Looking to the farm business

Approaches to managing native grassland in south-eastern Australia

Jim Crosthwaite and Bill Malcolm – The University of Melbourne

National Research and Development Program on Rehabilitation, Management and Conservation of Remnant Vegetation

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GPO Box 2182
Canberra ACT 2601
Telephone: (02) 6257 3379
Facsimile: (02) 6257 3420
Email: public@lwrrdc.gov.au
WebSite: www.lwrrdc.gov.au

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Authors: Jim Crosthwaite, Bill Malcolm
Department of Food Science and Agribusiness
Institute of Land and Food Resources
University of Melbourne
Parkville VIC 3010.
Telephone: (03) 9344 5008
Facsimile: (03) 9344 4095
Email: j.crosthwaite@landfood.unimelb.edu.au
WebSite: http://www.landfood.unimelb.edu.au/research/grass_eco/index.html

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Foreword

Native grasslands in south-eastern Australia are among the most degraded, depleted, fragmented and threatened ecosystems on the continent, reduced to much less than one per cent of their original extent. From a public policy perspective, conservation of remnant native grasslands is a high priority at state and national levels. The fragments that remain, apart from tiny islands in old country cemeteries and along roadsides and abandoned railway reserves, are primarily on private land managed by farmers.

The conservation of these grasslands, let alone potential efforts in rehabilitation and restoration, thus depends on the cooperative actions of farm families in maintaining their conservative management of these areas — light stocking, relatively low fertiliser inputs and no irrigation or intensive cultivation. Yet such families are under increasing pressure from low commodity prices (particularly for wool) and the inexorable long-term decline in farmers' terms of trade. There is ever greater pressure on farmers to optimise production from every hectare of their land if they are to reach their entirely reasonable aspirations to make a profit, raise a family, provide options for children and for their own retirement, and maintain an acceptable standard of living.

This report[1] offers extremely valuable insights into the practical and financial implications of conserving native grasslands on private farmlands. The research upon which it is based was funded by LWRRDC and Environment Australia through the National R&D Program on Rehabilitation, Conservation and Management of Remnant Vegetation.

Jim Crosthwaite's meticulous on-ground surveys and in-depth interviews with families on eight case study properties in northern Victoria and southern New South Wales, coupled with Bill Malcolm's rich and pragmatic farm management economics, combine to present a detailed understanding of grassland conservation from a farm family and farm business perspective.

This perspective is critical. Too often, things are demanded or expected of farmers in the public interest, without a comprehensive appreciation of just what is being asked in practical and financial terms. This report makes it clear that if society expects farmers to conserve native grasslands, in most cases that means expecting farmers to act altruistically. From a farm business perspective, the conservation option most often involves a real cost to the farmer that is not outweighed by on-farm returns.

Further, conservation programs generally focus at the scale of the site of interest — the patch of bush, critical habitat, reach of river or area of grassland — without considering the social and economic context of the whole farm(s) in which the conservation asset is situated. In some cases, it may well be appropriate to simply provide funding assistance for a fence to protect a patch of bush or a stream. But in many other cases, it may be more effective to assist a farmer to make changes at the scale of the whole farm business to make the conservation option more viable in the long term.

This report should be of great interest to people developing public policy or managing extension programs aimed at conservation on private lands. It provides detailed and practical insights into how extension and incentives programs could be better designed from a farm family and business perspective, and consequently how they might be more effective and durable. It is grounded in the reality of eight case study properties. The considerable diversity even within this small sample, provides compelling evidence that blanket prescriptions are unlikely to work, and that effective programs will need to have sufficient flexibility and room for local interpretation to encompass the unique circumstances of every farm and family.

There are many lessons in this well-written report which could and should inform the design and management of large public funding programs.

Andrew Campbell
Executive Director
Land and Water Resources Research
and Development Corporation

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Executive summary and recommendations

Introduction

The aim of this research report is to explore how conflict between public goals and private interests on commercially operated farms might be resolved. Public goals include maintaining biodiversity and achieving sustainable land management, while private interests include farming to generate profits, meet family needs and ensure farm survival. It is shown that taking into account how farm businesses operate is likely to improve the effectiveness of current approaches to attaining public policy goals as well as suggesting new approaches. It is argued that the capacity of the farm business to meet the goals of farm families is critical. Consequently, management of the farm *business as a whole* will greatly influence how resources are utilised and how conservation sites are managed, and whether or not an explicit stewardship approach is adopted.

Case studies and options for native grassland management

A series of case studies of farms with native grasslands — both on lowland plains and on hills and tablelands — was undertaken in south-eastern Australia. Four case study properties are located on the Riverine Plain between Bendigo in Victoria and Hay in New South Wales, and four properties located on the hills and tablelands of north-eastern Victoria and the Southern Tablelands of New South Wales.

The case studies are used to explore the net benefits of different farm management options, including sowing introduced pasture, fertilising native pasture, cropping native grassland, planting saltbush, reducing stocking levels, and fencing off small areas of conservation interest.

For each case study, the key technical and economic aspects of how each farm currently operates are outlined, taking account of farmer goals, pasture types, livestock utilisation of pasture, and the current farm financial position. The technical details of alternative farm management options are then specified and their expected profitability evaluated. How the farm might be organised in future by comparison to the present is of particular interest.

Deriving appropriate public policy mechanisms

The case studies form the basis of a review of possible incentives and other mechanisms for achieving public policy goals relating to conservation and long-term productivity of farmland. While some mechanisms are appropriately directed to management of the site of conservation interest, four other levels which might be targeted in order to achieve policy goals are considered — the farming system, the farm business, the ownership and operation of the farm business, and off-farm. The proposed approach thus not only focuses on the future of the conservation area to be managed; it also emphasises the future of the farm itself.

Broadening current policy approaches

Failure of policy approaches to conservation and land management to incorporate serious and detailed consideration about the operation, constraints and potential of farm businesses will have major consequences. Substantial short-term gains will undoubtedly arise from the use of a policy approach which includes management agreements, financial incentives, rate rebates, covenants, regulation, duty of care, education and provision of information. However, analysis of the case study results suggests that remnant vegetation will decline in quality or be lost on many properties over the long term if farmers do not develop sound strategies for achieving their farm business goals and are not able to carry them out. The alternative might be much more costly intervention in future years when those farmers find their private interests even further removed from the public interest.

Recommendations

The recommendations in this report are aimed at people who are looking for more than a manual with ready-made answers. Questions about how much one hectare of native grassland is worth, or how much a farmer should be paid to manage it in a specified way, are answered for particular contexts — as can only be the case. By using the report to understand the underlying processes about how farms with native grasslands work, and how they ought to be analysed, better judgements can be made about answers to the above-mentioned types of question. With an understanding of the farming and management processes, people are better equipped to ask the right questions about native grasslands, in circumstances other than those analysed in this report. Those seeking quantification should bear in mind that the answer from a good practitioner will always be 'it looks like this amount, but it depends on …'

The recommendations are also about getting the direction of policy right, rather than refining particular instruments.

Recommendation One. Recognise that future conservation and land management are closely linked to prospects for the future of the farm, and that opportunities for influencing this future should be sought through public policy programs.

Recommendation Two. Develop a tool-kit of approaches that can be used at several different levels at which farm behaviour can be influenced — management of the site of public interest, farm practices, the farmer, the farm business, and the off-farm context.

Recommendation Three. For high conservation value sites where management is in private hands, aim for a package of measures which specifically achieves appropriate site management but also addresses the contextual issues of management practices and the future of the farm business.

Recommendation Four. Target the farm business and capacity building of the farm business as key elements in the tool-kit. For the tool-kit consider approaches such as:

- reviewing the needs of the farm family, the operation of the current business and its potential;
- initiating discussions about how conservation areas should be managed in the context of plans for the future of the farm;
- assisting in developing and implementing a farm business plan linked to participation in a management agreement;
- providing off-farm investment advice;
- advising on succession planning and on achieving other major changes in business structure;
- identifying training needs (especially in the case of properties with sites of high conservation value); and
- encouraging participation in courses and programs aimed at making farm managers better informed.

Recommendation Five. Seek ways of providing targeted farm business and capacity building programs to farmers with high conservation value sites. This might involve a sub-program within existing programs, such as the Property Management Program.

Recommendation Six. Ensure the tool-kit includes mechanisms aimed at whole farm management practices. Such mechanisms could involve:

- promoting the concept of duty of care;
- linking property management planning and drought preparedness to biodiversity conservation;
- accreditation for sustainable production systems; and
- assistance with initiatives to take pressure off pastures, eg. introducing new grazing systems, planting saltbush, changing lambing time or other aspects of animal management, or improved planning of crop–pasture rotations.

Recommendation Seven. Place the emphasis on assistance for farm business adjustment rather than on compensation for foregone opportunities.

1 Introduction

The use of privately owned land for agricultural purposes is leading to the loss of biodiversity and to unanticipated changes in how ecosystems function. These phenomena have been identified as major problems by public bodies internationally, and by both Federal and State Governments in Australia, because of concerns about conservation, long-term productivity and off-site effects (eg. DEST, 1996; DNRE, 1997). Strategies for biodiversity conservation and for land management are being developed at catchment, state, national, and international levels. These strategies propose a range of actions to address the issue on private land.

An overriding theme of the strategies is to shift the behaviour of landholders towards stewardship — in terms of long-term sustainability of production and protection of areas that have important biodiversity values. While there has been a marked increase in the number of landholders working in this way, the extent of change is still relatively small.

The aim of this research project is to explore the value of using a farm business perspective to identify how to bring about the desired shift in behaviour. This approach is explored through a series of case studies of farms with native grasslands from south-eastern Australia — both on lowland plains and on hills and tablelands. The results of the case farm analyses form the basis for a review of possible incentives and other mechanisms for achieving public policy goals relating to conservation and long-term productivity of farmland.

The economics of stocking native grasslands more lightly than at present is examined for both the Riverine Plain and the hills and tablelands of south-eastern Australia. The situations examined include a property that already lightly stocks native grasslands of high conservation value, and another property that may need to reduce stocking rates across most of the farm if pasture productivity is to be maintained. The effects of resting small areas of native grassland and of total destocking are outlined for eight different case studies. While these results are interesting in their own right, the emphasis in the report is on whether, and how, such conservation management might be achieved within the context of a 'win–win' business plan. The issue is whether the farmer has opportunities for investment or improved management that more than compensate for any costs associated with appropriate conservation management.

A range of investment options that might increase the income of farmers is explored in this report, and in the technical reports on which this report is based. Some of the investments are aimed at increasing the utilisation of native grasslands in ways that might be consistent with sustainable land management while not having deleterious effects on conservation values. For example, planting saltbush on properties on the Riverine Plain is examined. For farms on the hills and tablelands, investments explored are the application of fertiliser at low rates, sub-division, and direct drilling a legume into native pasture. Cropping areas of lowland native grasslands is currently an issue; the economics of doing so is evaluated. A number of options for increasing income by investing elsewhere on the farm is also considered. Farmers face alternative investment opportunities and, in choosing between them, require reliable information. This report provides examples of the appropriate methodology for fully evaluating each option. For instance, the results obtained are affected by accounting for the grazing phase of a cropping rotation or for the expected life of a pasture investment.

The economics of managing native grasslands and native pasture on farms is of direct relevance to formulating government policy. Native grasslands are one of Australia's most threatened ecosystems, and much of what remains is on private land. Particular management by farmers may be required if they are to retain their conservation values. Pastures that contain deep-rooted, perennial native

grasses are more widely found than native grasslands ofconservation value. These grasses may help prevent land degradation and so native pastures may thus be important in maintaining the long-term productivity of the land. Both types of remnant vegetation — native grassland and native pasture — are considered in this project.

Contents of this report

Relevant background material is provided in Section 2. A brief overview is given of the ecological and land management issues (which are outlined in more detail in the relevant sections on each type of native grassland). Production issues are then considered, with an introduction to the place of native grassland in farming systems, and the land types in those systems. As a preamble to later sections, reconciling production, conservation and land management issues is discussed, the growing stewardship expectations placed on farmers are sketched, and how farmers are responding is outlined.

The approach taken in this study is outlined in Section 3. We begin by explaining that the object of our enquiry — native grassland in the context of the farm business — requires a different approach to a purely neoclassical economics approach in which the roles and operation of the market are central. The conduct of the case studies is then explained, followed by an outline of the methods of farm business analysis which have been applied in the case studies.

The regional studies are presented in Sections 4 and 5. Initial policy and extension implications are drawn out in each section, with further discussion in Sections 6 and 7. Overall conclusions are drawn in Section 8.

The studies in both the plains and the hills/ tablelands regions were both carried out in a similar way. However, there are differences in how the future of each farm is approached. The section on the farms on the plains begins with a discussion of possible future strategies for each farm, followed by an examination of conservation options and cropping. By contrast, for the farms in the hill country, a similar set of income-increasing options is examined for each farm. The scope to afford conservation options is placed in the context of the options available to increase farm income. This difference between sections reflects a difference in the case studies — for the farms in the hill country, it was easier to identify options for making the farm significantly better off. Distinct options for making the farms on the plains better off were not so apparent, and the options considered varied more from one farm to another. The same approach to policy issues is taken in both sections, but the findings differ considerably.

2 The issues

In this section, firstly an overview of the ecological issues associated with the management of agricultural land, particularly native grasslands, is given. A brief overview of management requirements, as recommended by ecologists and others, is then provided. We then examine how farmers are currently dealing with environmental management issues, and how they might do so in future. This leads into further discussion of the land that they manage. Expectations about how farmers should manage have changed over time, and these changes are outlined. Finally, the response of farmers to these issues and expectations is explored. This will be followed in the next section by discussion of the responses of government.

2.1 Ecological and land management issues

The use of privately owned land for agricultural purposes is leading to the loss of biodiversity and to unanticipated changes in how ecosystems function. There are also problems of land management such as salinity, erosion and acidity that are reducing long-term productivity.

In Australia, these phenomena have been identified as major problems by both Federal and State Governments because of concerns about conservation, long-term productivity and off-site effects (eg. DEST, 1996; DNRE, 1997). Here the case of native grasslands is examined. A similar account could be given of other forms of vegetation found on private land, eg. wetlands or grassy woodlands.

The characteristics of native grassland vary greatly both between and within regions (Kirkpatrick *et al.*, 1995). The most important distinction for the purposes of this study is between natural and secondary grasslands, both of which have changed dramatically since European settlement. Natural grasslands have changed through different grazing pressure and changed fire regimes; these grasslands are mostly located on lowland plains. Secondary grasslands are former woodlands that were cleared by European settlers. In most cases the secondary grasslands are on hill country, are relatively species-poor, but are very important in providing perennial ground cover. The policy issues and the respective solutions for these two types of grasslands also differ. More detail is given about the grasslands in later sections.

2.1.1 Management requirements

Grassland ecologists believe it is generally desirable to maintain the historical pattern of management for sites of high conservation significance unless such management is obviously having a deleterious effect, or unless research suggests different management (Diez and Foreman, 1996; Ross, 1999). For other native grassland sites, a frequent recommendation is to lighten stocking levels or to remove stock during spring to allow seed set. Total destocking is rarely recommended as native grasslands require some form of disturbance to maintain inter-tussock or inter-bush spaces. Additional management recommendations relate to avoiding soil disturbance and compaction, and minimising weed invasion (Diez and Foreman, 1996). In most cases, this means continued light grazing, no fertiliser and no cropping.

Considerable rethinking is occurring about the role of both native and introduced pasture on the hills and tablelands of south-eastern Australia because of problems with introduced grasses in these areas. The identification of low input native and introduced species suitable for these areas, and the persistence of these grasses, has become a focus of research in recent times (Garden *et al.*, 1996). Pasture ecology is receiving renewed attention (Michalk and Kemp, 1994) and research on introduced grasses is now swinging back to emphasise persistence whereas research on grasses over the last 50 years has mainly concentrated on productivity (D. Chapman, pers. comm.). The value of native grasses on less productive soils depends on appropriate management and relevant techniques

are being increasingly identified (Simpson and Langford, 1996a,b). Key requirements are to maintain perennial cover and manage according to land capability. Weed management may also be important.

The role that native pastures may have in production and in addressing salinity, acidification and erosion on certain land classes have been, and are being, investigated in programs coordinated or funded by the Murray–Darling Basin Commission, New South Wales (NSW) Agriculture, the Land and Water Resources Research and Development Corporation (LWRRDC), and Meat and Livestock Australia (MLA). Some of the research involves investigation of alternative practices such as rest periods, fertiliser application, and stocking to manipulate species composition (see, for example, Johnston, 1999; Kemp, 1999; Simpson, 1999).

Perennial grasses have a role in grazing systems because they provide feed, particularly green matter, at times of the year when annual grasses and legumes have died off. Consequently, given the variable climate in Australia, perennial grasses provide more stability in the feed supply than would otherwise be the case (Wilson and MacLeod, 1991).

2.2 Native grassland and agricultural production

Native grasslands have long been a component of production systems across south-eastern Australia. Aborigines burned native grasslands to attract game to freshly growing plants, they gathered seeds and other materials from these plants, and they turned over the soil as they dug for tubers (Gott and Conran, 1991). As Europeans colonised areas with native grasslands, these practices were disrupted and the introduction of sheep and cattle had profound effects on the grasslands (Barr and Cary, 1992; Foreman, 1993; Kirkpatrick *et al.*, 1995). The modified grasslands supported the production systems of early Europeans prior to the era of mechanised sowing of introduced pastures.

As the area of sown pasture increased, native grasslands declined. In some regions, they now play a negligible role in farming systems and have been reduced to remnants. Elsewhere they are still the basis of production, though usually in a greatly modified form. In the hill country, where woodlands have been cleared, the secondary grasslands now mostly comprise a few native grasses, no other native species and a large number of exotic species — there is nevertheless considerable variation in species type according to topography and aspect (Simpson and Langford, 1996a,b). On the Riverine Plain, the grasslands vary considerably and some may have high species diversity.

In a farming context, native grasslands are one of the resources used by the farm business to generate revenue, through grazing of sheep or cattle. The private interest of the owners of properties with native grassland is to manage this resource over time so as to help meet the farm family goals — with immediate financial needs looming large. Where these needs and demands are high relative to the size of the farm, the more likely it is that the native grassland will be replaced or excessively high stocking rates will be sustained.

Even within a single farm business, management may extend over several different land classes, or different vegetation types within a particular land class. Native grassland is likely to be found on all but the highly productive land. However, it may no longer be present if intensification has previously occurred. In the case of native grasslands of high conservation value, there is no consistent pattern to their location in terms of topography and soils. While these factors are important in some cases, any one of a number of other factors — farm size, owner attitude, farm layout — can explain why a remnant grassland remains on a particular property (Crosthwaite, 1997).

More recently, concern has arisen about how current and past practices might be negatively affecting the long-term capacity to maintain and increase productivity. Such negative effects include loss of

vegetative cover, soil erosion, soil structure decline, acidification and salinity. A number of programs are in place to identify the nature of these problems and to solve them. The National Land and Water Resources Audit is currently a major policy response (NLWRA, 1998). Agricultural policy now embraces the three dimensions of production, adjustment and sustainability — see, for example, the Federal Government's Action Plan for Australian Agriculture, Food and Fibre 2000–2001 (AFFA, 2000).

2.3 Reconciling different agendas

Public policy goals for remnant vegetation include maintenance of biodiversity and long-term agricultural productivity, and minimising negative off-site effects of farming activities. These public policy goals are consistent with the aspirations of those farmers seeking to maintain the long-term productivity of their land and the diversity of the agro-ecological systems that they manage.

A growing number of farmers, including the case study farmers, are taking biodiversity conservation seriously. However, values, attitudes and intentions are not the same as behaviour. Farm management practices are conditioned by short- and medium-term income needs, and farmers need to reconcile multiple goals, or subordinate some goals in favour of others. There may not be easy conservation solutions when a farm business is under financial pressure or without a realistic long-term strategy to maintain viability. Consequently, even where attitudes are favourable, private interests may be difficult to reconcile with longer-term public policy goals, and loss of native grasslands of conservation significance may still occur even if their retention can be shown to be consistent with maintaining income over the longer term.

This conflict at the farm level is also reflected in the difficulty of reconciling multiple goals at the public level. Policies on agricultural production, conservation and land management do not sit easily together in spite of recent efforts to reconcile them. The conflict at the public policy level largely mirrors the conflict at the private level, but it also involves other factors such as: competing research agendas; the interests of agribusiness; bureaucracies with differing histories, constituents and goals; and the wider concerns of government.

There has been and will continue to be conflict between managing native grasslands for short-term income and managing them for conservation of biodiversity or long-term productivity. By understanding more about how properties with native grassland operate as businesses, this study will help determine the extent of the conflict, at least at the private level.

As farms are businesses organised around generating income for business survival and profit, understanding how different parts of the farm contribute, or might contribute, to the profitability and cash flow of the farm business is central to resolving the public policy issues.

Farm businesses vary. No two farms are alike when all the factors making up a farm are taken into account, such as farm size, soils, enterprise type and size, grazing practices, family characteristics and available labour, debt levels, management style, and attitudes.

A farm business analysis can provide powerful insights into the underlying driving forces influencing farm management, but it does not provide the whole picture. While some attention is paid to what motivates the individual landholder, this is not thoroughly explored and the place of native grassland in farmers' non-economic goals may be underestimated. Consequently, this research must be seen as complementary to research into values, attitudes, intentions and practices, and the relationships between them, as a sociologist or psychologist might study them. Conversely, social research into farming cannot hope to uncover the factors that an economic study of this type might find important.

This study aims to generate transferable lessons about how the farm business operates, and the place of the native grassland in the farm business. The observations about the attitudes and knowledge of the farm owners in the case studies are less transferable. The study also has little to say about the public value of native grasslands. The contribution of native grasslands to the farm business is only one, albeit very important, benefit of native grasslands.

2.4 Responses by farmers and their significance

It is important to acknowledge that many farmers recognise problems associated with the loss of biodiversity and increased land degradation. However, the ways in which landholders are responding to changing expectations from politicians, the media and others are not easy to determine. While the ultimate benchmark is the state of the environment itself, tracking how farmers are responding is important in order to identify the relative effectiveness of different ways of bringing about change.

There is a sequence of responses. An initial one might be learning about a problem. This may or may not lead to attitude change. Whether behaviour then alters depends on a host of factors. Even when behaviour changes, land management and biodiversity may not change and may even continue to deteriorate. Many different studies target each of these responses (Vanclay, 1992; Frank and Chamala, 1993; Garden *et al.*, 1993; Millar and Curtis, 1995; Cary and Wilkinson, 1997; Curtis, 1997).

The issue is not simply one of private failure for which a public response is required. Governments over the last thirty years have increasingly intervened in land management. There has been a significant public shift away from a production orientation towards one of sustainable development. Strategies for biodiversity conservation and for land management have now been in place for at least 10 years. There has also been significant institutional change and the adoption of a large range of different strategies and mechanisms. These changes are at best having only partial success in the short term, given that few of the relevant biophysical indicators show signs of improvement, and most indicators show a worsening trend (State of the Environment Advisory Council, 1996).

The problem of making little progress in achieving public land management goals is likely to revolve around economic circumstances, which dictate that there is a premium on short-term rather than long-term gain. Relatively certain short-term gains are likely to outweigh concerns about the uncertain long-term effects of environmental damage. This problem is not confined to the rangelands about which Stafford Smith *et al.* (1997) eloquently wrote:

> "... in the short term, heavier stocking rates are generally economically rational; it is only the poorly documented suspicion of incipient long-term damage that triggers the researcher's caution. With the best will in the world, a pastoralist who is trying to get out of debt or put children through school will usually conclude that reacting to the uncertain risk of long-term damage does not justify certain short-term pain for the family."

This outline of the problems, the situation of farm businesses and responses of farmers and governments sets the scene for considering whether analysing how natural resources fit within the farm business context can help advance the situation.

3 The approach

3.1 The economic approach

The main policy problem associated with sustainable agriculture can be characterised as one of public versus private interests. From this perspective, the public interest requires a solution to the twin issues of biodiversity loss and unsustainable land management, while the private interest is about profit, cash flow and business survival. However, the public–private distinction may obscure some important issues. Firstly, farm business goals will frequently clash with other goals that farmers might have, or might adopt. Secondly, there might be scope to reconcile these goals and hence the dichotomy is not necessarily perpetual. Private interests are not inevitably or wholly opposed to public interests.

The markets in which farmers sell their produce are largely competitive, and farmers have no choice but to meet market expectations if they are to survive in the long term. The end-product markets broadly determine how a wheat crop or livestock will be produced. The pressures on farmers arising out of their participation in agricultural markets leads to changes in land management. There are some similarities across farms, with the market tending to produce 'standardised' land management outcomes in some cases. In some instances, it is the adoption of particular new and profitable techniques that leads to the land management change, eg. technologies for sowing introduced pasture on particular land types. These technologies cause relatively uniform changes on the farms that adopt them, and the land degradation that occurs is relative similar. Examples are dryland salinity resulting from tree clearing, and acidification of soils resulting from pasture development.

To the extent that market pressures do lead to land management changes via the introduction of new technologies, there is scope for addressing some land degradation issues by improving the operation of agricultural markets. However, some change in land condition, particularly that relating to biodiversity conservation, can be understood by reference to the markets only in the most general way. The proximate causes of land management change in these cases are endogenous to the farm. On the one hand, the presence of a wetland or native grassland may be associated with conscious plan, accident, convenience, nuisance or neglect (Crosthwaite, 1997). On the other hand, these natural resources may contribute to or act as an obstacle to a particular investment strategy. Relatively few farms have sites of high conservation significance, and often each such site is unique (see Section 4.1 for further details).

In either case — where land management changes can be closely linked to markets and where they cannot — the final decisions about managing natural resources on farms will depend on factors associated with the farm business. Furthermore, farmers are not managing a uniform natural resource, but a bundle of natural resources that occur on different parts of the farm and which may not have uniform characteristics. Management of the whole will influence how the parts are managed, and this will mediate the influence of market pressures. Non-market factors such as experience and attitudes also have a powerful influence on land management. It is difficult to causally link the external pressures with the timing, character and extent of biophysical changes to the land, as the land itself varies greatly both within and between farms, and because farm management involves working with complex agro-ecosystems.

Changes in land conditions generally occur slowly over time, except in cases of extreme disturbance. The farm business can be expected to grow significantly over such time scales. The way in which the farm business expands is likely to be associated with particular ways of managing the land, and business growth will thus have a critical bearing on environmental outcomes. The nature of competition in agriculture can explain some, but not all, of the changes in land condition and land

management practices. The growth path that the farm business follows will have considerable influence.

When conservation is interpreted in terms of the internal dynamic of the farm business, then how, and whether, the farm business survives is seen to have a major impact on conservation outcomes. Patterns of survival and growth will vary from one farm business to another. Accordingly, how the different resources available to the farm business are utilised will also vary. As Penrose (1997) in her classic study of firms (businesses) states:

> "The services yielded by resources are a function of the way in which they are used — exactly the same resource when used for different purposes or in different ways and in combination with different types or amounts of other resources provides a different service or set of services."

Further, environmental resources mean different things on different farms and this is one of the factors which makes each individual farm unique.

It is important to go beyond treating the farm business as a 'black box' about which only prices, costs and production functions need to be known. An alternative approach to the farm business (Crosthwaite, 1999) means recognising that:

- alternative business strategies might create new opportunities for conservation — comparison is required between where the business might be (in the future) with where it is now;
- production possibilities can be created by agents, and are not necessarily known or determinable;
- farm business goals vary, and to assume that farming is solely about maximising profit is a poor representation of reality;
- resources, capabilities and competences vary between farm businesses;
- some managers of farm businesses act in entrepreneurial ways, both using and creating opportunities;
- competition is essentially a process involving rivalry between farm businesses; and
- time is important — farm businesses learn over time, and time means uncertainty, not just risk.

In conclusion, biodiversity conservation outcomes, and to a lesser extent problems of unsustainable land management, depend on the specific circumstances of each farm. These issues thus revolve around the uniqueness of the natural resources, how they are integrated into the farm business, and how the business changes over time. An economic approach is needed that can explain environmental issues by taking the behaviour and growth of individual farm businesses as the object of study. Because many determinants of land management are endogenous to the farm, rather than exogenously determined through the market, the policy approach to sustainable agriculture that is derived from an approach focused on market behaviour alone is likely to be incomplete. Moreover, competitive markets in biodiversity services, which are provided from farms and valued by others in society, are almost totally absent. These include pest control and pollination by native fauna, and water use by native vegetation. Important as market relations are, and may become, it is the farm business which is the main object of analysis in this study.

3.2 Approach to the case studies

Eight case study farms were selected in consultation with regional extension officers. Four farms are on the natural grasslands of the Riverine Plain of northern Victoria and southern New South Wales (NSW). The other four are on the hills and tablelands of north-eastern Victoria and the Goulburn section of the Southern Tablelands of NSW. A steering committee was established to guide the project, and to help with the adoption of results by government agencies and community groups. Case study theory was drawn on during the design and implementation of the project (Crosthwaite *et al.*, 1997). This was to ensure that the results could be generalised to other farming situations apart from those encountered on the case study properties.

There were five stages to the analysis for each case study as shown in Box 1. The relevant information was collected during interviews with the owners and from farm records. Botanists or agronomists, who in some cases also assisted in clarifying possible farm business strategies, conducted pasture surveys.

Selection of the method for evaluating the farm business was important for two reasons. Firstly, a rigorous means of determining the value of native pasture to the farm business was needed. This value was revealed in a *whole farm analysis* by comparing the profitability of the current farm business relative to how the farm business might otherwise be organised. Secondly, use of the approach helped to 'flesh out' and then evaluate business strategies that might provide a more secure future for the native pasture than the current one.

The extent to which private interests regarding remnant vegetation management diverge from public interests is not static, and varies with the business strategy of farm owners. The need for action to secure public policy objectives and the effectiveness of different policy mechanisms could thus be clarified once the alternative farm scenarios were developed.

The approach was then to examine whether public policy approaches working at the level of the farm business or of farm-wide production systems might assist in achieving remnant vegetation objectives in the long run. The examination of each farm business and its production systems thus helped to identify mechanisms that could complement or replace other measures that seek to directly bring about (or retain) the desired management practices for protecting remnant vegetation, or to change the attitude of owners to such management.

The pasture assessment method essentially involved the following steps:

- grouping paddocks on the farm according to pasture type, based on information provided by the owner;
- selecting paddocks to inspect;
- locating a 'typical' part of the paddock away from fences and water — sometimes two sites were selected in one paddock;
- identifying species at the site and recording their abundance status (rare, localised, common, abundant) — approximately 20–30 minutes was allocated;
- visually estimating percentage composition in dry matter terms of the pasture (eg. introduced annual grasses, native forbs, native perennial grasses) using the dry weight rank technique (Jones and Hargraves, 1979); and
- verification of the accuracy of composition estimates by throwing 50 quadrats at one or two sites on each property.

The method for assessing livestock utilisation of pasture is outlined in the report "Who's Eating Where?" (Crosthwaite, 1998). In essence, it involves determining the livestock months of feed that are being utilised in the given paddock or pasture type on a total and per hectare basis. It requires input of livestock numbers by type, livestock weights by month of the year, supplementary feed given out by paddock, paddock names, and stock movements from one paddock to another.

3.3 Aspects of investment analysis

The need for a whole farm perspective has been outlined. A short overview of the main aspects of investment analysis, and how they are used in the case studies, is now provided. In investment analysis, the distinction is made between economic and financial analysis whereby the economic analysis captures the profitability aspects and the financial aspects address how feasible it is for the investment to be undertaken given the expected cash flow.[2]

2. The terminology is used differently in evaluation of public policy issues where financial analysis refers to the analysis of profitability to the private decision-maker whereas an economic analysis tackles the welfare gains or losses to society.

Box 1. Stages in farm assessment used in the case studies

Stage one Determine how the farm system currently operates:

(i) clarify the farm family goals, the resources available and farm activities;
(ii) determine the botanical and agronomic characteristics of each pasture type;
(iii) determine the contribution of each pasture type, eg. track livestock movements between each pasture type, or roughly estimate stocking rate month by month; and
(iv) determine the current financial situation of the farm business by estimating net farm operating profit and return to capital (profitability measures) and net cash flow and liquidity (financial measures).

Stage two Investigate the potential contribution of different investment options to the farm business:

(v) find out what investment options and management changes, if any, are currently being considered for the native pasture area, for elsewhere on the farm, and off-farm;
(vi) consider what other options are possible for this farm business; and
(vii) investigate these options and determine the expected effects on farm operating profit and net cash flow. Consider options that both maintain and adversely affect conservation values.

Stage three Investigate possible 'conservation management' options for native pasture:

(viii) consider what options are possible; and
(ix) investigate these options and determine expected effects on farm operating profit and net cash flow.

Stage four Investigate off-site effects:

(x) assess any off-site effects associated with the current management, and with the options considered in stages two and three.

Stage five Compare farm business strategies and identify necessary incentives:

(xi) group investment and conservation management options into realistic strategies — include continuing current management as one strategy;
(xii) clarify how the strategies differ in terms of profitability, financial feasibility, riskiness and conservation outcomes; and
(xiii) given the specifics of this farm and the options available, consider whether incentives are appropriate to achieve public policy goals, and if so, what form of incentive and where it should be targeted, eg. the conservation site, the farm grazing system, farm business management.

3.3.1 Profitability

Profitability is an economic concept indicating how well a business is doing or how an investment might perform in comparison with some other such business or investment. The purpose of the measure is to allow comparisons to be made — between businesses, between what is and what might be, and between alternative scenarios.

For each case study, the profitability of the current farm business is assessed by deriving the net profit/loss and the rate of return on capital. Variables such as wool price and numbers of livestock are based on expected values, ie. what the owner expects to happen on a 'most likely' basis in the future.

The profitability of alternative farm investments is also evaluated. How the farm is currently organised provides a basis for 'with change'/'without change' comparisons. A first look involves examining whether, after a change has been made, expected annual income exceeds costs — once the new plan is fully operational. This is called a 'steady state analysis'. Extra operating profit after tax is based on the extra activity gross margin less non-allocated variable costs such as fertiliser, and any changed overhead costs. In the case of an investment aimed at increasing livestock numbers, the activity gross margin takes into account wool price, wool cut, animal health and other costs as well as livestock sales and purchases.

If the steady state analysis shows a positive result, then profitability is assessed using a discounted cash flow analysis to estimate return on invested capital over the life of the investment. Net present value (NPV) and internal rate of return (IRR) are used as measures of profitability. These measure the return to extra capital invested over the life of the investment. The NPV can be calculated using different discount rates — eg. 5, 10 and 15%. Results can be in real or nominal terms; real terms are used here. Real values have the effect of inflation removed while nominal values include the effects of inflation. If NPV is greater than zero at the required rate of return (discount rate), it means the investment is more profitable than the alternatives to which it is being compared. The IRR is a measure of the return to capital invested over the life of the investment, but it is less satisfactory than the NPV (Makeham and Malcolm, 1993; Price, 1993).

3.3.2 Cash flow

Cash flow is a financial concept concerned with the survival of a business unit or a firm. It indicates whether the stream of income is sufficiently greater than the costs for the business unit to continue the activity being undertaken. Cash flow gives a picture of whether the current business is generating sufficient income to service debt and meet family needs as well as provide for asset replacement.

It is also important to know the expected cash flow arising from an investment. There are several measures that are relevant. Cumulative nominal net cash flow indicates the cumulative net cash contribution to the business over time after tax and interest have been taken into account. The years of debt and size of maximum debt are two measures of the financial feasibility of the investment. Even if an investment promises to be profitable, it may not be within the owner's financial resources to undertake it.

While the economic outcomes of investments can be analysed in either real or nominal values, financial outcomes have to be analysed in the expected future nominal values that may apply, because servicing of debt and other commitments has to be met using the nominal dollars of the time in question. It is assumed that the current real relationships between income and costs are maintained over time. This implies that if there is inflation affecting costs, then net returns will also rise similarly. In broadacre agriculture, prices received do not generally increase at the same rate as costs, but farm productivity does increase sufficiently to offset a real rise in costs, thereby maintaining real net returns.

3.3.3 Risk

There are at least five elements of risk that farmers will take into account when evaluating pasture investment decisions. These are:

- the potential loss of initial capital — this will be lower with a small capital outlay;
- how quickly the benefits are received — the longer the period before break-even, the more likely that costs, prices and other factors will change;
- the stocking rate increase needed to reach break-even — the greater the lift required, the more chance there is of the increase not being achieved;
- the potential productivity of the land where the investment might be made — the more productive the land, the more likely the investment is to succeed; and
- the expected gross margin for the enterprise being run.

These criteria can be used to help clarify farmer decisions about which parts of the farm to invest in and, in the case of native grassland, whether to sow a new pasture, fertilise a native pasture, or sub-divide and add clover seed to a native pasture. Sowing a new pasture carries the risk of a high potential loss because of the substantial initial capital outlay. The prospect of a rapid increase in stocking rate in the early years helps offset the effects of this risk, though the increase usually has to be both large and sustained for a considerable period. Fertilising a native pasture involves small capital outlays over many years, so there is little risk of a large loss of capital. Benefits may not be realised for several years until the stocking rate rises sufficiently to recover the investment in the extra fertiliser. If it becomes clear that the pasture will not respond in the way expected, or other factors like fertiliser prices or livestock product prices change and expected profitability declines, then the development expenditures can be halted. Sub-dividing native pasture and adding clover seed has a smaller initial capital outlay than sowing a new pasture, and so the potential loss is lower. However, the stocking rate is likely to increase slowly and wool prices and other factors may be less favourable by the time the investment reaches its break-even point.

3.3.4 Discounting

The choice of a discount rate is an important determinant of measured profitability. Concerns about the use of discounting in investment analysis undertaken to inform public decision-making has been widespread (Sagoff, 1988; Daly and Townsend, 1993; Price, 1993; Young, 1993). Discounting is less controversial in private decision-making. This study is concerned above all with private decision-making, and how public policy-makers can seek to influence it.

Discounting of future cash flows is usually justified on the grounds that: people have time-related preferences for consumption; there are alternative uses for capital; and the earnings foregone over time from alternative uses of funds have to be considered. Price (1993) criticises the usual rationale on which discounting is based and draws attention to the unintended consequences of the practice. He argues that return on investment and time preference are not sufficient justifications for discounting. He suggests that diminishing marginal utility provides a rational way of treating risk, and "correctly understood it yields an [appropriate] cause for discounting". This argument is particularly potent in private decision-making — depending on their wealth, income needs and their aspirations, farmers will vary in the value they place on having an extra dollar now compared to the value they place on having that dollar sometime in the future.

In this study, the discount rate is not varied from one case study to another according to the marginal utility of extra money for the owners. Instead, as indicated in the section on profitability, most results are shown on the basis of three different discount rates (using real rather than nominal values). The specifics of the farm, including the circumstances of the family and their goals, have been taken into account in ways other than adjustments to the discount rate.

3.3.5 Salvage value

Salvage value at the end of the investment period reflects what remains of the initial capital invested. Taking account of salvage values ensures that an

accurate return to capital is estimated because changes in the initial stock of capital over time are accounted for. Depreciation of invested capital over time may or may not occur, depending on the annual capital maintenance expenditures. In the case of pasture improvement based on introduced grass species, it is common to allow for a decline in pasture species, quantity and quality over time despite annual maintenance, fertiliser and pasture expenditures. This is done by salvaging a proportion of the initial investment in a 'bank' of superphosphate and introduced pasture seed.

In other situations, the initial capital invested may appreciate in real terms over time, and salvage value of initial capital will reflect these real capital gains.[3] If fertilising native pastures leads to an increase in the productive potential of the pasture into the future, this has to be counted as a benefit of the investment at the end of the analysis period (15 years). That is, the salvage value of the capital investment over the life of the project ought to reflect an appreciation in the productive value of the area of native grassland in question.[4]

3. For example, if an investment increased the long-term value of the land, then the initial capital invested would be salvaged at a value reflecting the real gain over the life of the investment.

3.3.6 Sensitivity of results

The sensitivity of results to changes in key variables can be explored in several ways. Some results are shown for a range of discount rates. Matrices showing how a result varies with changes in two or three variables are used in this report and in the associated technical reports. Examples include how economic return from an investment varies with discount rate and expected rate of pasture decline, and how gross margin per hectare varies across a range of crop prices and yields. Another approach is to show threshhold values for variables, such as establishment cost or rate of pasture decline, beyond which an investment is no longer the most profitable.

4. This appreciation of native grassland productive potential can be salvaged or valued (if it is sustainable into the future) in terms of either:
   (i) the present value of the capital which a buyer of unfertilised native grassland would have to invest in order to bring productivity up to the level attained, or
   (ii) the capitalised value of the extra net returns to the native grassland from the extra productivity from the end of the project into the future. This is the extra amount a buyer of such developed grassland would be prepared to pay above what they would be prepared to pay for grassland in the initial, undeveloped state.

4 Native grasslands and farm businesses — the Riverine Plain

4.1 Native grasslands on lowland plains

Native grasslands, mostly located on the lowland plains, represent one of the most threatened ecosystems in south-eastern Australia. Their area is now restricted to less than 1% of their pre-European distribution (DNRE, 1997). While the most diverse remnants are now generally found on small public land reserves, rail-lines and roadsides, the largest number of remnants are located on private grazing land (Kirkpatrick *et al*., 1995).

Native grasslands are now recognised under both national and state biodiversity strategies (DEST, 1996; DNRE, 1997), as well as in regional catchment management strategies (eg. Glenelg Regional Catchment and Land Protection Board, 1997), action plans (DCNR, 1994) and, to a lesser extent, in native vegetation retention regulations and property management planning guidelines. Nevertheless, despite these various public policy initiatives, the number and area of relatively intact grassland remnants on the Monaro, the Riverine Plain of New South Wales, the basalt plains of south-western Victoria and elsewhere continue to decline. Principal causes of this decline are conversion to cropping and sown pastures, as well as ongoing degradation through overgrazing and fertiliser use.

Those areas of native grassland on private land that are botanically diverse, or are less diverse but support threatened species such as the striped legless lizard (*Delma impar*) and red swainson pea (*Swainsonia plagiotropis*) have an importance out of proportion to their size. They can be found on very few of the many thousands of farming properties across lowland south-eastern Australia — possibly on 150 properties in Victoria[5]. In some cases, these botanically diverse grasslands on farms also have introduced clovers and medics, and some have considerable numbers of weeds.

The native grasslands in this study are located on the Riverine Plain as defined by Butler (cited in Benson *et al*., 1996; Diez and Foreman, 1996). This plain extends from Ivanhoe in New South Wales south to central-west Victoria and is largely treeless except in drainage lines and sandhills. There were originally several different vegetation communities (Benson *et al*., 1996; Diez and Foreman, 1996) which have been greatly modified: first by the cessation of the Aboriginal practices of burning, digging and gathering (Gott and Conran, 1991), and second by the introduction of a new forms of disturbance — usually continuous grazing by sheep and cattle within fenced paddocks.

Bladder saltbush (*Atriplex versicularia*) was commonly the dominant species, with other bushes, annual native forbs, some native grasses and small palatable chenopods always present. Now in grasslands where bushes remain, cottonbush (*Maireana aphylla*) is the usually the main bush unless grazing practices have favoured the unpalatable dillon bush (*Nitraria billardieri*). On large areas, the structural element of bushes no longer remains and the main species are either native perennial grasses, native herbs or naturalised annual grasses (Benson *et al*., 1996; Diez and Foreman, 1996). Often there are relatively few grasses, and these areas have become known as herblands.

Native grasslands on the Riverine Plain have been identified as important in various conservation and

5. Authors' estimate based on discussions with regional conservation officers in the Department of Natural Resources and Environment, Victoria.

land management strategies. Some sites are recognised at regional, state, national or international levels as having high conservation significance (Benson *et al*., 1996; DEST, 1996; Diez and Foreman, 1996; DNRE, 1997; Lunt *et al*., 1998). These grasslands and herblands are important for large numbers of native species, including plants, vertebrate animals and invertebrates. Plants or animals that are vulnerable to disturbance and competition are more likely to be found in a diverse and relatively intact ecosystem than in a modified ecosystem (McIntyre, 1994). Consequently, the species-rich grasslands and herblands are usually the ones that contain the species that are recognised as threatened or endangered. There are some exceptions, eg. the plains-wanderer, a ground-dwelling bird that requires a large area of habitat, may be found at least partly on depauperate grasslands (Lunt *et al*., 1998).

Native grasslands of lesser conservation significance are also important from a conservation perspective because they will often buffer adjoining significant sites from disturbance. They may also form part of a mosaic in the wider landscape (McIntyre, 1994). Patches of native vegetation contribute to how ecosystems function and to the survival needs of birds, mammals and reptiles that are mobile across larger areas.

Species diversity is not the only reason that native grassland is recognised under State legislation as important for conservation. Structural elements of native grasslands, specifically the perennial grasses and shrubs, may maintain the soil cover. This function is important on both the plains and hill country. In the drier regions, these larger plants also create a micro-environment in which water and nutrients are trapped and which is partly sheltered from the elements. This provides a favourable niche between bushes and tussocky grasses for other grassland species.

The importance of vegetative cover has been recognised under legislation. For instance, the Western Riverina Natural Grasslands have been designated under the *Native Vegetation Conservation Act 1998* (Western Riverina Regional Vegetation Committee, 1999). The Act requires any clearing to be undertaken in accordance with a Regional Vegetation Plan of Management[6]. The draft plan specifies that (a) sites of known high conservation value must be retained, (b) grassland must not be cleared below a basic threshold limit of 15% of the property area, and (c) a tiered approvals process applies, with the process depending on the level of bush or shrub cover. Areas with fewer than 5% shrub can be cleared subject to (b) above. Areas with between 5 and 10% shrub cover require inspection and approval by a vegetation management officer, while areas with more than 10% shrub require more detailed assessment and higher level approval.

4.2 Background to the case studies

In this section, results of an analysis of four case study farms on the natural grasslands of the Riverine Plain are presented. The background to the conservation and land management issues was given in Section 2. Two of four case study farms are near Echuca and Bendigo in Victoria (the Northern Plain) and two are near Hay and Deniliquin in NSW (the Hay Plain). In Section 5, results are presented for four case studies undertaken in regions where secondary grasslands may still be found — the hills and tablelands of Victoria and NSW. Detailed reports, one for each case study, can be obtained from the web site <http://www.landfood.unimelb.edu.au/research/grass–eco/index.html>. This section is organised as follows.

First, the current operations of the case study farms are compared. The characteristics of the native grasslands are described, and then the current economic and financial position is outlined. This provides the basis for answering the question —

6. This plan is likely to be similar to the Plan of Management for Specified Native Grasslands in the Western Riverina (no date) which was prepared prior to the Act coming into force.

how do native grasslands fit into the whole farm system and contribute to profitability and cash flow?

In the second section, the family goals and possible future of each farm is discussed. This leads into the third section, which identifies alternative strategies for achieving production and conservation goals. The fourth section analyses the issue of cropping native grassland — which is generally destructive of conservation values. Here we address questions about the comparative performance of alternative strategies for the native grassland, the profitability of investment opportunities elsewhere on the farm, and the scope for incorporating conservation management options into both the current and future farm business. These results allow a judgement to be made about whether farms with native grasslands can be sufficiently profitable to meet family needs.

Finally, the policy implications of the case studies are drawn out. A framework for identifying possible policy mechanisms is developed in this section. This framework is also relevant to the case studies from the hill country (Section 5). The relevant research questions considered are: the type of policy mechanisms that are necessary; whether or not they should be based on 'economic' principles; how the 'fit' of native grasslands into the whole farm system influences their effectiveness; whether some types can play a 'circuit-breaking' role; and the need for a mix of policy mechanisms.

The case study farms are all grazing properties. All four have sheep enterprises while one also has cattle. Dryland cropping occurs on the two Victorian farms, and irrigation cropping is undertaken on one of the NSW farms. Cropping contributes at least one-third of the income on these three farms.

The main characteristics of each farm are outlined in Table 1. The stocking rate is based on the whole area of the farm, including all cropping areas except for leased land. The owners of plains case study farm 3 (Farm P3) lease an additional 480 hectares, which is cropped.

Table 1. Characteristics of the case study farms on the plains

Details	Units	Farm no.			
		P1	P2	P3	P4
Location		Hay Plain, NSW		Northern Plain, Victoria	
Size	ha	4,791	8,000	2,430	852
Native pasture	ha	4,791	7,500	729	741
Introduced pasture/crop	ha		500	1,619	50
Farm labour	labour unit	1 +	1 +	3	0.5
Enterprises					
Crop	ha		100–300	810 + 480	101
Ewes	no.	2,500	3,500	2,700	700
Wethers	no.	0	0	1,700	400
Fat lambs	no.			1,000	
Beef cows	no.		80		
DSEs carried	DSE	5,860	8,619	7,150	2,092
DSE/ha	DSE/ha	1.2	1.1	3.1	2.5

Note: DSE = dry sheep equivalent

Farms P1, P2 and P3 are organised as two-generation partnerships (parents–son and wife). Responsibility has largely been handed over to the younger generation in all cases. Only the father on Farm P3 is actively involved in the operation of the farm. There are three full-time operators on Farm P3, and one each on Farms P1 and P2. There is also some extra assistance from other family members on Farms P1 and P2. An eighty-year-old farmer runs Farm P4 and works an estimated 50% of what a younger operator would do.

In the analysis, labour and management services are costed on the basis of $40,000 per year for a sole operator, and $25,000 for additional labour.

4.3 The native grasslands in the farming system

The main reason for studying the native grassland on the case study farms was to determine its role in the farming system, rather than to classify it from a conservation perspective. Given the objectives of the study and available resources, a comprehensive floristic study at each site was not possible[7]. Details about the native grasslands and how they fit into the farming system are given in the case study reports (Crosthwaite and Malcolm, 1999) with an overview provided in this section.

All of the case study farms are located on former native grassland or shrubland, with woodland also present in drainage lines and on sandhills. The size and characteristics of the native grasslands varies greatly, as does their place in the farming system. Both Victorian properties are participants in the Land for Wildlife scheme, and both have native grasslands that are recognised as having conservation significance. The grasslands are not very diverse floristically on one of these properties, however plains-wanderers have been sighted and a high invertebrate diversity has also been noted.

7. Usually no more than one hour was spent at each of the 10–15 sites inspected on each property. Fauna was not studied at all.

Plant species diversity on the NSW properties is at least as high as on this Victorian property.

The diversity of plant species was found to be highest on parts of Farm P2, as shown in Table 2. The very dry seasonal conditions at the time of the survey (spring 1997) and over the previous winter meant that annual species may not have germinated or may have already died off. Likewise, warm season perennial grasses that are reliant on late spring rainfall to initiate growth may also have been under-represented.

One common feature of the grasslands is the presence of naturalised annual grasses. These comprise a significant proportion of the vegetation on all pasture types, including high conservation value grasslands. There is a large variation in species composition between grasslands, as shown in Figure 1 which shows the percentage dry weight for each species class averaged across all sites on Farm P1 and the very large variations around each average.

The contribution to net farm income of grazing activities based on the native grassland varies from one farm to another. Grazing on native grassland is the only source of farm income on Farm P1, though there are important variations in the seasonal contribution of different types of grassland. On Farm P2, grazing is estimated to contribute two-thirds of the total activity gross margin (ie. gross income less activity costs, but leaving aside farm overhead costs) with rice production contributing the other one-third. Nearly all of this grazing is on native grassland, with stubble grazing on the rice making a minor contribution.

On Farm P3, approximately two-thirds of the land area is devoted to cropping. Of the 1,100 hectares that is pasture, 500 hectares is native grassland and 600 hectares is sown lucerne. These proportions will vary over time. All of the native grassland was previously cropped in the 1960s, and 200 hectares that was recently cropped for two years is expected to revert to native grassland over time. Cropping generates an expected 60% of the activity gross

margin, with grazing contributing the remainder. Grazing on native grassland is estimated to contribute less than 20% of the total gross margin.

Cropping contributes an estimated 25% of total gross margin on Farm P4, but occupies only 6% of the farm area. Nearly all the farm is native grassland, 30% of which has never been cropped, and with the remaining area reverting to native grassland after cropping. Grazing on the native grassland of high conservation value is estimated to contribute less than 25% of the total gross margin, with grazing on the rest of the farm contributing an estimated 50%.

4.4 The current economic and financial situation

The health of the farm business as it now operates will influence how native pastures are currently managed and also influence plans for the future. Measures of importance in determining the health of a farm business are profitability — which relates to efficiency of resource use, and cash surplus — which relates to financial viability. In Table 3, expected annual operating profit after tax and return

Table 2. Plant species diversity on the case study farms on the plains

Details	Farm no.			
	P1	P2	P3	P4
Location	Hay Plain, NSW		Northern Plain, Victoria	
Number of species identified				
– native	37	59	22	15
– exotic	19	26	26	26
Maximum native species at any one site	14	19	7	14
Native forbs/legumes — abundant or common	6	15	1	6
Date of survey	7 October 1997	21 September 1997	20 October 1997	21 October 1997
Assessor	A. Wilson	A. Wilson and B. Mulham	A. Wilson	A. Wilson

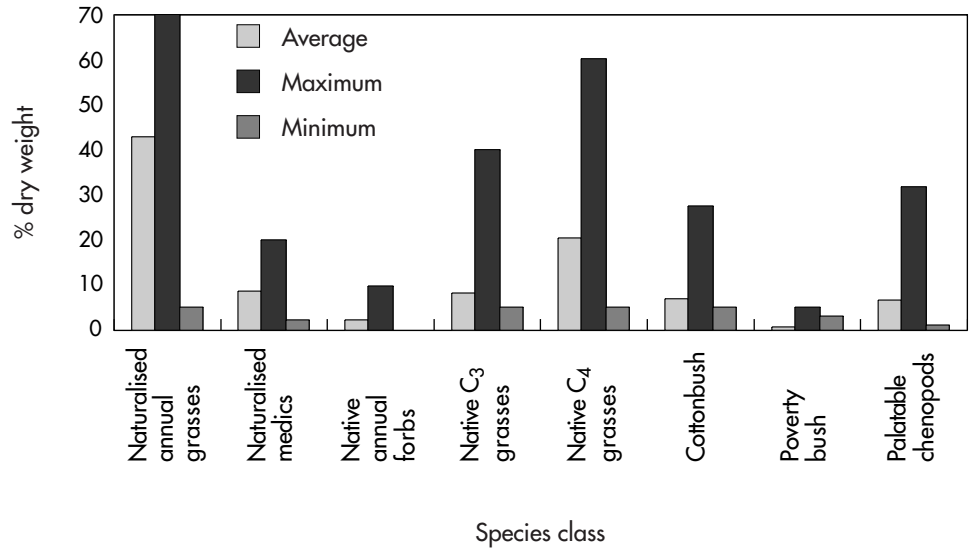

Figure 1. Estimated species composition (% dry weight) of grasslands on Farm P1. Note: C_3 and C_4 refer to the mode of carbon fixation exhibited by these grasses.

to capital are used as indicators of the efficiency of resource use. Expected annual cash surplus, or net cash flow before and after debt servicing, indicates the likely financial viability of the business — that is, the ability to meet all financial demands including family consumption before allowance is made for equipment replacement or investment out of cash flow for farm development. These results are the expected results for a 'typical' year; they do not reflect the year-to-year changes that occur in farming.

Farm P1 is expected to have the lowest return to capital, and a negative net cash flow. The results for this property are fairly typical of properties solely reliant on sheep enterprises at present. The farm business needs to generate a higher return to capital and a positive net cash flow in the future, and is not likely to be viable in the long term if this cannot be achieved. A flock of 2,500 ewes is not a large one, though it is sufficient for survival at the present time. Generally in Australian broadacre farming, the cost–price squeeze means that output needs to increase by 1–2% every year for the farm business to maintain profitability. Given the intensification of this squeeze in recent years due to poor wool prices, more dramatic changes are needed. While an increase in wool price from $4.30/kg to $5.50/kg or higher would make a significant difference, any expectation of such an increase in the current uncertain wool market is unrealistic.

On Farm P2, the farm business is expected to generate a modest annual cash surplus, with its combination of grazing and irrigated cropping. By comparison to Farm P1, cropping is expected to make a significant difference to the anticipated profitability and cash surplus. However, the cash surplus may not be sufficient to meet future investment needs as well as paying off the family loan, particularly because decisions about the area that can be irrigated have to be made every year.

Looking at all the farm businesses, Farm P3 has the highest expected return to capital, and the highest expected annual operating profit after tax. Expected annual net cash flow is also the highest. Farm P3 is expected to achieve an average return to capital of over 5%, which is what should be expected on a well-managed cropping property. After paying off

Table 3. The current economic and financial situation of the case study farms on the plains

Details	Units	Farm no.			
		P1	P2	P3	P4
Location		Hay Plain, NSW		Northern Plain, Victoria	
Total capital	$'000	1,190	1,646	1,476	747
Equity	%	88	82	87	100
Economic situation					
Expected operating profit after tax	$'000	14	32	72	11
Return to capital	%	1.2	2.0	5.6	1.5
Financial situation					
Expected uses of cash					
Cash in (ie. income)	$'000	155	293	484	75
Cash out	$'000	162	270	438	62
Net cash flow (before equipment replacement or investment out of cash flow for farm development)	$'000	–7	23	47	13

loans and the overdraft and deducting a very modest sum for consumption, there is a reasonable sum left for reinvestment. However, these expected results mask the yearly fluctuations. For instance, in recent years, return to capital and net cash flow have been unsatisfactory. Poor seasonal conditions have adversely affected crop yields, and the owners have had difficulty in paying off the overdraft built up from when crop planting. Debts have consequently accumulated. The problem is compounded by current low wool prices.

Farm P4 is a much smaller business than the others, and the farm is being run at much below its productive potential, particularly as the area of cropping has been reduced considerably as the owners have aged. The business has a positive net cash flow because costs are few and consumption requirements are low. Over time, consumption needs are expected to be adequately met. However, there is little left for farm investment and the owners are likely to have to draw on cash reserves in years when prices are down or crop yields are poor.

The current situation on Farm P4 is likely to be unsatisfactory for different owners working full-time on the farm and with greater needs. Return to capital is almost zero if the operator's allowance is increased from $20,000 to $40,000. Doubling the consumption allowance reduces net cash flow to below zero, leaving no funds for farm investment.

4.5 The future of each farm and the place of native grasslands

The issues surrounding the future of the native grassland, and hence the options that are available to the owners, are different for each case study farm.

Three of the farms have relatively young operators who are expected to continue farming, presuming the farms remain viable. Farm P4 is likely to be sold within 10 years as the owners are in their eighties. Maintaining or increasing net farm income is important on the first three farms, though the owners on all three share an interest in sustainable resource management. This means the owners are perhaps more open to alternative forms of management than farmers without an interest in natural resource management.

However, these farmers will not be able to sustain their business for a long period into the future if any alternative they pursue significantly weakens farm viability. This means that financial criteria rather than attitude will be the ultimate test of any options that are pursued. Consequently, in evaluating the future place of native grasslands on properties on the Riverine Plain, the options that might have a place on these farms will also have a wider relevance.

Opportunities for major changes to grazing enterprises that might increase net farm income are limited, especially for the properties on the Hay Plain. Possibilities include saltbush plantations and rotational grazing systems based on holistic resource management (HRM) principles. There is presently anecdotal information about the success of properties using either of these approaches, but little documentation about profitability. This report examines planting saltbush, but not HRM systems. Opportunities to increase income on the Victorian properties using dryland cropping will be discussed.

4.5.1 Farm P1

On Farm P1, maintaining annual net cash flow is the most critical goal, particularly for the family running the property on a day-to-day basis. The owners are consciously managing the farm in a way that is consistent with conservation priorities and retention of productive capacity for the long-term. Grazing is relatively light. Considerable areas of remnant vegetation are fenced off and further limited fencing according to soil type is planned.

The owners view the property as providing the major source of income, but do not expect it to provide all their requirements in the future. Investing any surplus funds off the farm is a high priority in years that there is a positive net cash flow

after consumption needs and equipment replacement requirements have been met.

Stocking more intensively is not regarded as an option by the owners, though they are clearly stocking more cautiously than many other properties. The owners are keen to increase their capacity to move stock according to livestock and pasture needs. They are not interested in rotational grazing based on small sub-divisions, because of the cost of fencing and extra management required. They see saltbush plantations as giving them the flexibility they desire. They expect these plantations will provide a source of feed in years with relatively poor seasonal conditions, and thereby help to maintain income levels.

Although many properties are making great short-term gains by investing in irrigation, this family is not interested given the investment required, uncertainty over future water entitlements and their concern for the long-term sustainability of the land. They would consider buying more land in an irrigation area before undertaking it here.

Hosting day visits by tourists and camping tours are being considered at present. Harvesting kangaroos is considered a possibility for the distant future rather than a realistic one at present, given the lack of market infrastructure.

4.5.2 Farm P2

On Farm P2, priorities for the owners are generating income, repaying the farm debt and sustainable management. There is no off-farm income. The owners are interested in resource management and rangelands management issues. They are increasingly aware of the effect of different management practices on the land, and are concerned with identifying farming methods that will meet income requirements while maintaining long-term productivity.

In recent years, irrigation water has been taken from an outfall from an irrigation district and used to grow rice and other crops. The extra net income has been very important in meeting consumption needs and helping to pay off the property. However, title to this water is not secure, and the quantity available has varied greatly. Uncertainty over the availability of water makes planning for the future of the property difficult.

Like Farm P1, the property is in an area designated under the *Native Vegetation Conservation Act 1998* as having native shrublands of conservation significance. This has no implications for current management, but it might place constraints on further clearing of native shrublands for the purposes of irrigation.

The owners do not presently have plans for any major changes to their grazing enterprise. However, they do have a problem with unpalatable dillon bush (*Nitraria billardieri*) that may affect their future income from grazing. Overstocking in the distant past led to a decline of palatable bushes and the creation of conditions favourable to dillon bush. A rangeland management and research consultant, A. Wilson, considers that the coverage of dillon bush is expanding on this property at a rate of possibly 1–2% per year, and that a one-third reduction in stocking pressure for 15 years might be necessary to reverse this expansion.

If the consultant is right, a major change to the grazing enterprises may be necessary. Quite reasonably, the owners would expect more evidence about the expansion of dillon bush and about the profitability of any alternatives before making any major investment decisions. The effect of a one-third reduction in stock numbers and an alternative of using saltbush plantations to achieve the required reduction in stocking pressure without decreasing numbers is tested in this report.

4.5.3 Farm P3

For the owners of Farm P3, maintaining net farm income and minimising year-to-year fluctuations in income are judged to be the predominant goals. The property will need to support three households for the foreseeable future.

The owners are likely to maintain their long-standing interest in the management of native pastures and in conservation issues. This is linked to their perception of their property as being on marginal country with difficult soils and erratic rainfall, making it difficult for introduced pasture species to persist.

The owners intend to reduce the 'boom–bust' fluctuations in net cropping income by removing break crops like canola and lupins from their rotation. In poor years, these crops do very badly in this marginal country. The owners are unlikely to increase the area cropped, and say that they would reduce the amount of cropping if wool prices were higher.

Cropping native pasture is under consideration because the owners believe that the stocking rate is half what it should be because of soil structure decline. The owners intend to move all the native pastures into the cropping rotation some time in the next 15 years. This includes eight native pasture paddocks, totalling approximately 500 hectares. Some of these have recognised conservation values, even though they have all previously been cropped at some time in the past.

An alternative to cropping these areas could be to decrease stocking levels, particularly in spring, to allow the native pastures to regenerate naturally. The owners regard the native pastures as overstocked — noting three poor springs in which plants have not been able to set seed. The owners have already established a trial saltbush plantation, and are interested in establishing more plantations.

The owners are planning to put their own lambs, and some purchased lambs, through a feedlot prime lamb operation. However, feedlots are risky when carried out on a large scale. Consequently, they expect to do it only in years when forward contracts can be signed with buyers.

4.5.4 Farm P4

The owners of Farm P4 are over 80 years old. The farm has supported them for a long time. They are surprised to be still farming, and think occasionally that they should have sold when wool prices were better. The owners have taken a keen interest, and a great deal of pride, in the species that are being found by researchers in the grasslands on their property.

The owners do not intend to make any changes to management and it is likely that the property will be sold some time in the next 10 years. The property consists of several blocks some distance from each other. There are two scenarios for its sale — either as a going concern or as separate blocks. The outcome will depend on the owners' intentions and on interest from potential buyers.

Each scenario has different implications for the conservation of the native grasslands and how they fit into the business of the future owner(s). If a neighbouring farmer buys the grassland block, the return to the additional capital will be significantly higher than if they buy the whole farm. If the farm is sold as one unit, the relevant question is whether it is large enough to be a viable unit if conservation management is continued on 30% of the property.

4.6 Strategies for achieving conservation and long-term productivity goals

In regions where rainfall is low and erratic, stocking levels in dry years need to be significantly lower than what might be feasible in better seasons, if irreversible damage to soils and consequent loss of pasture productivity is to be avoided (Harrington *et al.*, 1984). Flexibility is thus required to rapidly reduce stocking levels in better years to the appropriate carrying capacity in dry times. If such flexibility is not possible, stocking levels in better years should not be much greater than the ideal in dry years.

If conservation values are to be maintained, lighter stocking in dry times is necessary to maintain vegetative cover, especially of perennial plants. In addition, pastures need to be rested in spring to

allow seed set of the native plants. This management should also prevent perennial grasses thickening up and crowding out inter-tussock species (Diez and Foreman, 1996).

Thus, the critical management tool for maintaining grassland biodiversity is the same as others have identified for rangeland management, ie. manipulating grazing pressure "both in time (according to rainfall and the condition of the plants), and space, by resting some areas at critical times" (Harrington *et al.*, 1984).

The problem is that while the type of management outlined above is conducive to the achievement of long-term public and private goals, it is likely to have an immediate financial cost because the farmer's income depends on animal production that is less immediately responsive to seasonal conditions than is vegetation (Harrington *et al.*, 1984).

Three strategies for maintaining conservation values and long-term productivity of pastures were investigated to inform the following discussion about options for property management.

The first option involves setting aside and managing a small area on each property, which might include remnant bush as well as grassland, for conservation purposes (see Section 4.6.1). Setting aside a small area is relatively easy to do for many farmers, and many are already doing it, often with fencing grants. It is worth knowing how much it costs relative to the size of the farm business.

The second option involves a large disinvestment in grazing, given the hypothesis that there might be gains in terms of long-term productivity and conservation if many properties across the Riverine Plain were less heavily stocked (Section 4.6.2). Destocking over large areas would be a very significant change in Australian farming — contemplated and tried by a few in the rangelands but possibly not elsewhere. Understanding the likely effects on the case study farm businesses might help in the development of strategies to achieve it elsewhere.

The third option involves investment in grazing (Section 4.6.3). The specific strategy investigated is the establishment of saltbush plantations which might provide an additional source of feed in poor seasons, and help to maintain income levels. Saltbush is also of interest as part of a strategy to achieve the destocking proposed under the second option.

4.6.1 Setting aside small conservation areas

One strategy for achieving conservation goals is to set aside selected areas on each property. Fencing off areas where species diversity is greatest in order to totally exclude or to maintain a lower stocking rate than elsewhere might enhance conservation values. Apart from grasslands, fencing off can be extended to woodlands, swamps, sandhills and other distinctive landforms.

Such areas could be totally destocked permanently or at least until regeneration occurred. In grassland ecoystems, permanent destocking is likely to lead to the loss of ephemeral plants occupying the inter-tussock spaces (Diez and Foreman, 1996). Once regeneration occurs, resting the area for an extended period in some or all years to allow seed set may be desirable.

The cost of setting aside small areas on the case study farms and the effect on net farm income was tested in this study. It is assumed that 2.5% of the total farm area is set aside. While all the case study farms are already managing some areas for conservation, the approach is useful to test the scope for increasing the areas set aside, and to examine how the results might apply to other properties that have not yet done this.

Some areas have already been fenced off on Farms P1 and P3. On Farm P4, the most significant native pasture from a conservation viewpoint is destocked for several months of the year. On Farm P1, some

areas have been fenced off in order to encourage regeneration. This has been done primarily to address problems on the sandy country, which is generally the most prone to degradation and management problems. It is expected that these areas will be periodically grazed in future. On Farm P3 and Farm P2, an area of lignum swamp and a small area of boree (*Acacia pendula*), respectively, have been fenced off.

The total costs of setting aside an area are shown in Table 4. Steps in the analysis are: first, estimate the annual foregone grazing income; and second, convert this to net present value terms (for several discount rates) and include fencing costs.

The present value of the foregone grazing income is included at a 15% real discount rate (the rate used for other analyses associated with the case studies). By adding together the lump sum fencing cost and the present value of the foregone grazing income, at whichever discount rate is appropriate, it is clear that Farm P2 faces the largest cost followed by Farm P1. The costs are lower if stock are not totally removed, but not proportionally so, given the high up-front costs of fencing.

If fencing grants were provided, the costs would be the foregone grazing income plus the owner's time to erect the fence. It should be noted that the labour required to erect the fence increases proportionately with property size.

4.6.2 Lighter stocking

There may be a gain in terms of long-term productivity and conservation if many properties across the Riverine Plain were less heavily stocked. Two of the case study farms provide prospective models for the trade-off between short-term income and conservation and long-term productivity benefits of lighter stocking. In each case, lighter stocking needs to be compared to the alternative land use that is most likely rather than to current management. Other studies have demonstrated that under certain conditions, lighter stocking can increase profitability (eg. Buxton and Stafford Smith, 1996).

Sheep numbers are reduced in this scenario by one-third across all of Farm P2, and by one-third on 500 hectares of native pasture on Farm P3. On Farm P2, the alternative is to continue current management, though this may lead to a decline in pasture productivity. On Farm P3, the owners are committed to a cropping/pasture rotation on native grassland (all of which has been cropped at some time in the past 40 years).

Expectations about the effect of lighter stocking on key variables are as follows (for a full explanation, see the case studies in Crosthwaite and Malcolm, 1998, 1999). Reduced livestock numbers will lead to an immediate reduction in activity gross margin. Savings in drought feeding costs and improved performance by the remaining stock in poorer seasons will partially compensate. The improved livestock performance is measured in the case studies by increased weaning percentage (leading to higher lamb sales) and to better wool cut. At the whole farm level, there may also be reductions in costs and use of labour and capital.

Table 4. Lump sum costs ($) to the farm owners of setting aside an area with no grazing

	Farm P1	Farm P2	Farm P3	Farm P4
Foregone income	13,209	18,484	12,660	3,298
Fencing cost	7,500	11,000	3,000	1,500
Total	20,709	39,484	15,660	4,798
Per hectare				
– with fencing materials	173	197	270	228
– without fencing materials	110	92	218	157

The implications of lighter stocking on Farm P2 are highlighted in Table 5 which compares the present values of the losses for different rates of pasture decline. It shows that the lump sum the owners might hypothetically require as compensation is significantly higher if no pasture decline is expected. However, it is clear that the resource owners are facing a cost if they reduce stocking regardless of the rate of pasture decline. Consequently, and unfortunately as far as conservation and long-term productivity are concerned, it may be most profitable to continue current management in spite of the long-term consequences. This is particularly so if the drop in pasture productivity is expected not to occur for some time.

This analysis shows that, on the assumptions used, this property faces a significant annual after-tax loss. This is significantly different to the result found by Buxton and Stafford Smith (1996) who analysed beef properties in northern Australia. The difference is partially explained by the fact that meat production declines more markedly in response to poor seasonal conditions than does wool production (A.Wilson, pers. comm.).

This potential loss needs to be considered in the context of other compensatory activities that might be undertaken on the property. Income-earning opportunities are limited because there is little scope to increase the area under irrigation. However, increasing the feed supply through planting saltbush might be one means of achieving the proposed reduction in stocking rate on the grasslands without adversely affecting net farm income — this is considered in the next section.

The results are somewhat different for Farm P3. The partial budget for this property (see Crosthwaite and Malcolm, 1999) shows that there is expected to be no significant change in net farm income as a result of reduced stocking on the specified 500 hectares by comparison to current management. The critical factors offsetting the lower stock numbers are the increase in wool cut that is expected in most seasons and savings in drought costs.

A different result is obtained when considering what the owners might achieve by implementing their plans for the 500 hectares. These plans are to sow a crop for two years and then to establish pasture in which they expect native species, especially grasses, will re-establish over time. The implications are highlighted in Table 6 which shows the present value of the net gain or loss from removing stock or

Table 5. Expected present value ($) of the losses associated with the reduced stocking option on Farm P2

	Rate of pasture decline		
	no decline	0.5% p.a.	1% p.a.
Discount rate 5% real	107,901	80,059	53,319
10% real	79,069	61,378	44,337
15% real	60,786	49,008	37,628

Table 6. Expected present value ($) of the gains/losses from removing stock on Farm P3

	Removing stock	Cropping/pasture	Difference	
			Total	Per ha
Discount rate 5% real	–5,599	112,328	117,927	236
10% real	–3,928	94,520	98,448	197
15% real	–2,935	81,394	84,329	169

from the cropping/pasture option. The difference reflects the foregone opportunity in removing stock compared to pursuing the cropping/pasture option. This result should be interpreted in the context of a property that is being run efficiently and with few other opportunities to invest capital.

In spite of these results, the adoption of the cropping/pasture option is not a foregone conclusion. The owners intend to crop the area primarily because its value as pasture is declining, rather than to expand cropping per se. The owners also have a positive attitude towards native grasslands, for production purposes primarily but also for their conservation values. Consequently, the owners are likely to be very interested if it can be shown that there is an alternative way to manage the grasslands so as to restore their productive capacity.

However, when considered in the context of the most likely option that the owners would pursue, there is a real opportunity cost. The owners are most likely to crop the area for two years and then have a pasture phase.

4.6.3 Planting saltbush

Saltbush is less susceptible than grasses to large variations in rainfall. The amount of feed it is expected to provide in autumn can be estimated and relied on with more certainty than for pasture. This security is important when crucial stocking decisions are made in spring. Saltbush is also expected to increase management flexibility. Large numbers of stock can be congregated onto small saltbush plantations enabling pastures to be spelled.

Three of the case study farms have planted saltbush, though only Farm P1 has moved beyond an initial trial plantation. How saltbush will fit into the farm system will vary from property to property.

The owners of Farm P1 see a major role for saltbush plantations across the farm. They expect these plantations will provide a source of feed in years with relatively poor seasonal conditions, and thereby help to maintain income levels. In better years there will be sufficient feed without the saltbush. The benefits that might be achieved in some years include: better sale prices for young stock (estimated at every third year), increased weaning percentages, higher wool cut, savings in supplementary feed purchase costs for young stock (every second year), and savings in drought feed costs (a major drought every seven years). Trial results make it clear that it may not be possible to use a given area of saltbush to achieve more than one of these benefits in any one year (reported in Wilson, 1998).

Saltbush may not fit into the farming system on Farms P2 and P3 as well as on Farm P1 due to soil type and difficulty in rearranging the livestock calendar to fully utilise the saltbush, given the conflicting labour requirements of cropping. Nevertheless, on these properties, a major benefit from saltbush might be to maintain the long-term productivity of degraded grasslands by allowing them to be rested for longer periods than might otherwise occur. In some years, the extra flexibility in pasture and livestock management made possible by the saltbush plantations is likely to help achieve higher lambing percentages and wool cut.

Planting saltbush on Farms P1 and P2 is now examined. For both properties, plantations are assumed to be 20 hectares in size with 690 bushes per hectare. Each plantation is expected to carry 45 livestock units/hectare for 60 days. If plantations are 20 hectares in size, it is estimated that 167 hectares are required on Farm P1 and 233 hectares on Farm P2. Establishment costs on Farm P1 total $61,423, or $369 per hectare and $0.53 per bush, and are of a similar order on Farm P2. The assumptions and the derivation of the area required and establishment costs are detailed in the case study reports (Crosthwaite and Malcolm, 1999).

For the purposes of this analysis, it is assumed that all the saltbush is planted in one year. The owners would almost certainly not do this — they would expand the area of saltbush as finances allowed and experience suggested.

The expected value of each benefit (if it occurs) is derived in each case study report (Crosthwaite and Malcolm, 1999). The benefits are not expected every year. For example, drought costs are estimated for Farm P2 to be $45,500 every seven years. The expected value on an annual basis for this and other benefits is shown in Table 7. Two of these benefits are not expected for Farm P2. The pasture decline factor are discussed in the results for Farm P2.

Table 7. Expected annualised value ($) of benefits from planting saltbush

Benefits	Farm no.	
	P1	P2
Increased wool production	3,780	4,457
Extra lamb sales	3,938	3,281
Better lamb prices	2,591	–
Saved supplementary feed costs	2,721	–
Saved drought costs	4,643	6,500

4.6.3.1 Results for Farm P1

For Farm P1, three scenarios are examined which reflect the differing expectations about pasture decline occurring on the property. The scenarios are:

- Saltbush saves drought feed costs only.
- Saltbush saves drought feed costs, saves supplementary feed costs and increases the sale price of young stock.
- Saltbush saves drought feed costs, saves supplementary feed costs, increases the sale price of young stock, and increases the wool cut and weaning percentage.

Steady state results, ie. once the saltbush is fully established, suggest that saltbush planted for drought-proofing alone (scenario 1) is not justified (Table 8). Scenarios 2 and 3 are worthwhile provided the evaluation shows they are profitable after taking the costs of establishment into account.

Table 8. Net farm profit ($ after tax) for Farm P1 — before and after change

	Scenario		
	1	2	3
Current farm profit after tax	13,760	13,760	13,760
Net gain/loss after tax and interest	–1,425	2,825	8,998
Farm profit after change	12,335	16,585	22,758

Under scenario 1, ie. with the drought benefit only, saltbush is not expected to have an acceptable rate of return on the given assumptions; this is shown in Table 9. Careful consideration is advisable before planting more than 50 hectares, ie. the area estimated to be required for running young sheep. The rate of return is acceptable under scenario 2, in which saltbush saves drought feed costs, saves supplementary feed costs and increases the sale price of young stock. Scenario 3, which also includes extra wool cut and a better weaning percentage, has a very high rate of return. This scenario is what the owners would hope to achieve.

In the main report for this study (Crosthwaite and Malcolm, 1999), the above results are tested for

Table 9. Profitability ($ after tax) of planting saltbush on Farm P1 for each scenario

		Scenario		
		1	2	3
Net present value at:	5% real	16,426	53,904	107,151
	10% real	– 9,359	16,899	53,763
	15% real	– 22,646	– 3,491	23,142
Internal rate of return (real)		8%	14%	22%

sensitivity to different stocking rates on the saltbush and to lower saltbush seedling costs. It is found that the results are very sensitive to stocking rate but less to seedling cost. However, this would change if direct seeding methods become technically feasible. If the expected stocking rate is 25% lower than anticipated, profitability is probably unacceptably low under scenario 2 and possibly under scenario 3. Unless the owners are very certain that their expected stocking rate on saltbush can be achieved, based on careful monitoring of the actual rates achieved with early plantations, they should be cautious about a major expansion in the area of saltbush plantations.

4.6.3.2 Results for Farm P2

As well as improving animal performance as outlined above, saltbush plantations might aid pasture recovery on Farm P2 by allowing all the sheep to be taken off pasture for four months a year. The consultant, A. Wilson, expects this to prevent a slow decline in stocking rate. However, based on their own observations, the owners do not share this expectation.

Two scenarios are examined which reflect the differing expectations about pasture decline. The scenarios are:

- Saltbush increases animal performance and saves drought feed costs, but does not affect stocking rate.
- Saltbush increases animal performance and saves drought feed costs, and also prevents a decline in stocking rate.

In scenario 2, extra stock are carried compared to what would have been the case without saltbush. Derivation of the extra stock and the associated gross margins for selected years for this scenario are shown in Table 10. The gain from sowing saltbush is equal to the difference between the stocking rate expected with saltbush and the stocking rate expected in its absence.

The effect on net farm profit is shown in Table 11. Saltbush can be expected to contribute substantially to annual net profit whether or not pasture decline is included as a benefit. If the pasture decline effect is included, it is expected to increase annual net profit by at least 50% over the current level in real terms.

Table 10. Effect of planting saltbush on Farm P2 under scenario 2 — extra stock carried and gross margin by year

	Units	Year			
		1	5	10	15
Stocking rate — with decline	DSE/ha	1.08	1.03	0.98	0.94
Stocking rate — with saltbush	DSE/ha	1.08	1.08	1.08	1.08
Difference		0.00	0.04	0.09	0.14
Difference in stock carried	DSE	–	340	745	1,131
Extra gross margin	$	–	5,129	11,258	17,086

Note: DSE = dry sheep equivalent

Table 11. Net farm profit ($ after tax) for Farm P2 — before and after change

	Year 1	Year 5	Year 15
Current farm profit after tax	32,557	32,557	32,557
Net gain/loss after tax and interest	13,140	17,243	26,809
Farm profit after change	45,697	49,801	59,366

Establishment costs are not taken into account in Table 11. Assessing the profitability of saltbush plantations requires a discounted cash flow analysis to account for the establishment cost and annual costs and benefits for 15 years. Expected results are shown in Table 12. With the benefits of improved animal performance and drought recovery, saltbush is expected to have an acceptable rate of return (scenario 1). With a pasture recovery benefit added (scenario 2), the rate of return increases and the net present value jumps substantially.

The effect of changing several key assumptions has been tested:

If the stocking rate is lower than expected, profitability is likely to be unacceptably low under scenario 1. Unless there is more certainty about both stocking rate and about the role of saltbush in preventing pasture decline, ie. that scenario 2 will occur, the owners are justified in being very cautious about saltbush plantations. If the stocking rate is only 50% of the expected rate, then the relevant question is how much would other factors (eg. seedling cost) have to change to make it worthwhile.

A drop in the cost of saltbush seedlings by three and six cents per unit has a considerable effect on profitability, and suggests that efforts to establish direct seeding techniques which lower the costs even further are worthwhile.

If major drought is expected more than one year in seven, the benefits of establishing saltbush increase considerably.

The present analysis assumes that the full benefits from saltbush are available from the third year after planting. The saltbush plantations might not provide adequate feed if a major drought occurred in the third, and even the fourth, year. If the full benefit is not achieved till the fourth or fifth year, this has a large effect on the results.

If the rate of pasture decline is only half the expected rate, the saltbush plantations are still profitable. However, this may not be the case if other critical assumptions such as expected stocking rate also change.

4.7 Cropping native grasslands

Where the climate permits, dryland cropping of native grasslands can be expected. Cropping using current techniques will almost certainly destroy the conservation values of native grasslands; and it will be many years before even the more resilient species recover. Cropping will almost certainly increase net farm income, but the extent of this increase can easily be exaggerated. Direct drilling, as one alternative cropping technique, has been shown to have a more benign effect on the native grassland at least in the short term (Jones, 1999). However, long-term effects and crop yields are unclear.

On Farm P3 the current owners plan to crop the 500 hectares of native grassland, while a new owner on Farm P4 could be expected to crop all the native grassland. The expected gain from a cropping–pasture rotation on one block of 260 hectares on Farm P4 is considered here.

Table 12. Profitability ($ after tax) of planting saltbush on Farm P2 for each scenario

		Scenario 1 No pasture effect	Scenario 2 Prevent decline
Net present value at:	5% real	76,936	141,523
	10% real	24,791	65,684
	15% real	– 3,971	23,121
Internal rate of return (real)		14%	20%

Cropping for five years is followed by grazing for five years. As the rotation includes both cropping and grazing, the contribution of each is averaged over the whole rotation. This is represented in Table 13 as the expected rotation gross margin per hectare.

Table 13. Expected rotation gross margin (GM in $) for cropping and grazing on Farm P4

	GM/ha	GM/rotation ha
Crop GM/ha	182	91
Stubble grazing	8	4
Pasture GM/ha	48	24
GM/rotation ha		119
Extra GM		31,108

The expected pasture gross margin is based on the same light stocking rate that the current owner employs. A new owner might get a lower gross margin per dry sheep equivalent (DSE), but will more than compensate with a higher stocking rate. As is clear from the results in Table 13, the cropping part of the rotation, rather than grazing, contributes most to the gross margin per rotation hectare.

It is expected that annual net income after tax will increase by approximately $13,000 or $50/hectare compared to the present situation. This is estimated in the case study report (Crosthwaite and Malcolm, 1999) using a partial budget showing gains and losses. The gain is the expected rotation gross margin from which must be deducted the loss of the gross margin from grazing which amounts to $13,000 (based on a $20 gross margin per DSE and a stocking rate of 2.5 DSE/hectare). The partial budget also takes account of taxation, interest paid on the overdraft required to finance cropping and interest that can be earned on capital freed by selling stock not required during cropping.

The gains from a cropping–pasture rotation are expected to be lower on Farm P3. The owners are interested in cropping primarily to restore the productivity of native grassland as pasture, and plan only two years of crop. The stocking rate is also expected to vary during the longer pasture phase. This has been analysed using a discounted cash flow budget in the main report for this case study (Crosthwaite and Malcolm, 1999).

The expected net present values from the cropping–pasture rotation on Farms P3 and P4 over a 15-year period are compared in Table 14.

In summary, the extra net income to be gained from expanding a cropping operation onto native grassland needs to account for:

- which crops are most likely to be sown over the cropping rotation;
- expected gross margins that incorporate expected fluctuations in price and yield;
- whether gypsum is required periodically;
- the length of the pasture phase in the rotation;
- extra grazing on the crop stubble;
- extra tax payable;
- interest earned on the sale of livestock no longer required;
- interest payable on an overdraft if required to finance cropping; and
- whether farm overheads will be affected (if the farmer is entering cropping for the first time, or the new area to be cropped is very large).

Table 14. Expected gain (net present value in $) from a cropping–pasture rotation compared to grazing native grassland

		Farm P3		Farm P4	
		Total	Per hectare	Total	Per hectare
Discount rate:	5% real	123,339	247	151,653	583
	10% real	98,497	197	113,957	438
	15% real	81,853	164	90,336	347

The farmer's decision about whether to crop an area of conservation interest needs to be placed in the context of managing all resources available to the farm business to help meet immediate income needs and to maintain the viability of the farm business over the longer term. Given the high returns from cropping relative to grazing, it is likely that cropping will come out near the top of the list when investment opportunities are ranked in terms of their profitability and contribution to net cash flow.

However, the question may be one of choosing which areas of pasture to crop. All other things being equal, the net gain from cropping the native grassland instead of other areas of pasture is *the difference* between the net return between these two options.

If the native grassland is the last remaining area not part of a cropping rotation, and it is profitable to expand cropping further, the net gain will be higher. It will be *the difference* between the net return from cropping and the net return from grazing this grassland. This is the likely situation on Farms P3 and P4 (assuming, in the latter case, that the block with conservation values is in the hands of a new owner).

If the owner's vision for the farm business in the long term is for some areas to remain under pasture, the task of achieving conservation goals may be easier.

4.8 Public goals and private interests

4.8.1 The problems and options on the case study farms

What farmers will do, and the pressures they will be under in the future, cannot be fully known. Consequently, even if there is a coincidence of public and private interests for some particular situation at the present time, future problems reconciling public and private interests are likely to re-emerge. What do the case studies reveal?

On Farm P2, opinion is divided about the most appropriate management of the native grasslands. If the rangelands consultant who assisted with the vegetation assessments is right, current management is leading to consequences that are potentially irreversible (within several generations at least). To avoid these consequences with some certainty, it is suggested on the basis of previous trial results that stocking pressure needs to be reduced in order to reverse the dillon bush encroachment. However the owners, who have a keen interest in natural resource management, have a different perspective, so there is potentially a conflict between the public and private interests.

There is also a conflict on Farm P3. Native grassland on Farm P3 has all been cropped in the past, though some areas are now found to have important conservation values. The owners have noticed a decline in pasture quality and have plans for rotating cropping across the whole farm.

The native grasslands on Farms P1 and P4 are currently being managed in a way that is consistent with public goals. Given the past history of management by the current owners, their goals and their 'land ethic', it is highly unlikely that they would change management in a way that lessened conservation values or long-term productivity. Nevertheless, this cannot be taken for granted.

A change in ownership will occur on Farm P4 within the next 10 years. As it is unlikely that the new owner will have the same conservation ethic, a conflict between public and private interests is almost certain.

Ownership of any one of the other three case study farms could change if family circumstances change or economic viability cannot be maintained. Any such change might potentially make reconciling public and private interests more difficult, given that the current owners of these farms all have some interest in conservation and natural resource management issues. There is no guarantee that a new owner would wish to continue current management, and every

possibility that they will be under pressure to generate high cash flow in the immediate future to pay off loans and meet family commitments. New owners are also more likely to change management simply because they have a different background, a different way of doing things, or a new set of ideas they wish to implement. A new manager may be better educated and have more awareness of environmental issues in general, but these two characteristics may not influence how they approach the management of a particular property.

A range of mechanisms is available to encourage management of the native grasslands in a way that is consistent with public policy. Our investigations of the case studies have explored several different aspects of the farm environment to which policies might be directed. These, and other mechanisms, which are only indirectly targeted at the farm, can be grouped in the following way:

- Site-specific
- Farming system
- Farm business level
- Ownership and management structure
- The off-farm context.

Each of these categories gives a different perspective on the native grassland. The site-specific level relates directly to the area of conservation interest. The next level allows us to see how grazing and other management practices on the grassland is part of a property-wide management system. The farm business level allows the way in which the native grassland and how it is managed be seen in the context of farm business goals and how all resources available to the farm business, including labour and capital, are utilised. There are then two broader levels influencing all the above with ramifications for the native grassland. Firstly, who makes the decisions is identified in the ownership and management structure of the farm business. Secondly, on-farm activities are influenced by the local community, farm advisers, policy-makers and players in the marketing chain (from inputs to end products).

The site-specific category is usually seen as the most important — because 'all may be lost' if the area of conservation interest is not managed appropriately. However, the other levels provide the context within which the area of conservation interest is managed. The farm business level is particularly important because this is where overall decisions about the farm are made, taking into account the owners' goals, the available resources, the different enterprises, and market conditions.

The lessons that can be learned from the four case study farms about the value of mechanisms under the first four categories for achieving policy goals outlined below.

4.8.2 Targeting the site of conservation interest

Site-specific mechanisms have received the most attention in the environmental policy literature. Mechanisms that might be targeted at specific sites include:

- rewards, including motivational mechanisms;
- initiatives to encourage voluntary actions;
- regulation;
- mechanisms based on the 'polluter pays' principle;
- cross-compliance;
- application of a duty of care principle; and
- facilitating development of alternative products from the area of conservation interest.

A large range of **rewards** is available to help achieve desired outcomes. These include:

- one-off payment or concession, eg. grant, tax deduction;
- continuing payment or concession, eg. rate rebate, tax rebate;
- payments under a standard or farm-specific management agreement; and
- awards or small payments designed to motivate the recipient.

Such rewards are unnecessary on two of the case study farms, because private actions are clearly

consistent with public goals. Grants for fencing may help to achieve conservation outcomes for small areas on the other properties. If major production cutbacks were required across large areas, as might be desired on Farms P2 and P3, then management agreements would be required.

A standard management agreement might be appropriate in achieving stock reduction across the farm and establishing saltbush plantations on Farm P2, and others like it. A farm-specific management agreement would be more appropriate for Farm P3 because important grassland paddocks comprise a relatively small area of the farm, unlike Farm P2. Some of these sites are important for the plains-wanderer and require particular management. A management agreement with the current owners of Farm P4 is not needed, but may be very important if ownership changes.

Review and provision for rollover to new agreements are crucial issues to be dealt with in the design of management agreements (Binning and Young, 1997). Management agreements are potentially very costly over the long term, and may be dearer than land purchase (Colman *et al.*, 1992).

Even where agreements, covenants or other mechanisms are in place to secure appropriate management of important conservation areas, how that area is managed during the period of the agreement and after will be influenced directly or indirectly by what else is happening on the farm and in the farm business. Given that the terms of agreements and covenants can be broken, and may be if it is profitable enough to do so, it is important to look at the whole farm context, which will dictate the farmer's behaviour. Agreements can also be terminated, or not renewed. Consideration of the whole farm context is even more important if agreements and covenants are not in place to secure the future of important conservation areas.

Initiatives to encourage voluntary action by landholders are not likely to make a major difference on the case study farms. Some are already members of Land for Wildlife. Given the concern with profitability, voluntary covenants are unlikely to be adopted on Farms P1, P2 and P3. Given that the property is no longer operating as a fully commercial farm, the owners of Farm P4 might consider using covenants to protect the conservation values of particular paddocks in perpetuity. This would be an important step in the event of ownership changing hands.

Regulation is irrelevant on the case study farms that are not considering management changes, at least under current management. It is inadequate on the others. The main point about regulation is that while it may be effective in limiting the deliberate removal of vegetation, it is less effective in bringing about or maintaining appropriate grazing management. Breaching regulations may be very profitable depending on the proposed activity; there will always be difficulty in setting penalties at a sufficiently high level to deter deliberate destruction (Bowers, 1998).

Application of the **'polluter pays' principle**, or in less emotive language the **responsible manager principle**, requires identification of the 'polluting act'. This may be possible for destruction of native grassland, but is almost impossible with slow degradation as is thought to be occurring on at least two of the case study farms. As a second-best option, the polluter pays principle could be used to require payment when native grassland is being destroyed in order to change land use. Given that approval processes now allow such loss, such a system may be reasonable. If followed, this would be best done within a framework of regional vegetation targets to ensure pursuit of extra income did not become a goal of the conservation agency. If targets were set, 'destruction' rights could be then assigned to successful bidders (these issues are further explored in Crosthwaite, 1998).

Cross-compliance involves requiring something of the landholder in return for providing them with something. Acquiring rights to water or crop within a defined region could, at least in principle, be linked

to grassland management. For a volume of water used per year or area cropped, an area of grassland would have to be managed appropriately as indicated under a management agreement. The approach could be similar to farm businesses obtaining carbon credits by planting trees.

The **duty of care principle** is seen as marking the boundary between the manager's current responsibilities and what they can reasonably expect by way of reward for land management actions (Industry Commission, 1998). A similar duty of care in the areas of occupational health and safety is currently required of employers who must provide a safe workplace. The duty of care does not specify in detail the requirements of the responsible person, but operates on the basis of what can be reasonably expected. This shifts the emphasis away from specifying management requirements in detail, and places the onus onto the responsible person (Binning and Young, 1997). Arguably, there has been sufficient research, publications and public debate about appropriate grazing management, particularly on the Hay Plain, over the last 50 years to form the basis of a community understanding or consensus (though always allowing for some mavericks who will not agree) on what can be reasonably expected of an individual property owner. Possibly all of the case study farms are meeting their responsibilities under this principle, if the criterion is what the regional community would reasonably expect of all farmers. It would be very difficult to argue for action against borderline cases in the political arena — two of the case study farms might be regarded as borderline.

If a new duty of care were defined, farmers not meeting the new expectations might expect compensatory payments if a reasonable adjustment period was not allowed (several years, given that farmers may have made fixed investments) (Young, 1992). These payments would ideally be tailored to achieve restructuring of the farm business rather than simply to provide compensation.[8]

Initiatives to encourage commercial development of **alternative products** from the area of conservation interest could be effective on all but the last case study farm. Possibilities include seed harvesting, wildflowers, 'saltbush lamb' and ecotourism. The owners of Farm P1 are considering ecotourism. Various ventures have been considered on Farm P3. The on-farm success of such initiatives is likely to depend very much on the management and marketing skills of the owners. The start-up costs are likely to be very high, unless a way is found to move into the activities slowly over time. Initiatives could include funding development of concept plans, seeding funds or capital subsidies if the concept plans can be justified. An economic evaluation would be appropriate at this stage. Recognising the difficulty for an individual operator to develop a new market, action and funds to bring together networks of interested property owners in the region may be appropriate.

4.8.3 Targeting the farming system

Changes made to the organisation of production systems may lead to better conservation management. Possible changes on the case study farms include increasing rotation of stock so as to rest pastures, planting saltbush to take pressure off pastures, and consideration of native grassland issues in planning crop–pasture rotations. Depending on how they are implemented, such changes may have a detrimental effect on areas of conservation interest. Although it is not being considered on any of the case study farms, a shift from autumn to spring lambing is another example of a change in the pasture–livestock system that could have a negative effect on areas of conservation interest. These issues are considered below in more detail.

8. Timber harvesting in native forests provides interesting parallels. Victoria implemented a strategy in the mid-1980s which led to reductions in available resource without compensation, but included mechanisms to bring about structural change. New South Wales is now offering compensation payments for reductions in timber availability, but without the links to structural change. The *Age*, December 1998.

Stock rotation. None of the case study farms practise set stocking of paddocks rigidly. Nor are stock moves made solely to meet immediate livestock requirements. Farm P4 is very lightly stocked, and stock are removed from the areas of conservation interest for extended periods. More rotation of stock within the existing paddock set-up could occur on the first three case study farms if pasture condition were treated as equally important as stock requirements. It could be largely achieved within the existing paddock set-up. This is recognised by the farm owners. The extra time required to shift stock is one of the factors explaining why more rotation of stock is not occurring on these properties. As the sheep manager on Farm P3 is aged over 60, there may be a reluctance to change.

Achieving the appropriate stocking of areas of conservation interest on these and similar properties might be best brought about by using incentives to change the grazing system further away from set-stocking and more towards rotational grazing. Incentives could include reimbursing any direct costs associated with making the shift, support in learning new management and pasture recognition techniques, motivational rewards, and possibly tax deductions.

The holistic resource management (HRM) system of rotational grazing makes pasture condition the main criterion for shifting stock. It requires small paddock sizes. It is not being considered on any of the case study farms. HRM has the potential to make it easier to rest pastures during flowering and seed set in spring. However, capital costs associated with sub-division of paddocks into manageable units (extra fencing and water supply) can be very high.

Until the pasture and livestock effects and the net financial outcome from implementing HRM systems are better known, it would be unwise to direct substantial funding towards encouraging the system. The conservation effects also need to be clarified first — the concentrated stock numbers in HRM systems may have unforeseen effects on plant diversity, on recovery of cottonbush and other bushes, on the cryptogam crust and invertebrate populations, and on the habitat required by birds and reptiles such as the plains-wanderer and striped legless lizard, respectively. There is no shortage of properties making the shift to HRM systems. Immediate funding of long-term comparative trials based on selected properties, taking account all of relevant dimensions, should be a priority.

Planting saltbush. While there is considerable doubt about the private benefits of planting saltbush on Farm P2, there are clear-cut public benefits of doing so. Encroachment of dillon bush onto other vegetation is almost certainly occurring, and while the rate of expansion is less certain, it has been argued that adverse effects on the vegetation can be expected. The private perspective of the owner is different. However, there is a public interest in acting now to prevent any possible encroachment because a precautionary approach is now accepted public policy. Public funds to assist in the establishment of saltbush plantations might be the most appropriate action.

Many property owners have already established saltbush plantations, while others have not. Hence, the subsidy likely to be required to convince a property owner to establish a plantation will vary from zero to some unknown sum. Asking owners to submit bids for funds, as is done for the Conservation Reserve Program in the United States, will reveal the minimum required by each farmer (assuming the bidding system is designed to ensure competitive behaviour). Where such a system is not used, a relatively simple evaluation by a competent economist or farm management consultant could establish the likely requirement.

In order to increase the likelihood that the owners will go on and establish many saltbush plantations without subsidy, every effort should be made to see that the saltbush trials are appropriately run. Provision of the initial funds should be accompanied by:

- appropriate technical support to assist farmers develop their saltbush plantations;
- assistance to ensure that these plantations are then integrated into the tactical management of the farm's pasture–livestock system;
- monitoring of the performance of the plantation, its effects on livestock and pasture, and its profitability;
- evaluation of the owners' skills in management, both business and pasture–livestock management, and provision of targeted assistance to improve these skills if needed; and
- assistance in development of a whole farm plan which has both physical and business planning elements.

The cost of achieving the public policy goals will be much greater if the owners are not convinced that further plantations are desirable, and if they are not equipped to effectively integrate them into their operations. The relatively small cost of implementing the points proposed above should be seen in this context.

It could be argued that this investment of public funds should only be made if there is a commitment or agreement in return. What is currently known about the conservation values of the grasslands suggests that they are not significant enough to warrant an individual management agreement between the owners and conservation agencies. It would be reasonable to require that the subsidy to establish the first plantations be conditional upon agreement to accept the action steps proposed above, and to developing a comprehensive farm plan.

Planning crop–pasture rotations. Two of the case study farms engage in cropping as well as run livestock. The crop and pasture systems are interrelated in several respects that are important when considering management of areas of conservation interest.

From a pasture management viewpoint, when cropping is introduced or its area expanded, stock numbers should be reduced more or less in proportion to the extra area cropped, after allowing for some grazing of stubble in summer. The reduction can be less if there is a crop–pasture rotation rather than continuous cropping. So long as cropping is a right, there may be little that can be done — except to draw attention to the issue, possibly via cropping advisers and the cropping extension literature.

Cropping systems can have other effects on areas of conservation interest. Herbicide sprayed onto crops may drift. Weeds encouraged by the soil disturbance will spread, particularly if a pasture is not sown when the cropping phase of a rotation ends. This suggests the need for buffers between areas chosen for cropping and areas of conservation interest. The ideal buffer is another area of native pasture that is of less conservation interest. Depending on how much land is to be cropped, and the relative productivity of different paddocks in cropping terms, it may be possible to ensure a buffer is present with little effect on the profitability of the cropping operation. In others it will be costly.

Several options are available:

- regulations or a code of practice might be appropriate — a parallel is forestry codes of practice that require buffers between forestry operations and streams;
- actively working to ensure that farmers with areas of native grassland integrate all activities, including cropping, into whole farm plans; and
- incentives to establish the buffers.

Timing of lambing. Lambing on all four case study farms occurs in late autumn or early winter. Changing the lambing time from autumn to spring is frequently promoted as a means of better matching feed supply to demand in some regions. It reduces pressure on the feed supply at critical times, usually autumn or winter, from a livestock management perspective. However, it increases feed demand in spring and may restrict options for

flexible conservation management, eg. removing stock during flowering and seed set.

4.8.4 Adjustment at the farm business level

How the whole farm context influences management of specific parts of the farm is demonstrated in this report. In particular, the economic contribution of each part can only be understood in the context of the whole. The relevant question is:

> What would it require to ensure that the farm in 20 years time is managed in a way that is consistent with management of the native grasslands for conservation and long-term productivity?

The answer will differ from farm to farm. The issues to consider in answering the question for each farm include:

- What are the possible futures?
- Do those futures generate sufficient cash flow?
- How profitable are they, taking account of development costs?
- What options is a business plan likely to include?
- Is the owner likely to do it without assistance?
- What sums are likely to be required to *help* the owner onto that path?

The vision for each farm is outlined below, and the public policy options summarised.

Farm P1. A 20-year vision for this property as a viable unit could include the following characteristics. It is still stocked conservatively. Plant diversity is as high as at present. Saltbush plantations are scattered over the property, and saltbush is self-seeding through pastures that have been rested periodically from grazing. Grazing income is more even over good and poor seasons, and modest income is generated from ecotourism, off-farm investments and off-farm work.

Although the owners are confident, the path towards the vision for this farm carries some risks. The farm is not a large one, and it may not be possible to find the productivity increases to keep up with the cost–price squeeze. Saltbush plantations may not even out income as much as expected. Off-farm income will depend on the return on investments, which could fluctuate, and off-farm work may not be continuously available.

There is a strong likelihood that if the property changed hands a new owner would increase stocking pressure to the point where long-term productivity declines. The best policy might be a duty of care to act as a safeguard against this decline. The second-best policy might be to increase the current owners' chances of remaining viable.

A review of the owners' needs is first required, but public assistance to increase the owners' chance of success might be best targeted to developing a farm business plan, establishing saltbush plantations, off-farm investment advice, and seeding funds for ecotourism activities.

Farm P2. A 20-year vision for the property could be for a viable property with improved conservation values and productivity maintained. This could involve: carrying the same number of sheep; many plantations of saltbush contributing to the feed supply; cottonbush returning across large areas; the same diversity of grasses, small chenopods and other plants; a halt to the expansion of dillon bush and signs of its breakdown as competition for water and nutrients by other plants increases; plains-wanderers being frequently sighted; secure entitlement to the modest amount of irrigation water now periodically available (this will depend on factors outside the owners' control); and investment of surpluses off-farm once saltbush plantations are established.

The future for this property under its current ownership depends partly on whether irrigation water is available, either on a secure basis or periodically, as is now the case. If there is no entitlement in the future, there is little prospect of the owners' expectations being met unless techniques for using relatively saline groundwater for irrigation become available. The main

contribution of saltbush is expected to be improved pasture condition and less fluctuation in income from grazing; it could at most be a partial offset if irrigation water is not available.

If further surveys show that dillon bush is demonstrably adversely affecting the production and conservation values of the native grassland, the owners are likely to commit to reducing the stocking rate. However, they would require assistance before this became feasible. Rather than a direct payment to encourage the stocking reduction, public assistance might be best targeted to securing the water entitlement, developing a farm business plan, establishing saltbush plantations, and later off-farm investment advice. Fencing off some areas could also be funded.

Farm P3. A 20-year vision for this farm could be for a viable property with improved conservation values, productivity maintained and farm debts repaid. This could involve: cropping the same or less area; carrying the same number of sheep; more rotational grazing and resting of pastures; some plantations of saltbush contributing to the feed supply if shown to be profitable in the district; increased species diversity on some of the native grasslands which will not have been cropped for between 30 and 50 years; plains-wanderers being frequently sighted; opportunistic fattening of prime lambs in a feedlot; and investment of surpluses off-farm once current debts are paid off.

The future depends on whether net income from cropping can be maintained at an adequate level. The last three years have been very difficult. A further run of bad years could lead to major problems. The future also depends on how the family will manage the transition to two family operators rather than three, and how this will affect the organisation of activities.

Public assistance to increase the owners' chance of success might be best targeted to developing a farm business plan, providing advice on managing the transition to a two-person operation, identifying training needs and their provision, and later off-farm investment advice. As the farm is already intensely managed, and the owners have plans to fully crop the whole property, protection of the native grassland might be best achieved via a management agreement. However, there may be considerable potential to increase whole farm viability; this will not be known at least until the scope to provide assistance and training directed at managing the farm business is fully evaluated.

Farm P4. A vision for this farm is for all areas of conservation interest to be permanently protected under a covenant or purchased by government or a non-profit organisation. In 1999, Trust for Nature did in fact purchase the most significant conservation area. Given the owners' age, the rest of the farm is likely to be sold within 10 years. The future of other areas of lesser conservation interest will be in the hands of other owners.

4.8.5 Ownership and operation of the farm business

How future owners and managers incorporate the management of conservation areas into the farm system is likely to differ from current arrangements.

On Farm P3, the sheep enterprise is mostly run by the ageing father, with some help from the two sons who run the cropping enterprise. Once there is one less family member involved in the day-to-day work, major management changes are likely. These could affect areas of conservation interest either positively or negatively. Options open to conservation agencies include:

- initiate discussions about how the area should be managed in the context of plans for the future of the farm;
- seek to have a covenant in place; and
- seek a management agreement in which the transfer of the property to other family members is covered.

Farm P4 will almost certainly be sold within the next 10 years, but there is uncertainty about when exactly

this will occur. There are three ways in which conservation agencies might secure the long-term future of the native grasslands. These are to:

- purchase the land from the current owner or negotiate a covenant which will be binding on a new owner(s);
- buy some or all of the land when it is for sale on the open market; or
- negotiate a covenant, management agreement or purchase with the new owner(s).

These choices are illustrated in Figure 2. If the conservation agency is committed to conserving the native grasslands, the stakes get higher after the first choice, and then the second. Passing up an opportunity, or failing to successfully negotiate or bid under the first or second choices introduces more uncertainty into how much the agency is likely to have to pay to secure the grassland. There is a trade-off between this increasing uncertainty and the prospect of achieving conservation outcomes at a lower cost than appears possible at the initial choice steps.

Both the current owner and the new owner of Farm P4 can potentially hold the conservation agency to ransom. On the open market, the agency faces the prospect of bidding against neighbouring farmers, who as shown in the case study (Crosthwaite and Malcolm, 1999) can afford to pay considerably more than other farmers. They may also have non-financial reasons for wanting the block as well.

As the current owner is concerned about conservation and has goodwill towards conservation agency officers, the agency would be wise to make every effort to negotiate a covenant or purchase *before* the property is put onto the open market. Given the likely interest from neighbouring owners, acting now is likely to be the most cost-effective action. If this opportunity is missed, then it is probably better to act in the open market than to negotiate a deal with the new owner.

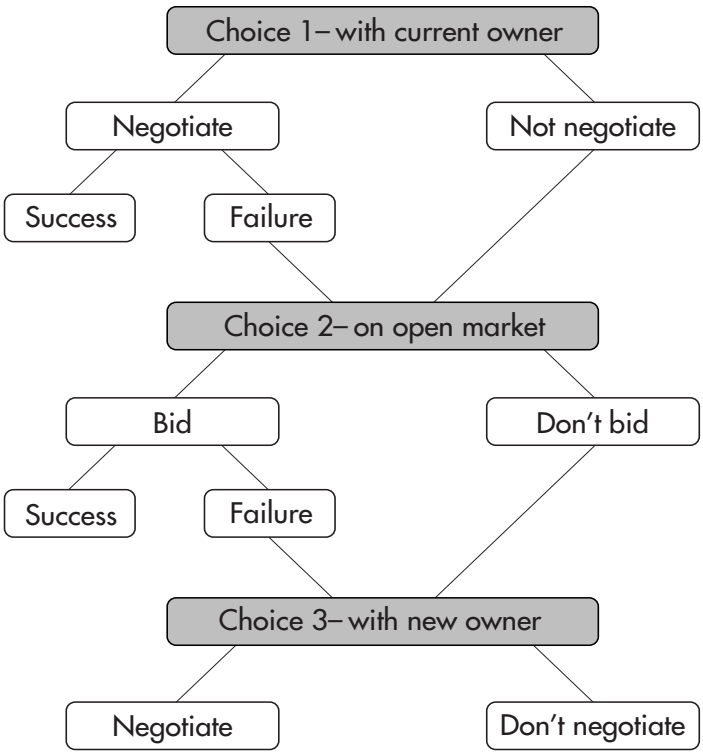

Figure 2. Choices facing the conservation agency regarding Farm P4

4.9 Conclusions regarding the case studies on the Riverine Plain

The role of native grassland in a farming business cannot be considered independently of alternative uses of the grassland, and of other investment opportunities available to the owners. As currently organised, native grasslands are the basis of the farming system in two of the case study farms, contributing at least two-thirds of total gross margin. The situation is the same on the third farm, but younger owners would almost certainly crop a much higher proportion of the farm. The fourth property relies heavily on cropping, but also has sizeable areas of native grassland contributing possibly 20% of the total gross margin.

There are no 'easy' answers on any of these farms to the questions of business survival and maintenance of conservation values in the long term. Moreover, the situation on each case study farm is very different. Farm P1 is reliant on native grasslands, and has clear plans for the future based on saltbush plantations — their future is likely to be reliant on wool prices unless an ecotourism option can be developed. On Farm P2, there are uncertainties over both water availability for rice production and the long-term stability of the native grasslands — seeking solutions through reduced stocking rates and investing in saltbush will compound the immediate uncertainty. Management on Farm P3 is fully extended with the large cropping and fat lamb operations; there are few obvious options available to increase income. The ownership of Farm P4 is likely to change within a few years, and native grasslands are likely to be cropped.

Action by government is almost certainly required on all but Farm P1 if the conservation values of the native grasslands are to be maintained. Action may make a difference on Farm P1 as well. The type of action required differs from farm to farm — this is also likely to be the case with the small number of other farms in the area with native grassland. Action targeted at the farm business level and at the farming system is at least as important as measures to directly protect the grasslands of conservation value — though some form of management agreement embracing all elements of assistance is needed to ensure that long-term conservation management is implemented.

5 Native grasslands and farm businesses — hills and tablelands

5.1 Native grasslands on hills and tablelands

This section of the report examines farm businesses in the hills and tablelands of north-eastern Victoria and the Southern Tablelands of NSW. For public policy in the regions, minimising negative off-site effects of farming activities and maintaining long-term agricultural productivity are at least as important as biodiversity conservation.

On the hills and tablelands, the decline of biodiversity is associated with the loss and fragmentation of the original native vegetation. Where clearing of the bush has occurred, most of the ground flora species have disappeared leaving a few native perennial grasses and, in the occasional paddock, additional groups such as glycines, lilies, orchids and daisies. These areas may contribute to conservation by providing genetic diversity within species, buffers for high conservation value areas, and some habitat for native wildlife. Naturally occurring grasslands were historically less significant than on the plains, except in particular environments like the Monaro Plains. Nevertheless, across the hills and tablelands, there are pockets of grasslands that are extremely important for conservation.

Native grasses form the perennial component of most pastures on the hills and tablelands of south-eastern Australia (Garden *et al.*, 1993; Pearson *et al.*, 1997). Garden *et al.* (1993) found the area of native pasture on the Central and Southern Tablelands of New South Wales to be over one million hectares. These areas are a major source of agricultural income, and may also have conservation value as outlined above. Given the large areas involved, and the range of microhabitats related to varying topography and aspect, it is likely that biological diversity is higher than commonly estimated, eg. the genetic variation within *Danthonia* spp. is thought to be significantly higher in the hill country than on the plains (I. Higgins, pers. comm.).

In the absence of trees and shrubs, perennial grasses are important in maintaining the long-term productivity of agricultural activities, and in minimising soil erosion. Preventing the loss of the topsoil and its organic content is particularly important given the shallow, skeletal nature of many soils in these regions (Johnston, 1999). The deep-rooted perennial grasses do more to prevent soil erosion and salinity than shallow rooted annual grasses, which die off in late spring or early summer.

There are many success stories about the establishment and longevity of introduced pastures, especially on more productive soils. However, survey results show that across wide areas where introduced grasses have been sown, they are no longer present (Quigley *et al.*, 1992; Garden *et al.*, 1993). Lack of persistence of introduced perennial grasses on less productive soils has also been identified as a problem (Garden *et al.*, 1996; Jones, 1996; Kemp *et al.*, 1996). Many reasons for this have been identified including drought, lack of phosphorus and poor management (Wilson and MacLeod, 1991). By contrast, native perennial grasses have returned in many previously sown pastures (Garden *et al.*, 1993). This fact is not widely recognised, possibly because the ability to distinguish between grass species is a quite specialised skill (Millar and Curtis, 1995). In pastures where there are few perennial grasses, whether introduced or native, there is likely to be greater water accession which may lead to off-site salinity problems and more erosion, especially after sudden downpours in summer when the annual grasses have died off.

5.2 Overview of the current operations on the case study farms

Two of the case study farms are located in north-eastern Victoria, near Wangaratta and Tallangatta, and two are located north of Goulburn on the Southern Tablelands of New South Wales (NSW).

The case study farms are all grazing properties. All four carry beef cattle, three have sheep enterprises, while on the fourth farm (Farm H4) sheep were replaced with dairy cattle 10 years ago. Only one farm is cropped, where grain is grown for use on the farm.

The main characteristics of each farm are given in Table 15.

Farms H1 and H3 are organised as two-generation partnerships (parents–son and wife). Responsibility is gradually being handed over to the younger generation. It is likely that the fathers in the partnerships will continue to be actively involved in the operation of the farms for many years to come. Costing the labour on these farms is an issue. In both cases, the farms could most likely be run by one full-time manager/operator, with some paid permanent or casual labour. This would be consistent with standard of one labour unit to 5–7,000 dry sheep equivalents (DSEs). Farm H4, which carries the most stock and has the most difficult country to manage, has one manager/operator. In these analyses, an operator's labour is valued according to established economic theory, by considering both the opportunity cost of the manager/operator's labour and the cost of obtaining the equivalent manager/operator's services in the market. In the analysis it is assumed that operator's labour and management services are provided at a cost of $40,000 per year.

Table 15. Characteristics of the case study farms in the hill country

Details	Farm no.			
	H1	H2	H3	H4
Location	North-eastern Victoria		Southern Tablelands, NSW	
Size (ha)	1,130	361	907	1,215
Area of farm in native pasture	66%	75%	63%	75% (estimate)
Stock using native pasture	Ewes and lambs Wethers	Beef cattle Dairy heifers Dairy cows	Young ewes and wethers Wethers	Ewes and lambs Wethers Cattle
Stock using introduced pasture	Weaner sheep	Dairy cows	Ewes and lambs	Weaner sheep and cattle
DSEs* carried	6,658	3,300 (estimate)	5,616	8,003
Farm labour	2 (father aged 55 and son aged 30)	1 (aged ~55)	2 (father aged 60 and son aged 30)	1 (aged ~ 45)
Enterprise size				
Self-replacing merinos (ewes)	1,000	–	1,250	2,500
Wethers	1,000	–	900	1,200
2-year-old fine wool	–	–	700	–
First cross lambs (ewes)	500	–	–	–
Studs (ewes)	275	–	–	–
Beef cattle (cows)	100	60	12	60
Dairy cattle (cows)	–	100	–	–

*DSE = dry sheep equivalent

5.2.1 Land management issues and conservation indicators

There are several land management issues associated with the case study farms. Erosion has been a major problem, but salinity and acidity are also concerns (see Table 16).

Conservation status was assessed by examining at plant species diversity and abundance at 10 or more sites on each property. There was no assessment of invertebrates, reptiles, or other fauna. All case study farms are located on former bushland, although Farm H2 has what may be a natural clearing which includes a range of native pasture species. The numbers of native species by type and the extent of remnant bush are shown in Table 16. The highest number of native species for all farms was found in the pasture on parts of Farm H3. The 14 species found in the most diverse pasture contrasts with the 50 or more that are sometimes found in relatively intact native grassland. All the native pastures inspected on these case study farms contained many non-native species.

5.2.2 Pasture status by land type

Estimates of the proportion of each farm by land class and pasture type are shown in Figure 3.

Based on established systems for land classification (and following the adaptation of these systems by Simpson and Langford, 1996a,b), land has been classed as follows:

Land classes 1 and 2 are arable, have high fertility, minimal erosion risk and are not acidic.

Land class 3 is semi-arable and found on lower slopes. It is likely to have lower fertility, be moderately acidic (ie. pH 4.5–5.0 CaCl), and have a moderate risk of erosion.

Table 16. Land management issues and conservation indicators on the case study farms in the hill country

Details	Farm no.			
	H1	H2	H3	H4
Location	North-eastern Victoria		Southern Tablelands, NSW	
Size (ha)	1,130	361	907	1,215
Area of farm in native pasture	66%	75%	63%	75% (estimate)
Land management issue				
Erosion	Minor, if at all	Land slips in the past	Gully erosion in the past	Severe slips and gully erosion in parts
Salinity	Minor at present	No	No	Minor
Acidity	Yes	No	Yes	Yes
Conservation indicators				
At any one site, the greatest number of:				
Native species	7	8	14	8
Native grasses	4	4	10	5
Native forbs	2	4	7	3
Native legumes	1	1	2	2
The number of native forbs or legumes either abundant or common:				
	0	0	2*	0
Remnant bush	Small area	Yes	Small area	Small areas
Bush regenerating?	Small areas	Yes	One paddock	Yes

* Common bog-sedge (*Schoenus apogon*) and kidney weed (*Dichondra repens*)

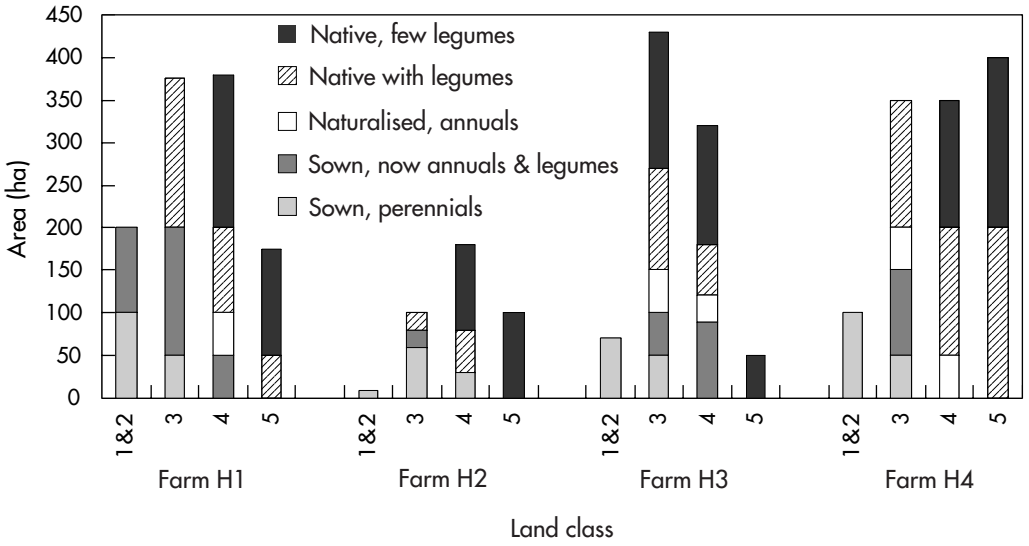

Figure 3. Area of pasture — pasture type, land class and farm

Land class 4 is non-arable land on middle to upper slopes with low fertility, shallow soils which may be acidic and have a moderate to high erosion risk.

Land class 5 is similar to land class 4, but is usually on easily eroded, steep upper slopes.

Farm H1 has 200 ha in land classes 1 and 2, which is slightly under 20% of the total land area; this includes leased land. The other farms have less than 100 ha in land classes 1 and 2. This is under 10% of the property in each case. In all cases, land of classes 1 and 2 has been sown to introduced pasture. Farm H1 has had poor results in recent years in establishing pastures, and around half the land in classes 1 and 2 is dominated by annual grasses.

Land class 3 comprises the largest land type on each farm and is suitable for direct drilling legumes, and possibly acid-tolerant introduced grasses. Land class 4 also makes up a significant portion of all the farms, and can be fertilised. Land class 5 is found on all farms. It is probably the main land class on Farm H4, and has a major impact on how the farm is managed.

5.2.3 The current economic and financial situation

The health of the farm business as it now operates is one of the most important factors influencing how native pastures are currently managed and will also influence plans for the future.

Measures of importance in determining the health of a farm business are profitability, which relates to the efficiency of resource use, and cash surplus, which relates to financial viability. In Table 17, the expected annual operating profit after tax and return to capital are used as indicators of the efficiency of resource use. Expected annual cash surplus or net cash flow before and after debt servicing indicates the likely financial viability of the business — ie. the ability to meet all financial demands including family consumption.

Looking at all the farms, Farm H1 has the highest expected return to capital, and its expected annual operating profit after tax is second highest. However, interest and principal payments and costs of leasing land mean that annual cash flow is expected to be negative (if a consumption allowance of $40,000 is made) under the current farm plan. Farm H2 is a much smaller farm than the others, and the expected annual net cash flow (with a $30,000 consumption allowance) is negative. Farm H3 has an expected annual return to capital of around 2% and a healthy expected annual cash surplus. Farm H4 has an expected annual operating profit after tax of around 1.5% and the expected annual net cash flow is positive.

In these cases, as is usually the case in Australian farming, the more highly geared businesses face the possibility of not being able to service their debts, at least in some years.

5.3 Alternative scenarios for the case study farms

5.3.1 Owner plans and opportunities

On all the case study farms, the owners are considering management changes that will affect the native pasture areas, including increased fertiliser use, sub-division, and sowing clover and other species, as well as changes to other farm operations (Table 18). Other alternatives, including options for improving conservation management (lighter stocking in spring and destocking), are also suggested in Table 18.

5.3.2 Options to increase income on each farm

Sowing introduced grasses on land classes 1 and 2. All four farms have pastures that were sown to introduced grasses within the last five years. Most were sown onto areas dominated by annual grasses and broad-leafed weeds. On Farm H1, extra land was leased to run the stock displaced by the pasture development program. The program has been only a partial success. Every year on Farm H2 a small area is sown to introduced grasses by direct drilling. A large area on Farm H3 was sown in the 1960s. Some of these areas have been recently re-sown.

Replacing native pasture. Native pasture on flatter areas of Farm H1 has been sprayed out, and introduced grasses and clover sown. However, the introduced grasses have not persisted. The owners are intending to confine future sowing to areas of the farm that do not have native pasture.

Pasture replacement is only being considered for the native pasture areas on the other farms where there are considered to be problem pastures. On Farm H4, a paddock dominated by rush (*Juncus* spp.) has recently been sprayed out and re-sown. Serrated tussock (*Nassella trichotoma*) has established a foothold on parts of this farm; pasture replacement may be one solution if it cannot be brought under control by other means.

Using more fertiliser on native pastures. All case study farmers currently fertilise the native pasture areas on a three- or four-year rotation, or less frequently. They all expressed a desire to fertilise more often — if it would pay to do so and if they could afford it.

There is a range of options for managing native pasture (Simpson and Langford, 1996a,b). The main

Table 17. The current economic and financial situation of the case study farms in the hill country

Details	Units	Farm no.			
		H1	H2	H3	H4
Location		North-eastern Victoria		Southern Tablelands NSW	
Total capital	$'000	1,251	845	1,340	1,680
Economic situation					
Expected operating profit after tax	$'000	18	2	28	10
Return to capital	%	2.3	0.2	1.8	1.4
Financial situation					
Equity	%	95	85	100	100
Expected uses of cash					
Cash in (ie. Income)	$'000	159	98	161	195
Cash out	$'000	168	114	132	173
Net cash flow	$'000	–9	–16	29	22

option considered in this study for increasing production from native pasture is for 100 or 125 kg of superphosphate to be applied to native pasture annually for 10 years. Trials have shown this rate of application to result in stocking rate increases of five DSE/ha over the 10-year period (Simpson and Langford, 1996a,b). These results have been obtained on native pasture where there is a sufficient legume base to respond to the fertiliser. If the native pasture did not have an adequate legume base, direct drilling or broadcasting seed possibly after spraying out the pasture would be necessary to achieve the stocking rate increases (Simpson and Langford, 1996a,b). Assuming a linear rate of increase in stocking rate over the 10 years is a reasonable approximation of what actually happens. If shown to be economically worthwhile, the strategy of fertilising native pasture might be adopted on at least some of the farms.

On Farm H1, the owners would like to fertilise some paddocks that can be easily traversed more often.

The owners of Farm H2 are currently increasing their annual fertiliser application four-fold in dairy paddocks that have areas sown to introduced species but which also have some native grasses — mostly on the steeper slopes. Annual fertilising (by air) of a native pasture paddock that is used by the dairy herd might also be of interest.

The owners of Farm H3 are prepared to annually fertilise paddocks in which legumes are being

Table 18. Changes that could be considered on the case study farms in the hill country

Details	Farm no.			
	H1	H2	H3	H4
Location	North-eastern Victoria		Southern Tablelands, NSW	
Owners' plans				
Native pasture areas	Fertilise more	Fertilise more Sub-divide and manage grazing	Sub-divide, direct drill and broadcast clover Fertilise	Fertilise Sow introduced species
Other resources	Expand stud Improve genetic quality of sheep Irrigate	Increase fertiliser on dairy areas Direct drill clovers and grasses	Buy rams to increase wool cut per sheep	Use separate mob* to increase genetic quality of sheep
Additional options				
Native pasture areas	Concentrate fertiliser Replace with sown pasture Direct drill clovers and grasses Agroforestry	Concentrate fertiliser Replace with sown pasture Direct drill clovers and grasses Agroforestry	Concentrate fertiliser Replace with sown pasture Agroforestry	Concentrate fertiliser Replace with sown pasture Direct drill clovers and grasses Agroforestry
Other resources	Remove stud	Sow pastures	Sow pastures Stock more cattle	Sow pastures Produce first cross lambs
Conservation management				
Currently done		Lighter stocking in spring		
Options	Lighter stocking in spring Destock	Destock	Lighter stocking in spring Destock	Lighter stocking in spring Destock

* Improve the genetic quality of the whole flock by running a separate mob of high quality sheep (the ewe lambs and some of the rams of which would be incorporated into the main mobs).

introduced into the native pasture to increase winter feed. On other pastures, they are concerned that the level of stocking required with this strategy is a high input strategy that would the system to its limits. For them, as stocking levels increase, feed shortages can develop much more rapidly if weather patterns are unfavourable. The recent long run of poor autumns on the Southern Tablelands have made these farmers cautious.

The owners of Farm H4 feel a strategy of increasing fertiliser use on native grasses would require fertilising another area less often, and pointed out the importance of fertilising the steep hill country where the ewes lamb. As this farm has 100% equity, there is an implicit concern about financing medium-term fertiliser applications from medium-term loans.

Although all four case study farmers are currently re-thinking their fertiliser strategy, they all expressed some reluctance to borrow extra funds to pay for fertiliser. This reluctance can be linked to the history of farm development over the last 50 years.

During the 1950s and 1960s, many farmers could afford to apply maintenance levels of fertiliser to the whole property every year because product prices (wool, meat and dairy) were relatively high and fertiliser was cheap. The autumn break was also thought to be more reliable during this period. Through the 1970s fertiliser became more expensive, farm area expanded and product prices began to fluctuate much more. Fertilising the whole property, or even half of it, was becoming more difficult. Lacking an alternative strategy, and under pressure to expand the farm area, many fell back to *ad hoc* fertilising of different parts of the farm when and if fertiliser could be paid for out of the previous year's cash flow. Some tried to fertilise the whole farm on a roughly three- or four-year cycle, with fertiliser being applied in years where the cash flow was high enough to cover the costs.

These points are illustrated by one of the case study farms. Fertiliser was applied through the 1970s every year or every second year to most of the farm. When new land was bought around 1980, fertiliser applications stopped for 12 years on the main part of the farm, with some areas on the newly purchased area receiving some fertiliser. A concerted fertiliser program was re-started in 1993, and the area being covered is gradually expanding.

In this report, optimal fertiliser strategies for each farm and the appropriate levels of maintenance fertiliser are not investigated. However, the merit of options to apply *extra* fertiliser as an investment (rather than as maintenance) in particular circumstances is considered. If an option to fertilise a particular part of the farm meets the key investment criteria of profitability, affordability and acceptable risk, then borrowing to do so is worthwhile.

Sub-division and introducing clover seed into native pastures. Sub-division of two large native pasture paddocks is a priority for Farm H3; one paddock is being sub-divided at present. The intention is to direct drill easily accessed parts of the new paddocks and to broadcast seed across the rest. These paddocks will then be fertilised on an annual basis. Farm H3 has one paddock that has many native grass species but is dominated by unpalatable wire grass (*Aristida* sp.) — the owners expect to be able to sow clovers into it.

Farm H2 also has two areas where sub-division is being considered. A fence that has fallen into disrepair previously divided one large area of native pasture. A large hill paddock used by the dairy cows could be managed better if sub-divided — the owner is very concerned at the erosion potential with cows creating tracks along the new fence boundaries.

Sub-division is not a priority on Farms H1 and H4.

Changing grazing method. All four farms have a grazing system that is based on set stocking but in which there is some movement of animals. On all four farms some paddocks are rested for short times.

Grazing systems based on more frequent stock movements can have several advantages relating to manipulating the pasture composition and shifting feed supply to the seasons of shortest supply. The composition of pastures can be manipulated by increasing stock numbers to eat out undesirable species at the time of year when the favoured species will not be adversely affected. It may be possible to change the composition of the pasture to obtain more green feed in summer and autumn if species that respond to summer and autumn rain are favoured.

None of the farms systematically pursue a rotational grazing system. It is likely that all four will move somewhat further in this direction given their current efforts to increase knowledge and experience in observing pastures. The owners of Farm H1 have been involved in pasture trials, including the Community Grasses program which aimed to increase farmer knowledge of native grasses and their seasonal changes. Farm H2 is involved in the Target 10 dairy extension program that closely monitors pasture response to seasonal conditions and fertiliser application. Both farmers on the Southern Tablelands are involved in PROGRAZE courses.

In all cases, there are constraints to moving towards a more flexible grazing system involving the whole farm. Three of the farms are split into several blocks. Increased movement of the main ewe flocks is limited on Farm H1 because the studs occupy a relatively large area of the farm. The owners are interested in trialling a system of rotating wethers around the paddocks. On Farm H3 the two-year-old ewes and wethers could feasibly be rotated around the block on which they run. However, the animals are now moved only four times a year and the limited labour this requires is an aspect of the current system that the owners value. The dairy enterprise occupies most of Farm H2, and rotational grazing is practised already — partly utilising native pasture. On the rest of the farm, sub-division would be first required. On Farm H4, it takes a full day to muster stock and move them from the steeper paddocks. Rotational grazing might be feasible on the flatter native pasture paddocks near the house.

Improving animal output. The three case study farms with sheep flocks are actively trying to produce heavier fleeces, finer wool or heavier weaners.

Farm H1 has recently established two studs — one Merino and one Border Leicester — as the basis for improving wool quality and better quality weaners.

Through genetic selection, Farm H3 is using fertiliser on introduced pastures to increase the dairy output per cow. Farm H3 has reduced the diameter of their fine wool from 19.3 to 17.9 microns over the past 12 years. Fleece weight has fallen slightly over this time to just under 4.2 kg per sheep. Now the owners are intent on buying rams to increase fleece weight while retaining the same degree of fineness.

The owners of Farm H4 are pursuing higher wool quality by keeping the better ewes in a mob separate from the main flock.

Changing the enterprise mix. There are no easy answers to increasing income by changing the enterprise mix on any of the case study farms — the rule 'it is not what you do but how you do it' usually applies.

Farm H1 has only recently established the two studs, and intends to trial them for five years. It is difficult to operate small studs so that they are the most profitable use of land, labour and capital. The alternative would be to expand the other livestock enterprises. Farm H3 previously had more cattle. The number of cattle could be increased to the point where the complementarities between sheep and cattle no longer apply. However, the owners are unwilling to run more cattle. Introducing some meat breed rams and producing first cross lambs is another option. Farm H4 could also produce first cross lambs, but the requirements for land on which to fatten them could conflict with the needs of the beef enterprise.

Other changes. The owners of Farm H1 have proposed irrigating a small area of pasture in order to complement other pastures by turning stock off those pastures faster in autumn and hopefully obtaining higher market prices.

Agroforestry is another potential option. It may be more realistic for the farms in north-eastern Victoria that are near large timber mills than on the Southern Tablelands of NSW. The owner of Farm H4 on the Southern Tablelands has indicated an interest in how carbon credits will affect the economics of agroforestry on the farm.

5.3.3 The new farm plan and expected annual profit after investment

The results of undertaking a range of investment options on each farm are shown in Table 19.

The annual operating profit after tax (at current prices) is expected to be higher in ten years time on all four farms. The investments in native pasture contribute to the net income on all four farms, but particularly on the two New South Wales farms.

The results from the case studies illustrate three points that are likely to apply across the hills and tablelands, namely:

(i) The strategy of fertilising native pasture is very different to other investments. It has a very low initial investment and a long period building up to the steady state. Because of interest payments, it also has a peak debt several years after the initial investment and a long payback period. It also has a high cumulative net cash flow by year 15 and a high salvage value in comparison to the initial investment.

(ii) Replacing native pasture is risky if pasture production does not remain at peak levels for at least eight years. With good management on fertile soils this may not be difficult to achieve, however on land classes 3, 4, and 5 it is difficult. The higher the number of extra stock carried, and the higher livestock gross margins, the greater the decline in pasture productivity that can occur and overall profitability remain attractive.

(iii) There is often scope for increasing net income by investing in pastures elsewhere on the farm and by making other management changes.

Table 19. Expected annual operating profit after tax ($'000) — ten years from now (current dollars) — for different investment options

Details	**Farm no.**			
	H1	H2	H3	H4
Location	North-eastern Victoria		Southern Tablelands, NSW	
Whole farm — without investments	21.0	1.8	24.1	21.8
Investments — rest of farm				
Direct drill grass and clover	6.4	2.8	–	5.7
Fertilising pasture	–	8.1	–	4.9
Irrigation	3.1	–	–	–
Investments — native pasture areas				
Fertilise only	3.6	–	4.5	8.7
Direct drill clover and fertilise	–	–	8.3	–
Sub-divide and fertilise	–	4.8	–	–
Whole farm — with investments	34.2	17.5	36.9	41.0

Note: Options that have been rejected because they are unprofitable, financially not feasible, or too risky are not included.

5.3.4 Conservation management options

It is assumed initially that the conservation management options do not have any production benefits. Whether or not the conservation management options are compatible with current and alternative farm arrangements, projected five years into the future, can be drawn from the data in Table 20.

In terms of adopting the conservation management options into the current farm system, annual after tax profit is not high on any of the four case study farms. Farms H1 and H2 would feel the reduced effects on profitability more than the other two farms, particularly considering their difficult cash flow situation. Unless there were counter-balancing production benefits, the first two farms are most unlikely to consider the conservation management options, even if they had a strong interest in conservation management. However, Farms H3 and H4 might be in a position to do so.

If other investments are made on the farm, meeting both income and conservation management goals becomes more feasible. The expected situation as it could exist five years after the pasture investments were implemented on the case study farms is shown in Table 20. The foregone net profit after tax associated with the conservation management options is relatively small compared to the extra net profit after tax from the pasture investments for all farms. All farms may now be in a position to adopt the measures voluntarily — if they are so inclined.

5.4 Public goals and private interests

5.4.1 The problems and options on the case study farms

Native vegetation on private land in the hills and tablelands is of public interest for several reasons. It may have high conservation value, or have a role as a buffer or corridor to other remnants. More likely, the perennial grass component may be important in land and water management, eg. in salinity control and in minimising nutrient run-off. This benefit applies to the case study farms.

Table 20. Expected operating profit after tax ($'000) — five years from now — with/without pasture investments and with/without conservation management options

Details	Farm no.			
	H1	H2	H3	H4
Location	North-eastern Victoria		Southern Tablelands, NSW	
Whole farm — without investments				
Without conservation management options	21.0	1.8	24.1	21.8
Retire land	–2.3	–0.5	–1.3	–
Rest land for 6–12 weeks per year	–1.7	–0.4	–0.5	–1.6
Sub-divide and rest	–	–	–	2.0
With conservation management options	17.0	0.9	22.3	21.4
Whole farm — with investments				
Without conservation management options	36.3	17.5	36.9	41.0
Retire land	–2.3	–0.5	–1.3	–
Rest land for 6–12 weeks per year	–1.7	–0.4	–0.5	–1.6
Sub-divide and rest	–	–	–	2.0
With conservation management options	32.3	16.6	35.1	40.6

On all four case study farms, the owners view native pasture as integral to their farming system. The use of introduced species is likely, in the near future at least, to be confined to the better land classes on which there is little native grass. The families on all four farms are likely to work towards achieving a species mix in which productive native grasses and introduced legumes are the main elements. This may change depending on the future development of pasture technologies.

There is likely to be a general coincidence of private and public interest on these four properties. The case studies were selected to give insights into how native pasture is now managed within farming systems, and to provide the raw material for examining how this might change in the future. They were selected to demonstrate whether hill farmers had a vested interest in management of native pasture for the public good. This has been shown to be so in a general sense, but the case study farmers do sometimes overgraze their land.

Erosion has been a noticeable problem on Farms H2 and H4. The problem has been linked to pressures to maintain income in the face of falling wool prices, combined with poor seasonal conditions causing, and caused by, overstocking. The owners of these two farms are keenly aware of the importance of the latter, and emphasised it in discussions. The skills of both farmers in understanding and responding to pasture condition are increasing.

Nevertheless, short-term pressures are likely to continue to influence management. There is a trade-off between short-term pressures to maintain income and maintaining the long-term productivity of the land. The 'preferred' strategy of fertilising native pasture at low rates over a long time period is not likely to be widely adopted because it is not profitable in the early years.

Retention of native pasture should not necessarily be a goal of public policy in itself. The public policy goals relate to long-term productivity issues, including acidification, and off-site issues like erosion, nutrient run-off and salinity recharge. Retention of perennial native grasses, and appropriate management of the pastures, are related means by which these public policy goals can be achieved.

Whether government programs should encourage farmers to better manage native pasture in their farming systems depends on the costs and benefits of doing so compared to other strategies for achieving the public policy goals. This question is somewhat beyond the scope of this project, particularly because the potential benefits need to be assessed on a regional scale rather than a farm scale, and because alternative strategies are not considered here.

The public policy approach to hill country management is necessarily different to the approach to native grasslands of recognised conservation significance. In the case of native grasslands, there are relatively few farms with such sites, they are particularly sensitive to changes in management, and once gone, are irreversibly lost. By contrast, large numbers of farms have hill country and native pasture. Native pasture is also relatively robust under varying grazing treatments. Native grasslands are important in their own right, whereas native pasture is more important from a public policy perspective for its role in minimising off-site effects.

Given these differences, it is more likely that native grassland conservation will involve one-to-one contact with farmers whereas hill country management is likely to involve standardised approaches across all relevant farmers.

The purpose here is to elaborate those elements of a public policy approach that arise from a consideration of the issues from a whole farm perspective. Such a perspective has not informed public policy in this area before, and several novel elements are suggested.

One implication is that incentive programs are likely to have a greater chance of success for less cost if they seek to change behaviour at the whole farm level.[9] This is not to say that specific incentives directed at the particular target area, eg. provision of fencing materials, are not appropriate. However, any program through which such an incentive is delivered should be designed with the current practices of target farms taken into account. The focus of attention should also be on how the parcel of land of public interest fits, or might fit, into the farm in 10 or 20 years time rather than now.

We now examine the relevance of different mechanisms for bringing about or, in the case of the four case study farms, maintaining desired management from a public perspective. As in Section 4, the mechanisms are discussed according to whether they are:

1. Site-specific
2. Farming system
3. Farm business level
4. Ownership and management structure
5. The off-farm context (considered in the next section)

As far as possible, those measures that are site-specific or relate to the farming system should be linked to changes at the whole farm level. This will maximise their effectiveness. As an example, assistance might only be provided if the farmer has, or intends to, take a course in farm business or property management planning.

5.4.2 Targeting the areas of public interest

Initiatives to encourage voluntary action by landholders have already made a difference on the case study farms. All the farmers are in either Landcare or PROGRAZE programs. Developing new ways of involving farmers, and providing the latest in management information, is important in maintaining interest.

Regional awards focused on 'best practice' management of native pasture and conservation of relevant areas might inspire farmers to emulate those receiving the awards. Two of the case study farms have sites that stand out from the rest of the farm in their botanical diversity, though they are probably not of regional significance. These areas are already treated as something special by one of the case study farmers, and the other was particularly interested in the botanist's findings and in plant identification generally.

All the four farmers are performing management tasks that they regard as normal and reasonable for the type of country for which they are responsible. In normal circumstances, rewards are simply unnecessary for them to adopt appropriate action. There are times of difficult circumstances when they may not have made the appropriate management decisions, such as destocking in drought. Rewards very early in drought to encourage destocking may be appropriate, but such measures are not specific to native pasture management.

Apart from agroforestry, there are no obvious alternative products that could be developed on the native pasture areas of the case study farms. Where appropriate, incentives could be directed at developing such products — ideally this should be part of a package aimed at the viability of the whole business.

Grants for fencing on all four properties may improve stock management on small areas that are prone to erosion or are important for salinity recharge. There are also areas of trees and pasture with native forbs that might be fenced if grants were offered. Large-scale fencing off of areas might require incentives that go beyond reimbursement of costs; the extent of public support will depend at least partly on how well the farm is doing. Land

9. Another way to consider this is to regard changes in the management of the individual parcel of land that is of public interest as a performance indicator, rather than as the target for action.

rehabilitation might also be achieved using cross-compliance mechanisms; this is further discussed in the next section where it is linked to changing the farm fertiliser program.

Payments to farmers to assist in managing particular areas of hill country could be formalised through a management agreement. As the required management is not likely to differ greatly from farm to farm, such agreements could be standardised (Bowers, 1996; Binning and Young, 1997). The advantage of an agreement is that it would specify the period of time over which the management is to apply, and it could specify conditions beyond the immediate issues, eg. development of a whole farm plan.

Regulation requiring the preservation of native pasture is unlikely to achieve public goals, although it does have the effect of shifting responsibility onto the farmer. Native vegetation regulations in Victoria and New South Wales cover pastures that are predominantly native. However, regulation *per se* will not bring about appropriate grazing management or prevent subtle shifts in pasture composition. It might, however, allow some control over ill-considered attempts to sow introduced pasture. A mechanism requiring farmers to notify any intention to develop their hill country is required. Self-reporting will be most effective if farmers perceive some advantage to themselves. Consequently, depending on the outcome of the application, it should lead to farmers receiving advice about hill country management or assistance in structural adjustment.

A duty of care can be required by regulation. It places the onus for developing practices that comply with the duty onto the responsible person (Binning and Young, 1997). Given the emphasis on managing for long-term productivity within Landcare and PROGRAZE, it should not be difficult to reach local agreement on acceptable standards of management. If the duty of care means short-term loss — say because stocking rates have to be lowered, at least initially — there may be a case for one-off assistance. Such assistance should ideally be directed towards farm business adjustment, as stated above.

5.4.3 Targeting the farming system

Changes made to the organisation of production systems may lead to better land management. Possible changes on the case study farms include improving stock management, so as to make better use of pastures while allowing them to periodically rejuvenate, and changing the farm fertiliser program. Changes elsewhere on the farm can indirectly ease the pressure on hill country.

As with the case study farms on the plains, none of the case study farms in the hill country practise set stocking of paddocks rigidly. Nor are stock moves made solely to meet immediate livestock requirements. Two of the farms have been involved in the PROGRAZE program, which is targeted at improved pasture management. The other two farmers have also received advice on pasture–stock management.

Changing the grazing system further away from set stocking and more towards rotational grazing is probably desirable on several of the case study farms. However, as outlined earlier, there are significant constraints affecting this. Incentives to partially reimburse any direct costs associated with making the shift, such as fencing, may be worthwhile.

Realistically, it takes years to learn effective plant identification skills and to be confident in new management techniques. Although all farmers have had some training, each may have absorbed the information at a different rate and, given their varying backgrounds, learned different things and applied them differently. There is a case for continued subsidies for PROGRAZE and other training initiatives over several years.

In some cases, large changes to the farming system may be required to achieve the desired management of the hill country while maintaining viable

businesses. Incentives may be justifiable in a limited number of cases. This is likely to be where the off-site effects of management of marginal country are large, and there is reasonable scope for the owners to destock and increase investment elsewhere on the farm.

Changing the fertiliser program is another action possibly warranting incentives. The approach of regularly fertilising native pasture as in the Simpson–Langford model (Simpson and Langford 1996a,b) is difficult to adopt, especially when it means less fertiliser for other paddocks. Although some of the case study farmers have begun to implement the approach, there is no guarantee that they will follow through. For several years the gross margin from the extra livestock carried is lower than the increased annual costs of fertiliser. Fertilising other areas of the farm may seem more pressing. The strategy is unlikely to succeed unless the farmer redesigns the fertiliser program for the whole farm. There is a case for short-term subsidies in this area and one such approach is outlined in Box 2.

There are some necessary conditions and issues of compliance. Ensuring that the fertiliser is used where intended is a problem, and soil test results might be required as proof. Nutrient run-off is also a potential problem, but not so great because of the low levels of fertiliser being applied. Nevertheless, conditions should specify action to be taken to minimise off-site effects. Regular fertiliser application would be a significant change for most pastures. It might lead to the loss of native forbs where they are present. It might be appropriate to make subsidies conditional upon a prior check to determine the conservation values of paddocks where the treatment is proposed. If the paddock has recognised conservation status, the farmer would be encouraged to select a different paddock as well as receiving a reward for bringing the paddock to public attention. The reward might not need to be large.

Box 2. A cross-compliance package involving the farm fertiliser program and land rehabilitation

The example is illustrative, and is not an unqualified endorsement of the use of fertiliser on native pasture.

Objective — increase both the profitability of grazing native pastures and the area of hill country that is rehabilitated through extended rest periods or retirement from agricultural production.

Action — develop a standard management agreement that:

- involves farmers in developing a fertiliser program for the whole farm, including the application of low rates of fertiliser on an area of native pasture;
- requires the owners to rehabilitate a given area of hill country where there are public benefits from doing so;
- funds both fencing costs and the application of low rates of fertiliser on native pasture until it is estimated annual applications will become profitable;
- encourages self-assessment of the owners' capabilities and business and management skills;
- subsidises enrolment in programs which assist in developing a whole farm plan and learning business planning skills;
- provides assistance through PROGRAZE or a similar program to encourage effective integration of the native pastures into tactical grazing management;
- requires self-assessment and reporting on the performance of the pastures and livestock, and profitability; and
- encourages the owners to join Landcare and other appropriate support networks.

5.4.4 Adjustment at the farm business level

What would it require to ensure that the farm is managed in 20 years time in a way that is consistent with minimising off-site effects and maintaining long-term productivity?

Much can be achieved if there is a duty of care, retirement of marginal land, good management of other hill country, and expansion opportunities elsewhere on the farm. Good business skills and a farm plan will also make a difference, and action to acquire or update these are important requirements in order to receive any assistance in managing hill country. A standard management agreement such as is outlined in Box 2 may be appropriate.

However, public agencies should aim to use these mechanisms in a way that does not require close involvement with farm owners, as the issues are *relatively* uniform across the farms in the hill country. What happens to the individual farm business may be important for public policy, but as far as good hill country management is required, it is less important than in the case of native grassland conservation. Survival of the native grassland is more intimately tied up with the fortunes of the individual property owner than is the management of the hill country, as it takes relatively little to destroy the grassland and (relatively) much effort to destroy the perennial pasture base of the hill country.

The case is slightly different regarding public policy goals for setting aside or resting small areas on farms in the hill country that might be more critical for conservation purposes, or for reducing off-site effects. Clearly such measures can be more easily afforded on a profitable farm, and less might be required from the public purse if this is the case. However, these areas still do not warrant the priority or one-to-one treatment associated with native grasslands of conservation significance. There is a case for the continued provision of training in business management and property management planning, provided issues such as setting aside, resting and conservation are considered in the course material.

5.4.5 Ownership and operation of the farm business

A change in ownership or management arrangements on a farm with significant nature conservation values has the potential to lead to the loss of those values as they are associated with a particular management regime. If management changes, it is likely that many species intolerant to disturbance will be lost. In the case of hill country, management is important for the maintenance of perennial ground cover. However, a species-poor pasture is more robust than a grassland with many rare forbs. Consequently, a change in ownership does not have the same importance.

5.5 Conclusions

In this section, the characteristics of farms with native pasture have been outlined. It has been shown that there generally are strategies on such farms for increasing income. The options for doing so are clearer than for the farms studied on the plains. Native pasture has a role on the farms in the hill country. A well-designed fertiliser program can contribute to the productivity of these pastures, though conservation values may be lost if care is not taken in selecting the pastures to be treated.

The public policy issue involves hill country management, rather than native pasture per se. However, native pasture is already present across much of the hill country and replacing it is clearly not economical under most circumstances.

The whole farm approach has thrown up new angles to possible policy measures to improve hill country management. These should generally be pursued as part of a standardised package available to all eligible farmers. By contrast to the case of native grassland conservation, individually targeted management agreements are not recommended. Changes at the level of the farm business can make a difference to hill country management, and relevant training programs should continue to be made available to

farmers. However, again in contrast to the case of native grassland conservation, there is not a case for public intervention at the level of the individual farm business.

Central to the development of effective public policy is recognising that native pasture is only one of the technical inputs making up a farm business. Policy directed at one aspect of a farm business without taking account of the whole farm context is unlikely to succeed. Consequently, the proposed policy program would need to be integrated with other programs relating to agriculture and land management. Initiatives across government rather than by conservation agencies working alone are required. Victoria's Biodiversity Strategy (DNRE, 1997) is an example of one such approach.

Three actions seem essential to an effective policy program. These are to:

- Work across Commonwealth and State agencies to incorporate knowledge and principles about native pasture considerations into research, policy and extension programs for both production and conservation. It needs to be recognised that misallocation of public resources is likely if these programs are encouraging land use that is not the most profitable and sustainable.
- Integrate native pasture management and whole farm management, including the basic principles of farm management economics, into programs like PROGRAZE, FARM$MART and Sustainable Grazing Systems, and other public and private advisory services (see the associated report by Edgar, 1998).
- Ensure that the information and expertise that is incorporated into these programs is of high quality, and that the programs are periodically audited for their level of quality.

6 Further lessons from the case studies

6.1 Introduction

In this section, further conclusions are drawn about native grasslands in farm businesses and about appropriate policy instruments. Involving the local community, farm advisers and policy-makers is also considered, as foreshadowed in the last two sections.

6.2 The findings about native grassland in farm businesses

The eight farm businesses described in this report vary greatly. While similar for one or two characteristics, there are significant differences when the range of important characteristics is considered — farm goals, current family situation, profitability, debt levels, enterprises, land types and history of land use, and available opportunities. How natural resources are integrated into the business is unique to each farm. Taking the farms on the plains: the two main soil types have an important influence on management on Farm P1; Farm P2 has significant areas of cottonbush; and on Farm P4 the native grasslands are stocked very lightly and have high conservation value. For the farms in the hill country: on Farm H2 the distance of the out-block from the home farm influences how it is managed and consequently the species composition, while on Farm H4 the rugged topography is a major factor.

Opportunities also vary greatly, though there is a more uniform pattern for the farms in the hill country. On these farms, there are prospects for increasing production from introduced pastures, and for investing in native pasture. Opportunities are more varied amongst the farms on the plains. Irrigated rice is possible, but problematic given water entitlements. Saltbush may provide a solution on the New South Wales farms, while there is potential for more dryland cropping on the Victorian farms.

The demands on the farm business in Farm P4 are very low, and the current owners do not need extra income. All the others have opportunities to increase income from the native grassland, whether by planting saltbush on the plains or by using fertiliser and other techniques on the hills. Five of the other properties examined in this project have investment opportunities elsewhere on the farm.

6.3 Generalising — is the situation similar on other farms?

The eight farms were selected in this study because they have significant areas of native grassland. They vary considerably in current economic performance and in prospects for the future. The degree of confidence with which the results can be generalised to other farms in south-eastern Australia is now considered by posing and answering four different questions.

Will most other farmers with similar country be able to develop business plans that project a significant increase in income?

This depends on investment options available on the farm.

Will most other farmers with similar country have investment options elsewhere on the farm?

On the plains, alternative activities are most likely to be irrigated or dryland cropping. On the case study farms, expansion of such activities would involve the destruction of native grasslands. It is reasonable to expect this to be the case on most other farms as well. For irrigated cropping on large properties, it might well occupy a relatively small proportion of the total grassland.

For three out of the four case study farms on the hills, there are investments that can be made on

areas other than the native pasture. It is reasonable to expect that most, rather than all, hill farms will have such options available. This could be tested with a statistical survey. It is likely that a minority will have already fully intensified on arable land, given current technologies, and have no further options worth pursuing at present on that country.

Are there options for increasing income from the native grasslands that do not compromise conservation values or diminish long-term productivity?

For farms on the plains, conservation values are likely to be lost through more intense grassland management in cases where native grassland is of high conservation value, such as on Farm P4. As with two of the other case study farms, there will be scope to plant saltbush on some properties, but it is not a universal panacea and the type of benefits will vary depending on the circumstances on each farm. Changed grazing management may lead to increased income, but this was not investigated for any of the case study properties. Options like ecotourism and kangaroo harvesting may be means of increasing income, but they are likely to be niche operations requiring significant infrastructure.

On all four case study farms in the hill country, it is expected that productivity of the native pasture can be increased significantly, and over the medium-term this will make a difference to the expected operating profit. This strategy is consistent with reducing off-site effects of poor pasture management, but it may lead to the loss of some biological diversity where native pastures include daisies, lilies and other forbs. Financial circumstances mean that only some of the owners are likely to pursue the strategy.

The expectations about fertiliser use are reasonable to hold about other farms, but can only be tested in practice — by involving farmers in a wide variety of circumstances in appropriate trials. Exceptions will be those farms that have replaced all native pastures, or have very little left. No such farms were selected as case studies, and results are not meant to apply to them. Another exception will be farms that have major weed problems, such as serrated tussock, that can only be controlled by pasture replacement. There will be some farms where the owners may be convinced that their next best investment option is to replace native with introduced pasture. Whether they can succeed depends very much on the soil type and topography, climatic events and management skill. Nationwide data on pasture persistence (Pearson *et al.*, 1997) and the opinion of many agronomists specialising in hill country suggest that relatively few will succeed in the medium term.

What are the prospects for setting aside or resting areas?

If there is scope for farms on the plains to develop business plans which project a significant increase in income, then it follows that the opportunity costs of setting aside or resting small areas will be *relatively* small.

6.4 Involving the local community, farm advisers and policy-makers

Landholders are more likely to take an interest in their native grasslands if local community and Landcare groups are active around conservation and land management issues. Landcare has been a major influence on farm management. Issues such as erosion and salinity have been central to discussion and action by Landcare groups.

While the owners make the ultimate decisions about farm and business management, farm advisers might have an important influence. Advisers include farm management consultants, bank managers, accountants, stock and station agents, pasture or crop specialists, and livestock advisers, amongst others. Recognising their importance, a small survey of advisers in north-eastern Victoria was commissioned as part of this project (Edgar, 1998). The extent to which native pasture considerations

and whole farming principles are incorporated into advice to farmers was found to vary greatly.

While consideration should be given to the role all these advisers might play in achieving better conservation outcomes on farms (Edgar, 1998), farm management consultants could be targeted to play a very specific role in achieving conservation outcomes on private property. This role can be construed as very similar to rural counsellors who target families that have specific social or psychological needs. Farmers pay farm management consultants for advice, usually annually, on achieving their production and business goals. It is usual for farm consultants to integrate consideration of four of the levels identified above as important — from the site-specific through to ownership and operation of the farm business.

Farm management consultants could play a potentially very important role in helping the owners define a 20-year vision for properties with native grassland that incorporates production and conservation goals, and then in working through the practical steps to achieve them. In the first year, the consultant may require three days of work, to be followed up by one day visits in each later year. The cost would be relatively modest by comparison to the funds required to support the incentive programs or management agreements used in Europe and the United States (Colman *et al*., 1992).

Appropriate consultants could be sought by tender. They would be required to undertake some training in native grassland ecology and management, or would have the backup of advisers knowledgeable about native grassland ecology and management. Part-payment by the farmers towards the cost of the consultant could also be considered, given that the advice is likely to improve farm business performance as well as help to achieve conservation goals.

6.5 Conclusions about policy instruments

Do the results of the investigations into the eight case study properties and the proposed directions for policy mechanisms apply to other farms? While no two farms are the same, there are common pressures on owners, and common resource management issues. Hence there will be some points from each of the case study farms that are relevant. The most important lesson is to see the likely future of native grasslands as integrally related to the future of the farm business, and to evaluate its current position and alternatives accordingly.

There are no easy solutions for achieving conservation or land management goals on private land. Some policy instruments will work in some situations but not others. For properties that have native grasslands of State and national conservation significance, a targeted approach based on the circumstances of the individual property is essential.

A standard policy mix may be appropriate for other properties. It is not likely to achieve the conservation of all areas that should be conserved, or bring about appropriate land management on all classes of land — but it might be the most cost-effective approach. As far as possible, the policy mix should include elements from each of the five levels highlighted previously — site-specific, farming system, the farm business, ownership and management structures, and the off-farm context. Given the stress placed on the farm business level, the policy mix package should include:

- assistance directed to help property owners with native grasslands to identify available strategic choices and their merits;
- incentives to prepare relevant business and whole farm plans incorporating appropriate management of the area of conservation interest; and
- ongoing advice on implementing these plans, notably from farm management consultants.

Site-specific measures to achieve conservation and land management outcomes on farms are essential. However, it is clear from the case studies that a policy approach that is aimed at an area of conservation interest in isolation from its context, especially the farm business, may succeed on some of the case farms, but not on others.

7 Reconsidering policy

Wills (1997), in the following quote, captures some of the key elements about policy that are consistent with the emphasis on understanding conservation and land management in the context of the farm business.

> It is more important to understand processes than to design 'solutions'.

The approach in this study has been to focus on the processes affecting the future of native grassland by taking the farm business — the key decision-making unit — as the object of study. With the insights gained into these processes, possible policy instruments can be considered.

The Organization for Economic Cooperation and Development (OECD) has adopted the following criteria against which environmental policies can be assessed: *environmental effectiveness*; *economic efficiency*; *equity*; *administrative feasibility and cost*; and *community acceptability* (Young *et al.*, 1996; see also OECD, 1999). In order to be environmentally effective, policies needs to be *dependable* and *certain* in the face of uncertainty, as well as being precautionary (Young *et al.*, 1996). Given the long time periods involved, policies should also provide a *dynamic and continuing incentive* (Young *et al.*, 1996).

How well does an approach to policy based on farm business considerations measure up against these criteria? It has been demonstrated in this report that such an approach will assist in reconciling production and conservation on some farms. However, such measures on their own will not provide certain, dependable outcomes, nor are they necessarily precautionary. Measures directed at farm business adjustment will have dynamic and continuing effects, but these effects may not be lasting (unless provision is made for a new round of such measures). Economic efficiency criteria can be met, more so than with schemes that offer uniform compensation payments. The measures are equitable to the extent that they are targeted only where needed, with others expected to act where they can afford it. Based on historic experience with adjustment schemes, implementation is administratively feasible and relatively cheap compared to compensatory programs. The measures are responsive to the needs of those who require assistance, but there may be pressures from others for more generous provisions so that they too can qualify for assistance.

No single mechanism or approach is likely to be adequate. The need for a combination of instruments is recognised in the area of biodiversity protection (Young *et al.*, 1996; OECD, 1999) and in sustainable land management (AFFA, 2000). Even in combination, there are likely to be gaps, particularly as some criteria (dependability through to permanence) relate to how environmental protection can be ensured in the face of changing circumstances over time. Because it focuses on the decision-making unit and on the future, the farm business approach can support, complement and, in some cases, replace other approaches that can be categorised as regulatory, market-based or voluntary. As an example of support, showing farmers feasible ways of meeting all their goals is likely to make management agreements more acceptable.

Governments in Australia have adopted ecologically sustainable development (ESD) as a framework not just for government activity, but one that should also be pursued by business, community organisations and individuals. A focus on what happens at the level of the farm business is required if ESD is to be successfully pursued in agriculture.

Australia's national strategy for biological diversity provides an example. The National Strategy for the Conservation of Australia's Biological Diversity (DEST, 1996) has a major section on integrating conservation and natural resource management. One proposal is for coordinated research into

ecologically sustainable use and 'further developing systems approaches such as whole farm or property management planning'. Delivery of government services for agriculture and pastoral systems is to be strengthened by "encouraging continued institutional reform and incorporation of biological diversity conservation and other ecologically sustainable development objectives in corporate strategic plans". Promoting the inclusion of conservation into the corporate strategic plans can apply to farm businesses as well as to off-farm agribusinesses, statutory authorities and government agencies.

The national biodiversity strategy provides a framework within which specific conservation strategies can be developed. Ross (1999) has recently examined 21 different approaches to native grassland conservation. The focus is on native grasslands of high conservation value. Best practice approaches are summarised; these range across information-gathering, priority setting, mechanisms (such as reservation, acquisition, management agreements, regulation), incentives, and stewardship. One of the case studies is the project on the economics of native grassland on which this report is based, and several reports and papers from the project are cited.[10] The approach to incentives advocated in the report is consistent with the emphasis here on the farm business context. It is suggested in the section of the report on incentives that their shape should be influenced by the whole farm situation. How this might be done is briefly outlined in the section describing each case study (Ross, 1999).

10. J. Ross, along with other policy and extension officers, attended a two day workshop in March 1999 in Albury which was organised to explain the findings of the grassland economics project and to convey the farm business perspective on conservation.

8 Conclusions

The economics of managing native grasslands and native pasture on farms is of direct relevance to formulating government policy in Australia. Native grasslands are one of Australia's most threatened ecosystems, and much of what remains is on private land. Particular management by farmers may be required if they are to retain their conservation values. Secondary native grasslands that contain deep-rooted, perennial native grasses are more widely found than native grasslands of conservation value. These grasslands help prevent land degradation problems such as erosion and salinity and are thus important in maintaining the long-term productivity of the land.

In this study, the key technical and economic aspects of how eight case study farms currently operate were outlined, taking account of farmer goals, pasture types, livestock utilisation of pasture, and the current farm financial position. Alternative farm management options were specified and their profitability and cash flow effects evaluated using partial budgets — both steady state and discounted cash flow. The management options considered included sowing introduced pasture, fertilising native pasture, cropping native grassland, planting saltbush, reducing stocking levels and fencing off small areas of conservation interest. Alternative ways of organising the whole farm business were then considered. In some cases it was found that the farm could be organised so that production and conservation goals are compatible. Some of these properties are already being managed in this way. In other cases, public assistance is necessary to bring about a reconciliation of public and private objectives.

The analysis of the case study farms formed the basis for considering possible incentives and other mechanisms for achieving public policy goals relating to conservation and long-term productivity of farmland. While some mechanisms are appropriately directed to management of the site of conservation interest, four other levels that might be targeted in order to achieve policy goals are: the farming system; the farm business; the ownership and operation of the farm business; and off-farm. The proposed approach thus not only focuses on the future of the area to be managed for public purposes, it also emphasises the future of the farm business itself.

Failure to consider the future of the farm business in policy approaches to conservation and land management will have major consequences. Substantial short-term gains will undoubtedly arise from the use of a policy approach which includes management agreements, financial incentives, rate rebates, covenants, regulation, duty of care, education, and provision of information. However, analysis of the case study results suggested that without assisting farmers to develop sound strategies for achieving their farm business goals and enhancing their capabilities for carrying them out, remnant vegetation will decline in quality or be lost on many such properties over the long term. Structural adjustment assistance might also be required. The alternative might be much more costly intervention in future years when the farmers find their private interests even further removed from the public interest.

Furthermore, these proposals for policy were considered for their consistency with other policy instruments, and how they might be integrated into complete policy programs, already existing or proposed. It was shown also that the farm business perspective is compatible with other policy approaches, although it is likely to be overlooked by those who emphasise solutions to market failure and externalities. Others have already proposed some instruments that target farm businesses, but it was shown that this approach could be made more comprehensive and systematic.

Whether or not this proposed approach, or any other, will be adopted and whether it can be successful are not questions that can be easily

answered. This depends on the extent to which the approach is consistent with the underlying forces leading to change in agricultural activities and the state of the environment, and with the various economic interests that are at stake.

9 References

AFFA (Agriculture Fisheries and Forestry – Australia) (2000). *Action Plan for Australian Agriculture, Food and Fibre 2000–2001*, on the Internet at <http://www.affa.gov.au/csg/rpc/actionplan/main.html>.

Barr, N., and Cary, J. (1992). *Greening a Brown Land. The Australian Search for Sustainable Land Use*. South Melbourne: Macmillan.

Benson, J., Ashby, E., and Porteners, M. F. (1996). *The Native Grasslands of the Southern Riverina, New South Wales.* (Report to Australian Nature Conservation Agency): National Herbarium of New South Wales.

Binning, C., and Young, M. (1997). *Motivating People — Using Management Agreements to Conserve Remnant Vegetation* (National Research and Development Program on Rehabilitation, Management and Conservation of Remnant Vegetation Research Report 1/97). Canberra: Land and Water Resources Research and Development Corporation.

Bowers, J. (1996). *Policy Instruments for the Conservation of Remnant Vegetation: a British Perspective* (CSIRO Wildlife and Ecology Working Document). Canberra: Commonwealth Scientific and Industrial Research Organisation (CSIRO) Wildlife and Ecology.

Bowers, J. (1998). Policy instruments for the conservation of remnant vegetation on private land. *Biological Conservation*, 87, 327–339.

Buxton, R., and Stafford Smith, M. (1996). Managing drought in Australia's rangelands: four weddings and a funeral. *The Rangeland Journal*, 18, 292.

Cary, J. W., and Wilkinson, R. L. (1997). Perceived profitability and farmers' conservation behaviour. *Journal of Agricultural Economics*, 48(1), 13–21.

Colman, D., Crabtree, B., Froud, J., and O'Carroll, L. (1992). *Comparative Effectiveness of Conservation Mechanisms*. Manchester: Department of Agricultural Economics, University of Manchester.

Crosthwaite, J. (1997). *Economic Benefits of Native Grasslands on Farms* (A report to Environment Australia Grassland Ecology Program Project Number GEP 017). Melbourne: Department of Natural Resources and Environment.

Crosthwaite, J. (1998). *Cost-sharing Approaches for Native Vegetation Management in the Goulburn Broken Catchment* (Background Report prepared for Goulburn Broken Vegetation Management Plan Steering Committee). Parkville, Victoria: Institute of Food and Land Resources, University of Melbourne.

Crosthwaite, J. (1999). *Natural Resources Policy and the Behaviour of Firms*. Paper presented at the Australian New Zealand Ecological Economics Society National Conference "Grounding the Paradigm", 5–7 July 1999, Griffith University.

Crosthwaite, J., Macleod, N., and Malcolm, B. (1997). Case studies: theory and practice in natural resource management. In F. Vanclay and L. Mesiti (Eds), *Sustainability and Social Research* (pp. 201–216). Wagga Wagga: Centre for Rural Social Research, Charles Sturt University.

Crosthwaite, J., and Malcolm, B. (1998). *An Economic Analysis of Native Pasture in the Hills and Tablelands of South-eastern Australia* (A report prepared as part of project UME 25 for LWRRDC and Environment Australia). Parkville, Victoria: Institute of Land and Food Resources, The University of Melbourne.

Crosthwaite, J., and Malcolm, B. (1999). *An Economic Analysis of Native Grassland on the Riverine Plain of South-eastern Australia* (A report prepared as part of project UME 25 for LWRRDC and Environment Australia). Parkville, Victoria: Institute of Land and Food Resources, The University of Melbourne.

Curtis, A. L. (1997). Landcare, stewardship and biodiversity conservation. In N. Klomp and I. Lunt (Eds), *Frontiers in Ecology: Building the Links* (pp. 143–154). Kidlington, Oxford: Elsevier Science.

Daly, H. E., and Townsend, K. N. (Eds) (1993). *Valuing the Earth*. Economics, Ecology and Ethics. Cambridge MA: MIT Press.

DCNR (Department of Conservation and Natural Resources) (1994). *Western (Basalt) Plains Grassland Community Action Statement* (No. 53). Melbourne: DCNR.

DEST (Department of Environment Sport and Territories) (1996). *The National Strategy for the Conservation of Australia's Biological Diversity*. Canberra: DEST.

DNRE (Department of Natural Resources and Environment) (1997). *Victoria's Biodiversity: Directions in Management.* Melbourne: DNRE.

Diez, S., and Foreman, P. (1996). *The Management of Natural Grasslands on the Riverine Plain of South-eastern Australia* (unpublished report NRSCP Project Number N405), Australian Nature Conservation Agency.

Edgar, R. (1998). *A Preliminary Study of Farm Advisors and the Advice Given to Farmers About Native Pasture and Whole*

Farm Management (A report prepared as part of project UME 25 for LWRRDC and Environment Australia). Parkville, Victoria: Institute of Land and Food Resources, The University of Melbourne.

Foreman, P. (1993). The pre-settlement state of the lands of the Fernihurst district. In *Reflections from the Kinypaniel—The Early Years of the Fernihurst District.* Fernihurst District Historical Society.

Frank, B., and Chamala, S. (1993). Effectiveness of extension strategies. In G. Lawrence, F. Vanclay and B. Furze (Eds), *Agriculture, Environment and Society* (pp. 122–140). South Melbourne: MacMillan.

Garden, D. L., Dowling, P. M., and Simpson, P. C. (1993). *Native Grass Management for Sustainable Agriculture* (Final Report to Murray–Darling Basin Natural Resources Management Strategy).

Garden, D. L., Jones, C., Friend, D., Mitchell, M., and Fairbrother, P. (1996). Regional research on native grasses and native grass-based pastures. *New Zealand Journal of Agricultural Research*, 39, 471–486.

Glenelg Regional Catchment and Land Protection Board (1997). *Glenelg Regional Catchment Strategy*. Hamilton: The Board.

Gott, B., and Conran, J. (1991). *Victorian Koorie Plants: Some Plants Used by Victorian Koories for Food, Fibre, Medicines and Implements.* Hamilton, Victoria: Yangennanock Women's Group, Aboriginal Keeping Place.

Harrington, G. N., Wilson, A. D., and Young, M. D. (Eds) (1984). *Management of Australia's Rangelands.* East Melbourne: Commonwealth Scientific and Industrial Research Organisation (CSIRO).

Industry Commission (1998). *A Full Repairing Lease. Inquiry into Ecologically Sustainable Management* (Report No. 60). Belconnen, ACT: Commonwealth of Australia.

Johnston, B. (1999). Perennial native grasses — the quiet achievers. In T. Barlow and R. Thorburn (Eds), *Proceedings of the Bushcare Grassy Landscapes Conference* (pp. 133–141). Clare, South Australia: Environment Australia.

Jones, C. (1999). Cropping native pasture and conserving biodiversity: a potential technique. In T. Barlow and R. Thorburn (Eds), Proceedings of the Bushcare Grassy Landscapes Conference. Clare, South Australia: Environment Australia.

Jones, C. E. (1996). Pastoral value and production from native grasses. *New Zealand Journal of Agricultural Research*, 39, 449–456.

Jones, R.M. and Hargraves, J.N.G. (1979). Improvements to the dry-weight method for measuring botanical composition. *Grass and Forage Science*, 34, 181–189.

Kemp, D. (1999). Managing grassland composition with grazing. In T. Barlow and R. Thorburn (Eds), *Proceedings of the Bushcare Grassy Landscapes Conference* (pp. 145–152). Clare, South Australia: Environment Australia.

Kemp, D. R., Dowling, P. M., and Michalk, D. L. (1996). Managing the composition of native and naturalised pastures with grazing. *New Zealand Journal of Agricultural Research*, 39, 569–578.

Kirkpatrick, J., McDougall, K., and Hyde, M. (1995). *Australia's Most Threatened Ecosystems — the Southeastern Lowland Native Grasslands.* Chipping Norton: Surrey Beatty.

Lunt, I., Barlow, T., and Ross, J. (1998). *Plains Wandering: Exploring the Grassy Plains of South-eastern Australia.* East Melbourne: Victorian National Parks Association and Trust for Nature (Victoria).

Makeham, J. P., and Malcolm, L. R. (1993). *The Farming Game Now*. Cambridge: Cambridge University Press.

McIntyre, S. (1994). Integrating agricultural land-use and management for conservation of a native grassland flora in a variegated landscape. *Pacific Conservation Biology,* 1, 236–244.

Michalk, D. L., and Kemp, D. R. (1994). Pasture management—where to from here? In D. L. Michalk and D. R. Kemp (Eds), *Pasture Management, Technology for the Twenty-first Century*. Melbourne: Commonwealth Scientific and Industrial Research Organisation (CSIRO) Australia.

Millar, J., and Curtis, A. (1995). *Farmer Knowledge and Experience with Perennial Grasses* (Johnstone Centre of Parks, Recreation and Heritage Report No. 39). Albury: Charles Sturt University.

NLWRA (National Land and Water Resources Audit) (1998). *National Land and Water Resources Audit: A Program of the Natural Heritage Trust: Strategic plan 1998–2001*. Canberra: NLWRA.

OECD (Organization for Economic Cooperation and Development) (1999). *Handbook of Incentive Measures for Biodiversity. Design and Implementation.* Paris: OECD.

Pearson, C. J., Brown, R., Collins, W. J., Archer, K. A., Wood, M. S., Peterson, C., and Bootle, B. (1997). An Australian temperate pastures database. *Australian Journal of Agricultural Research*, 48, 453–465.

Penrose, E. T. (1997). The theory of the growth of the firm. In N. J. Foss (Ed.), *Resources, Firms, and Strategies:*

A Reader in the Resource-based Perspective. Oxford: Oxford University Press.

Price, C. (1993). *Time, Discounting and Value*. Oxford: Blackwell.

Quigley, P. E., Ward, G. N., and Morgan, T. (1992). Botanical composition of pastures in south-western Victoria. In *Proceedings of the 6th Australian Society of Agronomy Conference*, Armidale, NSW.

Ross, J. (1999). *Guide to Best Practice Conservation of Temperate Native Grasslands*. Sydney: World Wide Fund for Nature (WWF) Australia.

Sagoff, M. (1988). *The Economy of the Earth*. Cambridge: Cambridge University Press.

Simpson, P. (1999). Balancing pasture development options for landscape diversity. In T. Barlow and R. Thorburn (Eds), *Proceedings of the Bushcare Grassy Landscapes Conference* (pp. 124–132). Clare, South Australia: Environment Australia.

Simpson, P., and Langford, C. (1996a). *Managing High Rainfall Native Pastures on a Whole Farm Basis*. Orange, New South Wales: NSW Agriculture.

Simpson, P., and Langford, C. (1996b). Whole-farm management of grazing systems based on native and introduced species. *New Zealand Journal of Agricultural Research*, 39, 601–610.

Stafford Smith, M., Morton, S., and Ash, A. (1997). On the future of pastoralism in Australia's rangelands. In N. Klomp and I. Lunt (Eds), *Frontiers in Ecology: Building the Links* (pp. 7–16). Kidlington, Oxford: Elsevier Science.

State of the Environment Advisory Council (1996). *State of the Environment Australia 1996*. Collingwood, Australia: Commonwealth Scientific and Industrial Research Organisation (CSIRO) Publishing.

Vanclay, F. (1992). The social context of farmers' adoption of environmentally sound farming practices. In G. Lawrence, F. Vanclay and B. Furze (Eds), *Agriculture, Environment and Society* (pp. 94–121). South Melbourne: MacMillan.

Western Riverina Regional Vegetation Committee (1999). *Towards the Development of the Western Riverina Regional Vegetation Management Plan. Discussion Paper*. Wagga Wagga: Department of Land and Water Conservation.

Wills, I. (1997). *Economics and the Environment. A Signalling and Incentives Approach*. St Leonards, New South Wales: Allen & Unwin.

Wilson, A. (1998). *Oldman Saltbush Is a Drought Reserve, But Not a Wonder Shrub*. Paper presented at the Role of Forage Shrubs Workshop, Condobolin.

Wilson, A. D., and MacLeod, N. D. (1991). Overgrazing in the rangelands: present or absent? *Journal of Range Management,* 44, 475–482.

Young, M. D. (1992). *Sustainable Investment and Resource Use: Equity, Environmental Integrity, and Economic Efficiency*. Park Ridge, New Jersey: Parthenon.

Young, M. D. (1993). *Some Practical Implications of Inter-generational Equity, the Precautionary Principle, Maintenance of Natural Capital, and the Discount Rate* (AMNRS Program Working document 93/5). Canberra: Commonwealth Scientific and Industrial Research Organisation (CSIRO) Division of Wildlife and Ecology.

Young, M. D., Gunningham, N., Elix, J., Lambert, J., Howard, B., Grabosky, P., and McCrone, E. (1996). *Reimbursing the Future: An Evaluation of Incentives for the Conservation of Biodiversity* (Paper No. 9). Canberra: Department of Environment, Sport and Territories.

Appendix – Project-related publications

The full set of reports from project UME 25 on which this report is based can be found at the web site:

http://www.landfood.unimelb.edu.au/research/grass_eco/index.html

Some of the reports have been placed in regional libraries and in libraries associated with departments of conservation, land management and agriculture in Victoria and New South Wales.

The publications and reports produced as part of the project are:

Crosthwaite, J. (1996). Economic aspects of managing Victorian pastures which contain native grasses. Paper presented to the *Native Grass Pasture Management Seminar*, Institute for Integrated Agricultural Development, Rutherglen.

Crosthwaite, J. (1998). Win, lose or draw. The economics of native grasslands on farms. *Trees and Natural Resources*, 40(1), 24–25.

Crosthwaite, J. (1998). *Who's Eating Where? A Livestock Utilisation Computer Spreadsheet Model*. Parkville, Victoria: Institute of Land and Food Resources, The University of Melbourne.

Crosthwaite, J. and MacLeod, N.D. In press. Retaining native vegetation on farms: understanding its private value. In J.L. Craig, N. Mitchell, and D.A. Saunders, (Eds) *Nature Conservation 5: Nature Conservation in Production Environments – Managing the Matrix*. Chipping Norton, New South Wales, Surrey Beatty and Sons.

Crosthwaite, J., MacLeod, N. and Malcolm, B. (1997). Case studies: theory and practice in natural resource management. In F. Vanclay, and L. Mesiti (Eds), *Sustainability and Social Research*. Wagga Wagga: Centre for Rural Social Research, Charles Sturt University.

Crosthwaite, J. and Malcolm, B. (1998). *An Economic Analysis of Native Pasture in the Hills and Tablelands of South-eastern Australia*. Parkville, Victoria, Institute of Land and Food Resources, The University of Melbourne.

Crosthwaite, J. and Malcolm, B. (1999). *An Economic Analysis of Native Grassland on the Riverine Plain of South-eastern Australia*. Parkville, Victoria, Institute of Land and Food Resources, The University of Melbourne.

Edgar, R. (1998). *A Preliminary Study of Farm Advisors and the Advice Given to Farmers about Native Pasture and Whole Farm Management*. Parkville, Victoria, Institute of Land and Food Resources, The University of Melbourne. .