FARMING WITHOUT HARMING: Can we do it?

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CHALLENGE FACING REGIONAL AUSTRALIA

Australian agriculture has been very successful for over 200 years, and has produced substantial wealth to support regional development of the nation. However, we are now producing commodities which have ever declining terms of trade and which are being produced at significant cost to the environment, as evidenced by the increasing degradation of our land and water resources.

It is ironic that in Australian agriculture, where shortages of both water and nutrients greatly restrict yield, it is the loss of this precious water and nutrients from the pasture or crops that is the fundamental cause of natural resource degradation. This immediately raises the prospect that if we can develop farming systems that make full use of available water and nutrients, they may be both more productive and ecologically sustainable. Unfortunately, at the moment, there are large areas of regional Australia where we do not have farming systems that will do that.

Our European style of agriculture is both mining the reservoirs of carbon and nutrients as well as leaking water, nutrient and pesticides to groundwater, rivers and wetlands. This perturbs the ecological and hydrological balances of our landscape. Our best farming practices have not been designed, at the outset, to operate in harmony with the uniquely Australian ecosystems in which they are cast. Progress towards ecologically sustainable development as reflected in improved quality of the natural resource, will be made when our land use practices have ecosystem and landscape functionality, which match those operating in the native ecosystems and landscapes.

To discover and build new land use practices that meet these essential criteria will require solutions to scientific and technical problems that are many, complex and difficult. At present, there are few such biophysical solutions on the horizon. Little work has yet been done on the use of natives plants, their genes and the processes these plants use to capture water and nutrients. Furthermore, there are serious gaps in our ecological understanding of the rehabilitation process in Australian landscapes.

Not only are the solutions to the biophysical problems scientifically demanding, they also require new ways of doing science within the imperatives of rural communities which are faced with radical social and economic change. It needs to be emphasized, however, that unless the land use practice has biophysical processes within it which are benign to the environment, social and economic initiatives can do little to address the fundamental cause of the degrading natural resources.

For rural communities in Australia this is both an opportunity and a challenge. Partnerships between government, businesses, community sectors and scientists can, I believe, build a better future for regional Australia through the development of farming that does not harm the environment.

BACKGROUND

Rural production has played a key role in Australia's economic development, and whilst there is much of a positive nature to point to in the history of Australian agriculture, there is a growing realization that many of the short term gains in Australia's agricultural development have been achieved at long-term cost to the environment and resource base; costs that may now be coming prohibitive (Wood, 1924; Cocks et al., 1980;

Cocks, 1992; LWRRDC, 1995; Hamblin and Williams, 1995; Goss et al., 1995; Reeves et al., 1997; Lovering and Crabb, 1997; Williams et al., 1998). Australian rural productions systems have been built by drastically changing the nature and seasonal patterns in the hydrological and nutrient cycles of native ecosystems; tropical rainforest was replaced with sugarcane monoculture; semi-arid clay plains became irrigated crop lands; and heathlands on sandplains were converted to wheat and lupin fields. Consequently, the diverse production systems of Australia's rural industries all face a common core of resource and environmental problems, which settle about the management of soil and water. The signs of depletion and degradation of our natural resources are becoming ever more obvious.

In 1994, Andrew Campbell stated: *"In short, existing systems of food and fibre production are unsustainable. The rural sector is ageing, declining, stressed and going broke, and depleting natural and human resources in the process ... more sustainable systems of land use and management are unlikely to be developed or implemented by people preoccupied with short-term survival."* This critical situation has arisen, in part, because Australian agriculture has developed largely by importing plants, animals and production systems from the Northern Hemisphere, and it is clear that many of these are not well suited to the unique characteristics and function of Australian ecosystems. In view of the measured depletion of many of our natural resources (Williams et al., 1998; Reeves et al., 1997; Commonwealth of Australia, 1996), there must now be questions about the extent to which Australia can continue to be competitive in international market places through sole reliance on our current production systems.

It is essential that Australian Rural Industries have in place technologies that can produce rural products that are free of contaminant and produced in such a way that maintains the quality of land and water resources and the off-site environment. Environmental management systems that can support quality assurance systems like IS0 14001 will become an increasing part of maintaining market access. Therefore degradation of soils, water and natural vegetation puts at risk income from rural production systems and undermines the realization of benefits arising from rural research, such as that aimed at the genetic improvement of yield or quality potential of crops or animals. Rural production remains a mainstay of much of regional Australia, so that maintaining the economic competitiveness of rural industries, whilst substantially improving their long-term ecological sustainability, is a high national priority.

NATURAL RESOURCE DEGRADATION: EXTENT AND ESTIMATES OF TRENDS

Overall, Australia's natural endowment for agriculture is poor. Its soils are relatively infertile, easily damaged and slow to recover. Often they do not recover – a consequence of the ancient, highly weathered nature of material from which most of our soils are derived (Beckmann, 1983). The same can be said for the unique ecosystems that are adapted to these soils (Hamblin and Williams, 1995; Lovering and Crabb, 1997). Coupled with the most variable rainfall pattern anywhere in the world Australian farmers and scientists are faced with a very demanding task in building productive farming that does not harm the environment or damage the soil, water or vegetation resource and restrict their use or productive capacity for further generations**.**

Forms of degradation

The forms of land and water degradation are now well documented (Williams, 1991; LWRRDC, 1995; Reeves et al., 1997) as are the general principles and process, which determine land use action and the catchment response (Williams et al., 1998). The nature of natural resource degradation issues can be described within:

- soil nutrient depletion
- soil acidification
- soil structural decline
- soil biological decline
- dryland and irrigation salinization
- wind and water erosion
- contamination with residues of agricultural chemicals
- river processes and environmental flows
- nutrient, salts and pollutants to wetlands, rivers and water bodies
- contamination of groundwater with nutrients, salt and pollutants
- riparian, remnant vegetation damage and rural tree decline
- decline in native pastures and environmental value of rangelands
- loss of habitat and biodiversity

The broad dimension of the land and water degradation in Australia were identified and regularly examined in terms of form and process during the 1980s but the spatial extent, trends, and the costs in lost productions and loss of environmental amenity particularly biodiversity remain very poorly documented.

Goss et al. (1995) state that "These impacts are of an enduring nature, not easily reversed and are becoming increasingly expensive to correct. Such damage has:

- reduced the productive capacity of lands (although in some areas productive capacity has increased);
- long term adverse impacts on water quality and biological diversity;
- put agricultural trade at risk through contamination; and
- threatened health."

Price (1993), LWRRDC (1995) and Lovering and Crabb (1997) have attempted to estimate the cost in lost rural production of approximately $1 billion in production per year does not include the annual estimated cost of about $450 million resulting from degraded water quality as a consequence of off-farm impacts on catchment and regional ecosystem function.

Salinity impacts beyond the farm gate

As the above listing indicates, the impacts and costs of natural resource degradation go well beyond the land and soil resources, on the farm. This is particularly true and becoming better documented for dryland salinity (Prime Minister's Science, Engineering and Innovation Council (PMSEIC), 1998).

Land

About 2.5 million ha of land is so far affected by dryland salinity, and there is the potential for this to increase to in excess of 12 million ha. The estimated capital value of land lost to dryland salinity already exceeds $700 million. Much of this is some of the most productive agricultural land in Australia. The area damaged by salinity to date represents about 4.5% of presently cultivated land, and known costs as indicated above include $130 million annually in lost agricultural production; $100 million annually in damage to infrastructure; and at least $40 million in loss of environmental assets. Salinity affects regions in all parts of

Australia. Whilst the impacts on-farm are large, the impacts on water quality and the amenity of the environment will become increasingly important.

Water quality

Increasing salt concentrations can be observed in many streams and rivers, particularly in the southern half of the Murray-Darling Basin (Lovering and Crabb, 1997; Williamson, 1998). Rising groundwater in the Basin leads to saline discharges to streams and at the soil surface where it affects runoff quality. Salinity levels in the Murrumbidgee River are increasing at between 0.8% per annum and 15% per annum, depending on where measurements are made. Stream salinity in the Murray exceeds WHO guidelines for about 10% of the year now. Recent preliminary work suggests that in the next 50 years this will rise significantly such that for long periods of the year the water will be considered undrinkable. These changes if they develop will have significant impacts on aquatic ecosystems and all extractive users.

Remnant vegetation and wetlands

Rising water tables and increasing salinity, have serious impacts on native vegetation. Remnant native vegetation is threatened, and since this is the only remaining habitat for a variety of important animal species, these are also under threat. Riparian vegetation, critical to stream bank stability, and wetland areas are already damaged and under increasing threat. In Western Australia, it was found that 80% of the length of rivers and streams was degraded by salinity, and half of the water bird species had disappeared from the many wetlands, which were once fresh or brackish. In western Australia some 80% of remnant vegetation on private land, and up to 50% of conservation reserves, are threatened by salinity (Prime Minister’s Science, Engineering and Innovation Council (PMSEIC), 1998).

Road, bridges and urban infrastructure

Road and bridge damage caused by shallow saline groundwater is a major cost to local governments. The National Dryland Salinity Program has estimated that about 34% of State roads, and 21% of national highways in south-western NSW are affected by high water tables, and damage costs about $8 million per year

The impacts of salinity are diffuse, indirect, and highly pervasive. Current estimates of extent and future costs are almost certainly far too low, and reflect our limited investment in measuring salinity and its effects. (Prime Minister’s Science, Engineering and Innovation Council (PMSEIC), 1998).

Soil acidification is extensive and continues

The damage to the chemical, physical and biological fertility of soils under Australian farming has been reviewed in detail by several authors (Chartres et al., 1992; Williams, 1991; Williams and Chartres, 1991; Hamblin and Williams, 1995; Lovering and Crabb, 1997; Williams et al., 1998). However, the emphasis of these papers has been on issue and process with very little quantitative assessment of spatial extent or temporal trend.

Soil acidification, is known to occur on over 90 million hectares of which 33 million hectares have a pH in water that has fallen below 4.8 (AACM International, 1995). It is important to discriminate between accelerated acidification as a consequence of land use and soils that are naturally acidic. This is not always done and does confuse analysis on the extent of soil acidification. It is important to appreciate that it is not restricted to temperate Australia and is now shown significant problem in both the humid and semi-arid tropics.

Future focus on water quality and river health

LWRRDC (1995) and Cullen and Bowmer (1995) set out the major degradation issues wherein land use, particularly agriculture, impact on water resources. Agricultural land use causes impacts on water quality and the environment in the following ways (Cullen and Bowmer, 1995):

- runoff from rural lands carries sediment, nutrient ,organic matter and agricultural chemicals

- the extraction of water from rivers and groundwater is central to irrigated agriculture and therefore has severe impacts on aquatic ecosystems of our rivers, wetlands and estuaries; the drainage water that returns from irrigation can carry high loads of salt and agricultural chemicals

- irrigation uses rivers and wetlands as storages and conduits, resulting in distortion of the river or wetland flow regime

- land clearing and irrigation activities cause rising water tables and salinization of rivers and wetlands.

The consequences of these impacts are seen in increases in the frequency and severity of algal blooms; loss of native fish; encouragement of introduced fish such as carp; loss of floodplain and riparian vegetation with impacts on habitat, ecosystem processes; and the introduction of agricultural chemicals into aquatic environments with uncertain long-term consequences.

Biodiversity loss

Biodiversity is the variety of all life forms and their patterns in space – the different plants, animals and micro-organisms, the genes they contain and the ecosystems of which they form part. The term biodiversity is poorly understood. Many people believe it means species diversity or the conservation of rare or endangered species. This interpretation leads to biodiversity being seen in an extremely restricted way. For example, in agricultural or pastoral landscapes, it is often assumed that biodiversity is found only on conservation reserves, on uncleared agricultural land, or on remnant patches of bush on farming land, that may or may not be fenced off. It needs to be appreciated that the biodiversity in agricultural and pastoral ecosystems that make up these lands is often central to the productivity of these lands. Agriculture is an ecological enterprise that is totally dependent on ecosystem processes and functions such as soil formation, nutrient cycling, maintenance of hydrological cycles, pollination of crops, etc that are driven by interactions between elements of biodiversity. The narrow species-focussed view of biodiversity gives rise to the notion that landscapes can be compartmentalised and that protection of remnant native vegetation is therefore the primary action required for the conservation of biodiversity. This attitude does not take into account the majority of biodiversity, and is leading to continuing loss of its essential elements. Much biodiversity is minute and exists in soil. These contribute to soil fertility and agricultural productivity, but are critically threatened by agricultural practices and being lost.

As biodiversity is lost, ecosystems become less complex. This sets in train a cascading sequence of events that can result in changes that can have important and long lasting consequences. Simplified ecosystems become less resilient, meaning that they are less able to absorb environmental shocks and disturbance and still continue to maintain their original levels of function (processes like rates of growth, transpiration, fixation and uptake of nitrogen). Reducing biodiversity means that there are fewer components to buffer the blows inflicted by drought, fire, exotic species and climate change.

Status of biodiversity

Loss of biodiversity is Australia's most serious environmental problem. Destruction of habitat by urban development, agriculture, forestry, fishing and mining is the major cause of biodiversity loss and it is still continuing at an extensive rate. Those elements of biodiversity that can be assessed all show declining trends. Five per cent of higher plants, 23 per cent of mammals, 9 per cent of birds, 7 per cent of reptiles, 16 per cent of amphibians and 9 per cent of fresh water fish are extinct, endangered or vulnerable. Australia has the world's worst record of mammal extinction. In the past 200 years, we have lost 10 of 144 species of marsupials and 8 of 53 species of native rodents.

The most severe losses are in Australia's agricultural zones. In many areas less than 10% of the original vegetation remains, with the cleared areas being used for production. The extensive loss of native vegetation is now having major impacts on ecosystem functioning in many parts of Australia. The hydrologic balance of the agricultural zones has been radically changed. Changes in vegetation have also led to changes in surface flow of wind and water and these have become severe degrading forces. In addition, there is now evidence that these extensive changes to the landscape may be resulting in changes in the radiation balance, in turn leading to alterations to the macro- and micro-climate. There is some evidence from rainfall records over the past 80 years that suggest that changes to the radiation balance are leading to reductions in rainfall in southwestern Australia.

THE SCIENTIFIC AND TECHNICAL ISSUES: ECOSYSTEM FUNCTION AND SUSTAINABLE LAND USE

Scientific solutions to causes of degradation are many, complex and difficult

To understand how Australia's rural industries might move towards ecological sustainability, it is appropriate first to identify the scientific and technological issues that have to be solved.

A reluctance to face up to first, the need for, and then, recognize the demanding scientific and technical challenges in finding sustainable agricultural systems for the Australian environment are barriers to progress. It has led to a failure to direct research to solving the fundamental scientific and technical issues that are the core causes of natural resource degradation. This tendency to trivialize the scientific and technical difficulty of building farming systems that do not harm the environment must be faced and addressed. So much policy has been flawed by assuming that solutions to land degradation are readily available. Consequently, there has been an absence of a strategy to seek solutions to the cause of degradation.

Research and development continues to focus on improvement of productivity and reduction in costs of current commodities such as wool, wheat and beef with very little effort in finding farming solutions which do not harm the natural resource base. Further, there is a failure to recognize that the problems faced by Australian scientists and farmers in finding new solutions are more exacting and difficult than for most other places in the world; due to a highly variable climate, coupled with the soils which, in general, are old, highly weathered, fragile and of low fertility. The scientific problems that are to be solved before Australian agricultural systems approach ecological sustainability are many, complex, and difficult. The solutions to the problems that confront rural industries are not only technically demanding, but they require radical changes to the orientation of research institutions, extension and consultancy agencies, research and development corporations, as well as to the priorities of large sections of our rural community.

Urgent need for new farming solutions

Australian rural production systems were built by drastically changing the nature and seasonal patterns in the hydrological and nutrient cycles of the native ecosystems. Therefore, despite the diversity of Australia's rural production all systems face a common core of resource and environmental problems, which settle about the management of water, nutrient and carbon.

Most of our farming operations leak water and nutrients. It is this very leaky nature of Australian agro-ecosystems which lies at the root of nearly all land and water degradation issues. We desperately need new biophysical solutions, which can plug leaky systems and capture the water and nutrient for productive purposes. It is ironic that in Australian agriculture where the shortage of both water and nutrients greatly restricts yield, it is the loss of both precious water and nutrient beneath the crop or pasture that is the fundamental cause of both salinity and acidification. This immediately raises the prospect that if we can develop systems that make full use of available water and nutrients, they may be both more productive and more ecologically sustainable. At the moment, we have few, if any, solutions.

In the case of salinization, while there are many actions communities can take towards more sustainable practice CSIRO's work consistently demonstrates that significantly to reduce watertable rise and salinization very radical land use change is required over large areas of our agricultural zone. We currently do not have alternative land use and farming practices for large areas of the agricultural zone that are capable of reducing salinization and at the same time provide adequate farm income (Walker et.al.,1999). However, we are now, in partnerships, wanting to work towards such solutions.

A similar situation exists for reduction in the rate of acidification and soil structural decline, delivery of nutrient and pollutant to streams and waterways. Australian scientific research agencies and the funding corporations need to give increased strategic research effort to finding and designing alternative land use practice, that is both effective in reducing natural resource degradation and able to generate enterprise incomes that can support sustainable rural communities. There is an urgent need for strategic research in farming systems which can find solutions to matching these sources and sinks, and then match the residual flows to these in the ecological and landscape functions operating in the Australian environment (Williams, 1999). A joint CSIRO/LWRRDC program entitled “Redesign of Agriculture for Australian Landscapes” is one such activity designed to quantify this leakage, in order to identify whether plant production systems can be redesigned (for example, through the addition of deep rooted perennial plants) or will need to be substantially reinvented (for example, by bioengineering new types of plants) in order to meet the requirements of the Australian environment for ecological sustainability. We need more information on the water using capacity of various types of vegetation; experimentation with new farming systems that are adapted to the temporal and spatial variability of the Australian climate (Dunin et al., 1999). Much of this research must be at a larger geographic scale that has characterized much past research.

Development of new farming operations which do not harm the natural resources and environment, whilst generating enterprise incomes that can support sustainable communities, must be an urgent goal for regional Australia.

Landscape design to match farming and land use pattern to Australian landscape and ecosystem function

A key strategic focus for science and technology, therefore, is to build productive agro-ecosystems that leak much less water, nutrient and carbon to the landscape in which they are located.

For success in this goal the scientific effort must first recognize that the soil/plant/animal agro-ecosystems must be studied in an integrated way and examined as part of the larger scale ecological and hydrological process that operate over the landscape. The solution must incorporate these functions at a range of scales including paddocks, hillslope, catchment, whole landscape and the regional basin. The landscape design will need to integrate sustainable production and maintenance of biodiversity for the catchment and region. Any revegetation program must have multiple objectives and therefore designed for restoring ecosystem function: hydrology, nutrient cycling, movement of biota, and maintenance of habitat. Focus on short-term animal or plant productivity without consideration of the consequences on the other essential components of the agro-ecosystem and the larger scale landscape processes; can be shown to be a primary cause for degradation of the natural resource. The way in which the production system interacts with the hydrological and nutrient balances and the implications of these interactions for the longer-term stability and ecological functionality has been neglected or studied in isolation from the production system. The first step in our search for an ecologically sustainable agriculture requires that we address agricultural production as an agro-ecosystem, which is part of the larger scale ecosystems and landscape processes. (Williams, 1991, 1995; Williams and Hook, 1992). The CSIRO is currently developing the “Heartlands” project with a view to providing tested design principles for the implementation of regional projects that involve large scale land use change. Knowledge of how best to revegetate and implement land use that is ecologically sustainable and which can support viable rural communities, is critical to any regional development plan. At the moment, we run the risk of stumbling from solving one problem whilst creating another.

THE SOCIAL AND INSTITUTIONAL CHANGES REQUIRED TO BUILD FARMING WITHOUT HARMING

Because solutions to environmental and natural resource issues require institutional, structural and social change as well as new scientific knowledge and strong economic drivers, it is key requirement that people from all sectors of the community need to be involved with scientists from the earliest stages of a program involving planning, research implementation, monitoring and evaluation. While scientific and technological innovation both on farm and in laboratory will play a fundamental and increasing role in the development of sustainable farming its impact will increase significantly if it becomes a tool within rural society, and is not used to set the agenda in isolation of the rural community. This will require a paradigm shift by research institutions, rural community, funding agencies and government. A catalyst is required to bring the change required.

The work being done on the new Natural Resource Management Policy Statement may be a vehicle to bring a realignment and focus on development of farming systems that do not harm. What ever the mechanism there will need to be a policy framework for change towards farming so that our landscapes are not damaged.

The development of farming systems that do not harm the environment will require a rationalization of resources; a refocus on farming system research within an ecological framework; coupled with adoption of participatory methods of on farm research; and cooperation between universities, CSIRO and State agencies in research and development which underpins the development of ecologically sustainable agriculture. A significant feature of the future will encompass rural community working with biophysical scientists, sociologists and economists to build new systems. The innovative use of on-farm measurement coupled with simulation models to design and examine alternative operations in terms of both production and impact on the natural resource, will be an increasingly important tool of discovery.

The Landcare Movement: Agents of Change

Andrew Campbell in his overview of the Landcare movement, was able to report in 1994 that *"…after 200 years, Europeans in Australia are starting to understand the characteristics of this ancient land, and some are starting to develop some humility in attempting to live with the land, rather than from the land".*

The development of a strong Landcare ethic within the rural and urban community has been a major success of the past decade. It has raised the awareness and commitment of the community to natural resource management issues and it has provided a low-cost, community-based delivery mechanism for on-ground works across rural and urban communities. Those in Landcare are now seeking farming systems solutions that are both profitable and benign to the resource and environment. There is an increasing awareness now that few such solutions exist. The next stage of Landcare will be to drive the development of farming systems that do not harm and which can generate wealth in rural communities. Their innovation coupled with appropriate strategic and well targeted science is a promising formula for the future.

Regional Natural Resource Management

The devolution of increased authority to regional and catchment communities for natural resource management is well developed in some states and appears to be a useful vehicle for change. The regional level planning and implementation are most effective when generated by the regional community. Indigenous people have much to contribute to sustainable land use, and it is most important that indigenous understanding of landscape functions and their relationship to the land are a central part of regional thinking and planning. There is much to be learnt from our indigenous people. This enables regional issues to be fully taken into account in negotiating trade-offs and outcomes for the region, and in tailoring the best approach given regional circumstances. This assumes that the regional bodies have access to resources and information sufficient to their mandate.

Environmental Management and Quality Assurance

Since the mid 1990s, rural industries have sought to use QA programs such as 'Cattlecare', to improve the market quality of meat and particularly to reduce the risk of pesticide contamination. Whilst ISO 9000 is established in Australia with a focus on service or product quality, QA with an emphasis on environmental management following the ISO 14000 standard is only now emerging as a possibility. Our forest industry is leading the way.

Global markets require quality produce and assurance that products are free of chemical residues, free of disease, and produced in a manner that is benign to the environment. Quality assurance procedures and practices have evolved at an international level and are essential to Australia's global positioning in export markets. Use of ISO 14000 standards could play a key role in providing procedures to establish Australia's credibility in global markets as a supplier of products that are 'clean and green'(Heinze,2000). If so this would represent an economic drive for building farming that does not harm.

FARMING WITHOUT HARMING: SOME POSSIBILITIES

The cause of much of the degradation is reduced water use, associated with the removal of native vegetation. Farm forestry, new agricultural production systems and restoration of native vegetation present opportunities to restructure the landscape with vegetation having a similar water use pattern to the original bushland, with the potential for substantial amelioration of the impending problems.

The possibility of implementing this type of solution is increasing. The expansion of forestry on cleared agricultural land is becoming more attractive. Commercial prospects for traditional grazing are poor while market prospects for the expansion of plantation forestry appear to be improving. Added to this there is increasing interest both in Australia and overseas in using the ability of trees to sequester carbon as a means of meeting greenhouse commitments. The combining of carbon sesquestration incentives with reafforestation to control dryland salinity is an opportunity receiving attention.

The use of native plants and animals may form an increasing part of rural production. Bush foods (CSIRO, 1996), native wildflowers, essentials and other oils for pharmaceutical or industrial chemicals are receiving increasing attention. Indigenous people have much to contribute in the use of our native plants and animals for food and fibre. This form of diversification in the farming enterprise will increase the planting of native vegetation back onto the Australian landscape. Alley farming of native trees, shrubs and leguminous plants with cereal and oilseed production is increasingly adopted in the light textured soils and wind erosion prone regions of Western Australia. Whilst many ideas are being considered, it must be emphasized that the work ahead to find sustainable solutions is enormous.

Whilst these are plausible objectives it is most important that it be recognized by government planners and the community that there are serious deficiencies and problems with our scientific understanding of the ecology of the rehabilitation process in Australian ecosystems and landscapes. We don't know how to reconstruct them. There are little tested theory or design rules for rehabilitation, quite apart from a process for communities to set objectives. It is all very *ad hoc* at the moment. There is little gain if dryland salinity is controlled by afforestation which subsequently results in serious decline in river flow. We must avoid solving one problem whilst creating another.

CONCLUSIONS

In the search for farming systems, while the move to ecologically sustainable land use will be incremental, it will not be well served by a failure to tackle the problem at its roots – the fundamental processes that drive the specific degradation process.

Development of ecologically sustainable farming systems that are profitable is a very difficult problem both scientifically and socially. Were this not so, we would not be in our present predicament. It is most misleading to assert or assume that our current knowledge base is sufficient and that ecologically sustainable land use is possible by simply applying existing knowledge. Current information must increasingly be applied, but it must also be recognized that many of the current management issues are the result of failure to develop farming systems within an ecological framework, which is integrated with the processes occurring in the landscape. There are few farming systems that are able to control the cause of land degradation and at the same time generate a farm income that can sustain rural communities. The search for farming systems and land use patterns that do not harm our environment is urgent. It must form a central plank in any strategy for regional development in Australia.

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