOYBEAN		MAIZE	BARLEY	MAIZE		SOYBEAN
2	MAIZE		SORGHUM		SOYBEAN	WHEAT	SUNFLOWER		MAIZE
3			SORGHUM	CHICKPEA		BARLEY	SOYBEAN	BARLEY	SOYBEAN
4	SUNFLOWER		MAIZE		MAIZE	CHICKPEA	SUNFLOWER		MAIZE
5		BARLEY	SOYBEAN		SORGHUM		MAIZE	CHICKPEA	SOYBEAN
6	SOYBEAN	BARLEY	SOYBEAN		MAIZE	BARLEY	MAIZE		SOYBEAN

As you can see in the above crop rotations there is no strict cropping pattern. The choice of crop is determined by the weed status of the particular block, the soil moisture reserves, the timing of harvest and of course, the presence of residual chemicals. I have never adopted a strict rotational pattern because this winter we would not fallow through at a time when there is ample subsoil moisture for an opportunity crop, whereas next winter a fixed program would indicate double-crop at a time when we might have only limited soil water reserve.

I'm watching with interest what the long term effects of opportunity cropping will be particularly on structure and fertility of the soil. As can be seen from the above examples some blocks have been cropped continuously for longer than two years with no cultivation whatsoever apart from the planting operation. I guess I apply a few theories or attitudes here. Double-cropping, I believe, is the ultimate in erosion control, the soil being under a continuous crop cover. However, other farmers may say that putting country back to pasture, and grazing with cattle, would be more beneficial to soil structure. The same farmers may say that because I am cropping continuously I am flogging my land. I invite comment on my theory that opportunity cropping, particularly with a high legume component, would be as beneficial to the soil as pasture, particularly when one considers that under grazing much of the above ground portion of the plant is removed. With continuous cropping, only the grain is removed and stubble is retained as a mulch. In fact under four or five continuous crops quite a thick layer of litter and decomposing stubble is evident on the soil surface.

As I mentioned before, we had a very wet summer crop harvest so I took advantage of the excess moisture and zero tilled a large area of barley and

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[1] The use of the proprietary names does not imply endorsement by the author or the publisher of this article

chickpea into maize or soybean stubble. With only one effective fall of rain since planting crops have established in compacted wheel marks satisfactorily and would be equal to any winter crop planted into fallowed soil in the district. I believe that the best way to break up compacted wheel marks is to establish a crop immediately, to dry the soil and crack it open.

MANAGEMENT PROBLEMS

1. Handling chemicals

One of the major problems for the grower is the need to handle toxic chemicals. I haven't got any good advice short of treating them with a very healthy respect and using good equipment for measuring, mixing and applying chemicals. I use chemical injector type measuring equipment to avoid the need to pour and thus spill chemicals.

2. Insects

The soil born insect problem has certainly increased for summer crops. I have found it essential to use an in-furrow spray at planting time for summer crops particularly for zero tilled opportunity crops. At the moment though we lack a suitable insecticide. I would encourage research to control these pests. At the same time however, beneficial soil borne life has also increased. Earthworms in particular.

3. Machinery

I have still retained the blade plough, chisel plough with rod weeded attachment and scarifier, although the blade plough is hardly ever used now.

I have built a summer crop planter using Janke Parallelogram units with a rod weeder attachment for cultivated soil. Coulters can be added for zero till. I establish winter crops with a Mason Conserv-a-til planter complete with coulters.

4. Summary

Using chemicals for weed control allows me to increase greatly my cropping frequency, enabling me to opportunity crop and thus increase my income. Erosion control is greatly increased under opportunity cropping and also by using a chemical substitution fallow. On the debit side, the use of chemicals causes concern to many people in the community. Alternatively, the burning of fossil fuels for tillage is causing many problems in the environment also; the green-house effect, the massive pollution possible with oil transport, e.g. the recent oil spillage in Alaska. The grower is put in the position of being between the devil and the deep blue sea.

5. Future

I certainly don't claim to have everything off pat at this stage. Each season

is different and if you look back you can always see where you could have done something better. I want to increase my emphasis on legumes and this year I want to lay down some trials on short season cover crop legumes between successive maize crops for nitrogen build-up and erosion control. Also I intend to work towards controlled traffic farming. I feel these steps have the potential to decrease my inputs slightly whether by reduced fuel or chemical use.

LAND CARE COMMITTEES AND THE ROLE OF FARMERS

I believe farmers have to play a prominent role in committees such as land care.

The average Aussie is taking a much keener interest in our environment and quite rightly so. However, some views of the more radical Greenies are becoming quite extreme. I feel it will become more important for primary producers and agricultural scientists to speak out to provide a more balanced debate about some of the past and present land practices.

This country is not in the fortunate position of being able to afford to lock up country just to be able to look at it. We must continue with substainable land development.

I guess no two Land Care committees are working the same way but all in general are working towards the same goal.

THE GLENGALLON COMMITTEE

In the case of Glengallan Land Management Committee, since our formation about 18 months ago, we have conducted various activities with the aim of improving land management practices in Glengallan Shire; e.g. farm walks and field days on reduced and zero till techniques; bus trips to look at alternative methods. Some members of the group are organising a planed tree replanting scheme with 18 participant land holders over a complete catchment area which has in the past been extensively cleared and has the potential to run into salt problems in the future.

We have applied for funding for three projects:

(1) To set up and adapt a chisel plough with seed boxes, moisture seeking tines, coulters, press wheels etc. The finished machine will be available to landholders in the shire to see how machinery can be adapted. Farmers will be able to use it on their own farms.

(2) To trial various pastures suited to our particular area. The objective is to phase out annual grazing oats because serious land degradation can occur on sloping country by fallowing during the summer period for grazing oats.

(3) To determine which species of trees are most suited to replanting in our district.

Our local DPI extension officer and member of the committee will lay down quite a large demonstration area to compare different systems. Accurate costings and returns will be made between the conventional cultivated fallow, herbicide substitution fallow and opportunity cropping such as I am doing.

Hopefully in a couple of years figures will be available to show local farmers that on soil types familiar to them it is economically worthwhile to change their techniques to those using less aggressive cultivation but which retain more stubble on the surface.

This should avoid the cry I hear so often from farmers "Those techniques might work there but it won't work on my place because my soil (or rainfall) is different."

How do you measure success with a committee such as ours? It is hard to say, but interest is increasing in the committee and interest is also increasing in improving land management techniques. When we can successfully get all these measures on the ground profile of the land care group should increase and that in turn may place some degree of peer pressure on those slow to conform.

The major hurdle that we as a committee have to face is the fact that a large number of landholders in the area are older people set in their ways. They aren't particularly interested in attending informative field days of farm walks. Attitudes may not change until younger people take over these properties; I hope by that stage there's still some soil left!

Worrying Trends

A major problem farmers seem to be facing in many areas is urban encroachment into farming land. This can have many effects. In my area many of the small farms have been bought by part time farmers; people who have jobs elsewhere and desire to live on a farm because of the lifestyle, or retired city workers with a big super cheque.

This has caused the decline of the dairying and grain industry in the area with a detrimental effect on infrastructure set up to service these industries, i.e. milk and cheese factories or grain depots. However, to their credit these people usually have a keen interest in the environment.

Their concern for the environment however, can be to the detriment of neighbouring landholders. The greatest single advance in improved land management practices for cropping, has been the substitution of herbicides in place of mechanical tillage.

To the uninformed, all such chemicals are considered a 'no-no' in the environment. However, if 'chemicals' were banned the alternative is to go back to some of the land degrading 'bash-and-bury' techniques we used in the past to handle crop residues and to control weeds. Landholders near rural residential areas are coming under increasing pressure not to use chemicals.

I believe a lot more research is needed on the use of chemicals in agriculture. We need to demonstrate to the urban population that chemicals are necessary and safe to use. If chemicals are unsafe we should phase them out and look at alternatives as quickly as possible.

CONCLUSION

We are approaching a decade of land care. A lot of far reaching decisions on the environment which concern land management are going to be made from Canberra.

We, as concerned guardians of the soil, will have to be vigilant that the decisions made are the correct ones to ensure long term financial viability of primary production.

There is still room for growth in primary production. It earns 40% of Australia's export income. No other Industry in Australia except for the extractive Mining Industry has the earning capacity of farming.

EFFECTIVE GROUPS AND GROUP EXTENSION: KEY TO LAND CARE ACTION

B R ROBERTS[1]

SUMMARY

Rural extension organizations have always had three main types of communication available: 1. Individual Contact, 2. Group Extension, and 3. Mass Communication.

All three approaches have an important contribution to make in different situations and at various stages of acceptance of new ideas. Queensland has used individual contact and mass communication widely and effectively for decades, but group extension has been applied only sporadically and by a limited number of extension workers, either departmental or private.

The emergence of the Land Care movement has not only placed new demands on the advisory services, but calls for a different approach to how they approach their extension task. The prime change in the advisory field is the shift of initiative from the extension service to the landholder groups in the form of Land Care or Land Management committees. This places the advisor in the position of a supporting resource person responding to requests of the groups.

The Land Care movement will stand or fall by the effectiveness of the committees which form the framework for improved land management. The factors which make for committee effectiveness have now become essential elements for study by the extension worker. These elements must be understood and dynamically integrated into the activities of the group. Group Property Planning and Demonstration Projects will form the central core of activities in this long-awaited era of environmental awareness in rural Australia.

INTRODUCTION

In 1987 the writer summed up the Australian extension situation as follows:

"Since the early 1920s the recognition of land degradation has led to the enactment of legislation and the appointment of soil conservation staff in all states. Over time there has been sporadic emphasis given to the extension of soil conservation information in different states, depending on the size of the erosion and salinity problem and the political climate prevailing at the time. An analysis of each state's effort to curb land degradation indicates how the thrust of government and the department concerned has reacted to the

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socio-economic situation prevailing over the decades. There has been a parallel variation in the soil conservation research and extension effort over the years."

The need for an increased rate of implementation of soil conservation was highlighted by the Collaborative Study (Anon 1978) which gave the first comprehensive overview of the land degradation situation in Australia. Despite its shortcomings, this report demonstrated the alarming extent to which existing knowledge on sound land management had not been applied in practice in virtually all states.

While many soil problems still require further research before competent recommendations for sound management can be offered, there is much evidence that many of the tried and tested principles of conservation farming and pastoralism have not been adopted by the majority of landholders. The Collaborative Study Report (Anon 1978) indicated that 51% of rural production land was suffering from moderate or serious degradation, usually erosion or salinity. There is no evidence to indicate whether this situation has changed during the past decade.

In an unpublished survey for the Federal Advisory Committee on Soil Conservation, Robertson (1987) reported on the role and function of extension services in all states. Table 1 reflects only the contribution of those organizations primarily responsible for soil conservation which responded to Robertson's survey in their capacity as the states' "agency" in this sphere.

Table 1: Allocation of Staff by Soil Conservation Agencies1 in Australia (Robertson 1987)

	NSW	VIC	QLD	WA	SA	TAS	NT	ACT
Percentage of Departmental Staff engaged in General Extension	50	4.6	11.6*	6.0+	20	7.9	10	30
Soil Conservation Extension	50	2.0	2.4	<1	2.2	0.5	2.5	5

1 NSW-SCS, VIC-CFL, QLD-DPI, WA-DA, SA-DA, TAS-DA, NT-CC, ACT-DT+PCS
* Excludes 6.5% staff with minor S.C. role
+ Excludes 9.4% staff with minor S.C. role

These figures exclude the contributions of secondary agencies such as the Department of Agriculture in NSW or Conservation and Land Management in WA. The data suggest that if significant contributions to soil conservation are being made in states other than NSW, they are being made by organizations which are not the states' prime agency. In recent years the appointment of NSCP-funded extension posts has improved the situation in soil conservation extension in at least five states.

Much of the information supplied by departmental officers on crop and animal production could be gained from commercial sources. However, in the field of land capability, farm planning and some aspects of conservation farming techniques, the states' soil conservation agencies are often the only source of scientific information used by landholders. A shift in public attitude may make it necessary to examine the advisory services available to agriculturists relative to the service available to other industries such as manufacturing, small business and commercial enterprize generally. The reason for such enquiry lies in the free apparent over-servicing of the farming community in the sphere of commercial production at a time when scarce funds could be better spent in the sphere of resource use planning and implementation of sound land management (Roberts 1987).

The identity problem of the professional extension officer has been described by the author (Roberts 1986) as follows: "While many in research would point to the severe cuts in funding which they have suffered in recent years, they do have an identity, a status, a well-established educational base, a range of specialist societies which act as their spiritual home, and regular professional conferences well reported in their research journals. Extension on the other hand has none of these pillars of the profession. It has virtually no recognized degree training programme (with one exception), no society, no journal, no status, no identity, no nothing! In practice, extension officers make do as well as they can. They seek a technical home in the agricultural societies, a sociological home in the social sciences, a methodological home in the informatics and a career path in whatever is available at the time. A useful bibliography of Australian extension contributions (Chamala et al. 1985) reflects the above problems quite vividly."

THE NEW SITUATION

For the first time in the nation's history there is not only a widespread awareness of the community's dependence on the land for the major portion of national production but a realization that land care is a necessary ingredient for national survival. Lost production through degradation has been valued at $600 million per annum. This long-awaited change in man/land relations has the potential to usher in an era characterised by new community values relating to environmental concern. This in turn can be expected to bring new responsibilities and roles for both landholders and land use advisors in agriculture, pastoralism, forestry, wildlife management and mine site rehabilitation.

The recent developments, singly and in combination, create a new and different frame of reference for both rural leaders and advisory personnel. The thrust has been for landholders to be more pro-active, more innovative and more responsible for giving direction in land management. This reflects a major change in the attitudes and actions in the rural areas of all states, and constitutes a "new deal" in environmental awareness in Australia. Advisors, researchers and administrators now find themselves responding to calls for support from a burgeoning corps of allies on the land, in their attempt to improve land management, productivity and stability of the ecosystems on which the community depends.

Rather than acting as the expert, giving advice on a one-to-one basis, the specialists are now invited to offer resources and support to groups acting in concert. Under the emerging circumstances, an understanding of effective

group extension methods, which have been neglected since their development by the Americans and the Dutch in the 1950s, needs special attention at an early date. Advisors will have their greatest effect on land management if they encourage the self-help groups to identify their own problems and to "own the solutions". This can be best achieved by evaluating causes and alternative solutions through vigorous and open group dynamics in which a majority of landholders are involved. In this way, land care, soil erosion and loss of fauna and flora will hopefully no longer be regarded as the government's problems waiting for the government's action.

WHAT IS SUSTAINABLE?

Predictably the rapidly emerging new approaches have led to uncertainty and insecurity on the part of those in leadership roles in producer groups, extension services, research organizations and educational institutions. The way to overcome the present tentative stance is to begin by discussing goals and objectives, in an effort to reach agreement on the targets of land care as a nation-wide movement of potentially immense significance. What are we trying to do? Who are the players? What are their roles? These are the questions that need to be seriously addressed within the concept of "sustainability" as the guiding principle.

Many researchers and advisors have tried to simplify the bewildering complexities of the large number of inter-related factors which contribute to sustainable rural production and "ecological health" of Australia's country districts. The result of what Odum has termed "the struggle for perspective", can be stated in simple tabular form as shown in Table 1, The Elements of Sustainable Agriculture (Roberts 1989). In essence the four factors in the right hand column are the targets which managers should aim at, whatever their production system. These can be achieved by a variety of practical methods on the property. It is suggested that if these four requirements are met, the system will be sustainable. Initially, it is not necessary to quantify in any precise way, the acceptable level of achievement within each criterion, provided the direction and trend is positive. It is suggested that these four targets are unlikely to be met unless the initial decisions on land capability (in the left hand column) are made correctly in the first place. These concern the fundamental issues of suitable slopes, clearing and carrying capacity. The central column of the table represents the elements of the socio-political framework required for acceptance and implementation of permanent production systems.

The "ifs and buts" arising from any attempt to crystalize thinking about a complex situation, must of necessity lead to qualifications and additions to the "bare" statements. Consideration of how each of the four target criteria can be achieved indicates how tree planting, wildlife habitat and the use of fire are incorporated as building blocks of balanced land use programmes.

COMMITTEE ACTION

The writer has been active in the encouragement and establishment of many local committees and has followed their progress with intense interest. Everyone agrees that setting up the committee is the easy part - the difficult

part is maintaining enthusiastic action within priority directions agreed by the group concerned. Our group, the Toowoomba Erosion Awareness Movement, has consistently emphasized the complimentary roles of education, incentives and regulations - in that order, as the three pillars of sound land management (Roberts 1987). Despite the progress made in recent years, it must be stated that there are still severe shortcomings in all three spheres, although the diverse and comprehensive range of educational materials funded by the National Soil Conservation Programme since 1983 has given the awareness campaign a significant boost in most States. Group-learning in practical settings is now what is required on a vast scale.

Committees will continue to have difficulty persuading many individuals that the available incentives are meaningful in their particular financial situation. The whole issue of who benefits from, and who pays for, land care now becomes the major issue for the Decade of Soil Conservation. It remains a basic truism (Roberts 1985) that if the community at large regards the landholder as the steward of the nation's soil resources, then the community should also ensure that the landholder is given the financial support required to carry out this vital stewardship role. This is the central land care issue requiring political realism and statesmanship in the 1990s. Neither positive attitudes through education, nor regulatory guidelines alone, can bring about sustainable rural production systems, if the manager and his family have to sacrifice individual benefit for the sake of "the common good".

Contrary to popular belief, there is a place for regulations in the framework within which land care committees must function. While the very notion of land use controls cuts across many independently-minded landholders' principles, as a final (and hopefully little-used) factor in land use policy, enforcable guidelines may be required where the majority are being prevented from achieving common unity goals, by uncooperative individuals. This principle already applies across much of our democracy and its legal system and has long been accepted in the zoning of local areas for particular uses (Roberts 1986a).

The connotations of names such as Land Management, Land Utilization, Land Care and Soil Conservation, as applied to local landholder groups, have an important imagery for both members and outsiders. For this reason the choice of name and more importantly, the careful wording of objectives, are important starting points for local action. The identity and community image of the group are essential prerequisites to local commitment. In turn, the preparation of meaningful projects and action plans are essential to achieving objectives and to maintaining involvement. After meeting with members of approximately 40 district soil conservation committees in Western Australia a set of common elements of success was identified by the writer. The differences between more successful and less successful committees are reflected in the list presented in Appendix 1.

While appropriate leadership is necessary, the development of a sequential plan of action is an essential early step in gaining commitment and maintaining the momentum of individual involvement. Such a plan of action can take many forms and the writer has found a circular diagram of the following type to be useful:

1 Agree of Objectives

Re-state Objectives 8
for second round

2 State Problems

3 Evaluate Alternatives

Evaluate Results 7

4 Select Best Solution

Implement Plan 6

5 Prepare Workplan

An example of guidelines set up for a Queensland pastoral group is shown in Appendix 2, in which an effort is made to use the interest and experience of individuals with special knowledge of particular problems and solutions by establishing subprojects with subcommittees of personal choice. The non-sectional character of the group is also important in avoiding the association of the group with a sole producer organization, a department or even a personality.

An additional factor which must be emphasized is the potential role of women in Land Care groups. The contribution of rural women to the secretarial aspects of community work is well known, but their special talent for taking the long term view of permanent production systems as a basis for on-going family security, has not been adequately tapped in Land Care groups to date. This matter was put to the Country Women's Association of Queensland (Roberts 1986a) and has received a positive and growing response. It is indeed heartening to witness the increasing number of women being elected to key roles in recently elected Land Care committees. Their role is of particular value in nurturing a sense of permanence and balance in the coming generation of landholders, which has every reason to include as many female as male managers in the coming years of increasing automation of farm activities (Roberts 1989a).

PROPERTY PLANNING AND LAND CAPABILITY

What is land capability? It is that level of yield that can be maintained in the long term. So in land use planning we have always aimed at two goals:

(i) To use each section of land according to its potential.

(ii) To protect each section of land according to its hazards.

In other words we aim to make full use of the productive ability and at the same time ensure that we don't degrade the land by producing higher short term returns at the expense of the soil's stability and future productivity.

Land classes are used to map sections of land according to their suitable intensity of use and to their need for conservation measures. This approach has been used with success since the 1930s and in essence, it distinguishes between deep level soils suitable for annual crops without any soil conservation measures, and steep shallow soils suited only to natural

vegetation and its careful use. The basic evaluation of whether land is arable (cropping) or not, determines whether land is suitable for clearing and cultivation. If this first decision in property planning is wrong it is often impossible to stabilize the land by whatever choices of cultivation practices are selected thereafter. As a rule of thumb in the summer rainfall zone, slopes above 7% should be classed as non-arable. However, in semi-arid regions even level terrain may be unsuitable for clearing if the rainfall is insufficient to produce enough stubble for effective surface cover.

In this era of enthusiasm for tree planting, it is important that the role, and thus the location, of trees in the Land Care programme is carefully evaluated. Trees have a number of important roles to play in combination with other soil stabilizing techniques in the property plan. So each aspect of sustainable production should be evaluated before planning of banks, waterways, trees, and tillage methods are combined in a complementary range of land care techniques.

PLANNING BY GROUPS

In Australia several states including Queensland, have inherited the British planning system based on land capability and land classes. This system which has much in common with the North American approach, has relied heavily on the mapping of physical resources and attributes, as the basis of farm planning. Over time it became clear that many farm plans were not used as a basis for on-going improvement of management - in fact the farm plan was often no more than a prized picture on the property office wall.

Seldom did the physical plan form a basis for management and economic decision-making. In many cases, the fact that the farm plan was only a resource inventory, was not made sufficiently clear and as a result, evidence now shows that the standard of management is little different on planned and unplanned farms. In addition, a recent survey by the Soil Conservation Service of New South Wales shows that of a sample of 2000 landholders whose farms had been planned by SCS over the past two decades, only a small proportion actually used their plan to any extent in their management and development.

The present situation reflects a response to producer organizations' desire to both take responsibility for, and give the initiative in, "whole farm" planning. This starting point alone, gives "farmer-led" planning a better chance of success than the previous departmental approach. However, several other differences between old and new strategies must be exploited if real progress is to ensue.

Three basic questions require consideration:

(1) Who should do the planning?

(2) What level of precision is required in mapping and description?

(3) How should management and financial decision-making be integrated with physical planning?

Wherever possible, landholders should take the lead in evaluating the potential and hazards of each section of their properties. This should be followed by the landholders own mapping and decisions on a land use programme which meets the objectives of sustainable production. This should be done on the basis of orthophoto maps, using transparent overlays and wax pens in the initial stages in which alternatives are considered. Group sessions in which individuals can be assisted and queried by their peer group could ensure that a range of alternatives are compared.

A rational analysis should be made of the usefulness of the detail on topography and soils as included in past plans. Serious consideration must be given to the use of generalized mapping of slopes, soil and vegetation types, bearing in mind that for practical management, slight variations in country will be combined in manageable-sized paddocks for production purposes. It is the writer's contention that in most cases a workable plan can be drawn up without detailed topographic and soil surveys, provided the landholders' local knowledge of their properties is sufficient to identify units of the landscape which require different management. This applies to suitability for clearing and or cultivation and to differential carrying capacity and erosion proneness.

OTHER COMMITTEE WORK

It will be found that Land Care Committees want to initiate projects on a range of aspects of land management which, although not strictly part of property planning, can increase knowledge and awareness of many aspects of management within the plan. Such initiatives should be encouraged in the fields of land use policy recommendations (eg clearing guidelines), community awareness and demonstration of land care techniques (trees, tillage, erosion control). In this way the parallel developments of plans and techniques can progress together. It would be a mistake (apart from a physical impossibility) to concentrate advisory services solely on property planning in the initial stages of Land Care Committee activity. Another matter which needs attention is the encouragement of bankers and other financiers to take part in planning and management seminars so that credit may be given (literally) to property holders who are making effective use of their production potential within a stable and secure system which can be appreciated by financiers.

One of the central questions requiring early consideration by all concerned with sustainable production from "improved country", is that of who should be responsible for decisions on where and how land should be cleared.

Producers justifiably ask, "What's the use of dense scrub which is neither productive nor rare?" and point to the apparently very stable kikuyu pastures carved out of dense rainforest in North Queensland. In the Brigalow belt, some 4M ha of "useless" scrub has been converted into productive country since the 1960s. Has the Brigalow Scheme been a success? Is it stable and sustainable or are the problems of regrowth and nitrogen depletion the symptoms of faulty planning and ill-advised development?

Where do we draw the line in defining the following as suitable for clearing?:

- Minimum rainfall.
- Slope.
- Soil type.
- Soil depth.
- Size and shape of retained timber.
- Distance from water courses.
- Density of pasture cover.
- Management to maintain cover.

In an era when the independence of landholders is being reduced, the appropriate roles of the manager, the local group, the departmental authorities, the Crown Land administrators and the community at large, in contributing to land use decisions, come into potential conflict. All are generally agreed that sustainable production, stability of the landscape and aesthetic values must be the prime objectives of the decision-making. However, we must first ask:

- Who has the knowledge and information?
- Who must manage the system in practice?
- Who is responsible for maintaining the resources?
- Who benefits from achieving sustainability?
- Who pays the price for ecological failure?

Ideally the manager espouses community environmental values and can afford to apply a conservative production system while making a reasonable income.

The question must now be asked whether it is practical and acceptable for anyone other than the landholder to make binding recommendations on proposed clearing. If not, can the competence and integrity of the landholder be depended on? Other States use various combinations of departmental and producer group representatives to recommend on clearing.

The terms of reference of the new committees in Queensland requires them to encourage conservation farming by all means available including property planning. They are also expected to play an educational role in their entire community and to advise the department of needs and progress in their shire or catchment. Committees can also lead by example and establish persuasive demonstrations of sound practices. It seems reasonable however, that Land Care Committees, elected by all shire landholders, should also recommend on clearing, at least on land which is not freeholded.

It is suggested that clearing guidelines and procedures be given serious attention at an early date. Such attention is required (i) from Land Care Committees who may be seen to be failing in their responsibilities if they do nothing, (ii) from the Queensland Department of Primary Industries who administer the Soil Conservation Act, (iii) from the Cattlemen's Union and United Graziers Association whose members hold tenure of the land, and (iv) from the Lands Department who control covenants on leases and the issue clearing permits.

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TABLE 1

THE ELEMENTS OF SUSTAINABLE AGRICULTURE		
1. LAND CAPABILITY PLANNING	**2. SOCIAL AND FINANCIAL FRAMEWORK**	**3. PRODUCTION METHODS**
A Choice of suitable Class I-III land for annual cropping.	A Education - practical information, permanent attitudes, appreciation of limits to sustainable production levels.	A Choice of crop and soil management - organic matter and humus build-up.
B Selection of appropriate land for clearing.	B Incentives and financial support loans, tax schemes and financial assistance.	B Fertility maintenance - legumes, phosphate.
C Stocking rates determined on actual pasture yield.	C Land zoning - advisory committees and peer group recommendations on sustainable yield.	C Soil stability - water and wind erosion control by earthworks, surface management and plant cover.
		D Control of toxic build-up - choice of sustainable pest and weed control methods to avoid chemical accumulation.

BRIAN ROBERTS
1989

APPENDIX 1

WHAT CHARACTERIZES EFFECTIVE LANDCARE GROUPS?

1 Clear goals which are specific, achievable, understood and agreed to.

2 Are seen to be formed by the local community, for the local community.

3 Clear recognition of the fundamental land problems causing recognised symptoms.

4 Problem-solving procedures which evaluate alternatives and design optimum solutions based on present information.

5 Appropriate positive, credible and adaptable leadership from their chairman who leads by example.

6 Members committed to the stated aims of district committees in a way which overrides personal and sectional goals of members or the bodies they represent.

7 Are accepted by their community as undertaking worthy activities for the ultimate benefit of that community.

8 Consists of members who are each willing to accept allocations of duties to get the committee's work done.

9 Work methods which plan work programmes in a sequential way which achieves step-wise progress towards the agreed objectives.

10 District size which is not so large as to reduce effective contact with the majority of landholders below the level required for cooperation in district programmes.

11 Ability to plan and implement conservation farming programs and community education, without undue dependence on departmental officers.

12 Meeting procedures and group activities which acknowledge and encourage individual member's contributions and teamwork.

13 Physical and financial resources satisfactory for effective functioning of the committee.

14 Develop a pride in their achievements and benefits derived from their work for the community.

APPENDIX 2

ELEMENTS OF A SHIRE LANDCARE PROGRAMME

(Example for Dalrymple Shire, extensive beef production, N Q)

1 Aims

To improve the productivity and stability of the land of the shire for future land uses.

2 Specific Objectives

To increase permanent carrying capacity through:

(a) Increasing fodder production through appropriate stocking rates and spelling.
(b) Controlling the balance between trees and grass.
(c) Introducing improved fodder species.

3 Problems

Symptoms:

(a) Reduced carrying capacity due to (i) loss of cover; and (ii) tree regrowth.
(b) Soil loss.

Causes:

(a) Stocking rates.
(b) Other (list).

4 Solutions

- Reduce stock numbers.
- Control trees by mechanical, chemical and burning methods.
- Other.

5 People Available for Programme Development and Implementation

- Landcare Committees
- Coopted Members
- Landholders
- Departmental Officers
- Private Consultants.

6 Sources of Funds

- Landholders
- National Soil Conservation Programme
- Shire
- Department of Primary Industries
- Water Resources Commission.

7 Planning

- Map problem areas
- Identify potential cooperators
- Summarise existing experimental and experiential information
- Select trial sites and treatments
- Decide on economic analysis and minimum trial period
- Gain commitment from cooperators for each trial site
- Elect subcommittee of three or more for each trial.

8 Project Preparation

- Prepare document describing trial, sites and cooperators
- List starting times for each trial.

9 Public Comment and Site Selection

- Present description of trials to public meeting for suggested additions, change and improvement
- Amend trials as appropriate
- Call for additional members to form subcommittees for each trial or project and cooperators to offer trial sites.

10 Implementation

- Prepare detailed sequence of actions and starting times for each project
- Implement treatments and commence recording.

11 Community Awareness

- Develop and implement a programme of field days, press releases, radio and television news items on the work of the group and the benefits to the community.

12 Programme Valuation

- Review of present projects in terms of achievement of original aims
- Propose new activities to meet update aims and second phase of progress.

13 On-going Expansion and Review.

SUSTAINABILITY OF ARICULTURAL AND PASTORAL LANDS

WHICH ROAD DO WE TAKE?

VICTOR R. SQUIRES[1]

INTRODUCTION

In listening today to the papers presented, and the questions and discussion which have been generated I am reminded of the story by Lewis Carrol. In his classic "Alice in Wonderland" he tells of Alice who was faced with a dilemma of which of several roads to take. As she was thinking about her decision, she was asked by the Cheshire cat the perfectly logical question "Where do you want to go?". To this Alice replied, "I am not sure". The Cheshire cat said, "unless you know where you want to go there is no point in asking which road should I take". So it is with the vexed question of sustainability of Australia's agricultural and pastoral lands. Where do we want to go? Just what is the dividing line between public and private responsibility?

Like it or not, all landholders will have to accept some controls on their farming and grazing operations. Obviously, our land resources cannot be allowed to deteriorate further. After all, we don't inherit land from our fathers - we borrow it from our children.

The relationship of Australian agriculture to the environment has been characterised by several phases. Firstly, a phase in which humans considered themselves the master, and the land merely a vassal, a servant, or at worst a slave. Settlers sought to dominate the environment. They ignored its intrinsic characteristics in the belief that one could simply impose an alien form of agriculture on it, and that the land would adjust to human needs. Very little was learnt from the Aborigines about land management, native flora or water resources. Gradually, the realities of the land asserted themselves but not without expensive lessons first being learnt and much degradation occurring. This readjustment phase could be regarded as a time during which landholders started to realise that the land has its own intrinsic qualities and constraints which need to be recognised although they could be ameliorated by certain actions. They gradually became more knowledgeable about these and about how to farm without causing massive degradation. This has been an evolutionary process.

In the early years, farmers, pastoralists and timber-getters treated land like an uncaring master treats a slave. But the slave revolted, and taught us that ultimately our-well being is dependent on our caring for its well being; as we no longer look upon land in such an arrogant manner, and we are entering a phase of partnership with it as an equal. We have not yet reached a harmonious relationship, which is what we are groping towards.

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In general terms, human use of environmental resources, whether of land, soils, water or energy, has been characterised by their profligate use resulting in the gradual degradation and contraction of the resource.

Slash and burn agriculture, as practised in tropical countries, is satisfactory until there is no more forest and people have to change their ways and make better use of what they have. Abba Eban, a former Israeli foreign minister, noted sagely that men and nations behave wisely when they have exhausted all other alternatives. Our history of environmental resource use proves the point.

We are now paying in terms of the tax foregone in the past. Land degradation has resulted. We are now paying via expenditure on major land care programs. I will not dwell on land degradation, as other speakers have covered it fully, but just note that land degradation, by its very nature, indicates a failure to understand the biophysical functioning of the environment or a lack of willingness to work within the constraints imposed by these characteristics.

A LAND CARE ETHIC

There is an emerging concern about the ethics associated with the stewardship of land. The establishment of the soil conservation movements, both in Australia and in the US, occurred in the 1930s in response to the dust bowls which had arisen in both countries. A more scientific way of viewing the land had emerged and was to help bring about a greater realisation of human impacts upon the environment. The new world-wide challenge is to move from a focus on food production to that of sustainable and productive rural development. Agriculture needs to move away from a commodity focus to an emphasis on development of new agricultural systems - an environmental view of agriculture.

But, before I go any further, I should clarify what I mean by taking an environmental view of agriculture. The environmental approach is rooted in an ecological view of the world, in which all the parts are interconnected and inter-dependent. We used to think of throwing something away but in ecological terms, there is no 'away', no part of the earth's biological systems is totally divorced from outside influences. The depletion of the ozone layer over Antarctica through the disposal of CFCs has brought this home to many people. Every action has an effect, for good or ill, on the functioning of the earth's biological systems, and we need to understand these effects to ensure that we work with the environment, not against it. So, an environmental viewpoint takes an holistic view, an all-embracing view in terms of both time and place, and is interested in the consequences of our actions on the whole system. Moreover, it is aimed at harmonising the provision for human needs, such as the production of food and fibre, with the earth's ecological capacity and with the functioning of nature.

The strong orientation toward production to the virtual exclusion of other goals has remained a central feature of many of the institutions and organisations represented here today. The needs of those in the agricultural and rural sector for sustainable development have changed very significantly over the years, and indeed they continue to change at an ever-increasing rate today.

As more and more nations reach the point where food production keeps pace with increasing demand, the problem of productivity and sustainability loom larger. In periods of scarcity, it is easy to convince farmers to produce more; in periods when supply begins to equal demand or even surpass it, serious problems related to productivity emerge.

As Arthur C. Clarke said, 'the future's not what it used to be'. Future agriculture will be a combination of what we want it to be and of factors beyond our immediate control such as changing markets and economic pressures, shifts in eating habits and changes in climate. The next few years will be interesting and challenging.

Many farmers are recognising that the land has been overcleared, and that many of the problems they face in managing the land have their origins in the lack of tree cover. Widespread tree planting on farms will, I believe, characterise agriculture in the future. Trees have a vital role to play in ensuring agricultural sustainability. We have been slow to recognise their importance in the agricultural ecosystem but are slowly beginning to use trees as components in farm management, employing them for the benefits they can provide in an overall farm plan.

THE ROLE OF GOVERNMENT

Government Agencies responsible for land management must develop policies based on a philosophy which is coherent and consistent, and which encompasses the gamut of potential conflicts. Without policy guidelines, the alternative is often a piecemeal approach in response to immediate problems, which may lead to 'solutions' unduly influenced by vociferous, politically-oriented special-interest groups.

Agricultural and pastoral lands are especially characterised by conflicts and potential conflicts over land use. The land-use conflicts in the pastoral lands are complicated by the fact that the outback regions are public lands and are in Crown ownership.

The Crown has a dual role, that of a proprietor whose business is to raise revenue for the State, and that of a steward of the land and its resources on behalf of the people. As a proprietor it has the expectation of getting some return on its capital. It also has a stewardship role. The two roles are not always compatible. This is particularly so in the outback where the Crown, as proprietor, leases out some of the land to individuals and companies so that they may engage in the business of producing food and fibre. At the same time the Crown, acting on behalf of the people, is the only body which can assume overall responsibility for stewarding the State's resources for the benefit of the majority of people now and in the future.

I believe that failure to recognise the dualistic nature of Government in Australia is at the root of many of the problems associated with the administration of our productive agricultural and pastoral lands. We are now at a crossroads and, like Alice, need to know where we want to go as well as which road to take.

A SHIFT TOWARDS SUSTAINABILITY

It seems to me that agriculture in Australia is pulling in two divergent directions. On the one hand are the technological farmers, those for whom the soil is a medium in which to grow crops or pasture, and who apply their skill in using the right amounts of fertilizers, pesticides and herbicides. These farmers adopt new technologies, and seek to make ends meet in the face of rising interest rates and declining markets. On the other hand are the growing band of farmers interested in organic farming, biodynamic farming, permaculture, sustainable agriculture .... call it what you will. These have quite consciously rejected certain aspects of conventional farming, particularly its reliance on chemical inputs, and try to farm in closer harmony with the intrinsic characteristics of the land.

While the first group is undoubtably larger and dominant, there are signs that an increasing number of farmers are becoming disenchanted with aspects of this mode of farming and are adopting, or at least trying out, some organic approaches. In the years ahead, hopefully what will emerge will be a synthesis of the good points of each.

The need for sustainable practices to permeate all of our systems is as great in agriculture as in industry, transport and other parts of society. Measures are needed to shift towards a more sustainable food system and the key to this is in the use of energy.

Faced with limits to the outward expansion of agriculture, we need to make better use of the land we have already developed, largely through measures aimed at lifting productivity. However, this must not be at the expense of either the resource or of the environment and we have much to learn in respect of both of these.

The increasing mechanisation of agriculture makes many wonder whether we are getting as much energy out of what is produced as we put in by way of fertilisers, herbicides, fuels, labour and so on. For example, the energy required to produce superphosphate is 1.9 MJ kg^{-1} Glyphosate (Roundup R), a commonly used herbicide, requires 183 MJ L^{-1} to manufacture.

At an application rate of 1 L ha^{-1}, this approximates the fuel energy used in tillage operations in light soils.

In Australia, the evidence suggests that the output at the farm gate is somewhat greater than the input which contrasts with some other industrialised countries such as the US. The dependence of modern agriculture on energy inputs is indicated by comparing it with subsistence forms of agriculture. Energy ratios as high as 40 are not uncommon, and 10-20 is the norm for subsistence agriculture. However, in constrast to industrialised countries where almost all of the energy is in fuel, chemicals, irrigation, electricity and machinery, almost all of the energy in subsistence agriculture is labour. A rice crop in India may require over 800 hours labour input compared with 30 hours in the US.

The energy costs after the produce leaves the farm in industrialised countries is high, and may amount to three times as much energy as is contained in the food. The additional energy is used in its transport, processing, packaging, storage and distribution.

A ROLE FOR ALTERNATIVE AGRICULTURE?

Alternative farming systems, particularly organic farming, is as old as agriculture itself. However, modern ideas of alternative agriculture date from early this century.

Over the past several decades, a spectrum of alternative farming methods has evolved to varying stages. The range includes organic, regenerative, biodynamic, natural, biological, ecological and sustainable farming. Basically, the alternative farmer seeks to farm and produce an abundance of safe and nutritious foods and fibres using methods which are ecologically harmless, sustainable and profitable. The National Association for Sustainable Agriculture in Australia defines sustainable agriculture as a system of agriculture able to balance productivity with low vulnerability to problems such as pest infestation and environmental degradation, while maintaining the quality of the land for future generations.

A recent review of alternative agricultural practices (reference) argued that the conventional agricultural system is jeopardising future soil and water productivity to maintain present yields, and that alternative forms of agriculture have the potential of providing viable solutions. Although alternative farming methods may decrease yields, and many argue that they do not, net farm income could be increased and become more stable. Low-input sustainable agriculture (LISA) should be viewed as a paradigm for the blending of the established and new technologies appropriate for particular regions.

Conservation tillage practices are a form of low-input agriculture which aim to incorporate at least 30% of crop and weed residues into the soil and conserve energy and soil. They also support greater populations of soil organisms such as insects, mites and earthworms. Increased levels of organic matter in the soil enable more water to be absorbed and stored, thus buffering against drought. Nevertheless, conservation tillage relies heavily on herbicides for weed control (a 15-40% increase), and there is the need to develop no-till systems which reduce such reliance. Research indicates that surface crop residues can suppress weed growth by reducing the amount of light at the surface, lower soil temperatures, raise soil humidity thus increasing the opportunities for seed pathogens. A promising area is the allelopathic effect - the release of chemical substances from living or dead plant material that retards the growth or germination of another plant species. Certain cover crops can leach such substances thus limiting weed growth.

Herbicides (instead of ploughing for weed control) have been widely adopted over recent years and, while less cultivation means less damage to soil structure and less erosion, there is concern about the potential effects of residues on the soil and on non-target organisms.

Pressure is growing for the agricultural industry to produce chemical-free products. Measures have been introduced covering meat, wool, cereals, fruit and vegetables. Major markets exist, particularly in Europe and North America, for chemical-free products. The New Zealand Government is encouraging the export of organic produce as a major plank of its agricultural policy.

At heart, alternative methods of agriculture and conventional agriculture do things differently. Innovation has always been an important aspect of

agriculture and in a sense those practising alternative agriculture are the innovators, the risk-takers. What is radical today can become commonplace tommorrow. When it first appeared, conservation tillage, was scoffed at by many farmers who called it "trash farming" as it left the crop residues on the soil surface instead of tidying them up by burying them or burning them. However, when they realised that such practices could save them money and time by reducing cultivation and also that the "trash" protected the soil from erosion and increased moisture storage in the soil, conservation tillage was widely adopted.

ECONOMIC VIABILITY?

The economic viability of alternative farming appears to be at least approaching that of conventional agriculture. So far, few studies have been carried out in Australia. A study of broadscale cereal farming in south-eastern Australia by Els Wynen of La Trobe University's School of Economics, compared the economics of conventional and sustainable farming. Overall, sustainable farmers used fewer inputs and therefore had lower cash costs. Returns per unit of land on capital were comparable with those of conventional farmers due to the sustainable farmer's lower machinery costs. Wheat produced by sustainable farmers fetched higher prices. However, even if it did not, sustainible farming would still be viable compared with conventional farming.

The major reasons cited for farming organically have included concern about the detrimental effects of synthetic chemicals, philosophical factors (concern for stewardship of earth), pollution of water and soils, and the costs of fuel, fertilisers and biocides. Overall, economic factors have played a relatively small part in influencing the 50 farmers surveyed to farm organically. This matches other survey findings. The most important reasons were deep concern over the deterioration of the physical environment - especially the effect of synthetic chemicals and conventional farming practices. Of those farmers who felt they could compare their economic performance with that of their conventional neighbours, all said that their costs were less and the majority said that their net returns were higher or at least equal.

Farmers using alternative forms of agriculture are still very much in their learning phase. Mistakes will be made, charlatans will make extravagant claims, and many farmers will give up and return to conventional agriculture because it is easier. Alternative farmers tends to understand the ecological workings of the property far more than conventional farmers; they must if they are to work with nature, exploiting predators and characteristics which are favourable, and learning to avoid degradation.

There is a shortage of good research and advice to assist the alternative farmer. Departments of agriculture, and agricultural research and education establishments tend to avoid alternative agriculture on an official level, but often individual researchers and advisors personally are deeply interested in and even involved in alternative agriculture.

LANDHOLDERS - THE STEWARDS OF THE LAND

To tackle land degradation, landholders, "the stewards of the land", must be involved and committed. No Government can afford to manage the land for people and provide funding for rehabilitation work. But Government can provide the incentives for rehabilitation initiatives. It is the primary responsibility of the landholder to rehabilitate the land but the community has a stake in it. The community input may include tree planting and tree care, and sponsorship of demonstrations, research and land-care awards. This approach is in tune with the national direction.

By encouraging the formation of soil conservation boards and community landcare groups, community attitudes will significantly change in the next decade and our lands will be better managed. There has been a widespread adoption of conservation farming practices.

Many older farmers have seen significant degradation on their family properties, caused by the practices of their forefathers. Consequently, in the past forty years they have been prepared to change from long fallows and fine cultivation to short fallows and minimum cultivation. Engineering structures have been introduced into the landscape, and many of the bad gullies filled and stabilised.

Sustainable development has powerful protagonists and popular support, and is now developing a body of scientific theory that will enable conservation policies to be put into effect with convincing assurance rather than with pious hope!

The Balance of Nature

In the beginning, there was Earth, beautiful and wild:
And then man came to dwell.
At first, he lived like other animals
Feeding himself on creatures and plants around him.
And this was called IN BALANCE WITH NATURE.
Soon man multiplied
He grew tired of ceaseless hunting for food;
He built homes and villages
Wild plants and animals were domesticated,
Some men became Farmers so that others might become Industrialists, Artists or Doctors
And this was called Society.
Man and Society progressed.
With his God-given ingenuity; man learned to feed, clothe, protect and transport himself more efficiently so he might enjoy life.
He built cars, houses on top of each other, and nylon.
And life became more enjoyable
The men called Farmers became efficient.
A single Farmer grew food for 28 Industrialists, Artists and Doctors.
And Writers, Engineers and Teachers as well.
To protect his crops and and animals, the Farmer produced substances to repel or destroy Insects, Diseases and Weeds.
These were called Pesticides.
Similar substances were made by Doctors to protect humans.
These were called Medicine.
The Age of Science had arrived and with it came better diet and longer, happier lives for more members of Society.
Soon it came to pass
That certain well-fed members of Society
Disapproved of the Farmer using Science.
They spoke harshly of his techniques for feeding, protecting and preserving plants and animals.
They deplored his upsetting the Balance of Nature;
They longed for the Good Old Days.
And this had emotional appeal to the rest of Society.
By this time Farmers had become so efficient
Society gave them a new title;
Unimportant Minority.
Because Society could not ever imagine a shortage of food
Laws were passed abolishing Pesticides, Fertilizers, and Food Preservatives.
Insects, Diseases and Weeds flourished.
Crops and animals died.
Food became scarce.
To survive, Industrialists, Artists and Doctors were forced to grow their own food.
They were not very efficient.
People and governments fought wars to gain more agricultural land
Millions of people were exterminated.
The remaining few lived like animals
Feeding themselves on creatures and plants around them
And this was called IN BALANCE WITH NATURE.

by Dr JOHN CAREW
Scientist, Teacher, Humanitarian
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