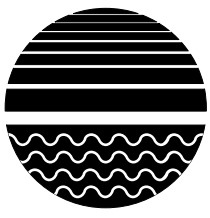
Exploring the Future Requirements for Managing Australia's Remnant Vegetation



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Preface

In 1994 the Australian Nature Conservation Agency, now part of the Biodiversity Group of Environment Australia, and the Land and Water Resources Research and Development Corporation (LWRRDC) joined forces to establish and fund a national program of research and development (R&D) to devise improved methods of managing bushland. The aim of this national R&D program is to assist government agencies, community groups and landholders to better manage and protect remnant native vegetation through the application of improved knowledge and understanding gained from research. The program has funded projects covering three main themes: the ecology of remnant vegetation; socioeconomic and policy research, and a series of state-based pilot projects to develop vegetation management plans on a regional scale. The program has a strong emphasis on practical outcomes in managing remnant native vegetation and also seeks to form better links between vegetation managers and researchers.

The first phase of the remnant vegetation R&D program is drawing to a close and there is wide support for it to continue. It is therefore timely to identify future R&D priorities to be considered in a second phase of the program and more generally for remnant vegetation management. With this in mind, Environment Australia (EA) and LWRRDC, in conjunction with the Council for Sustainable Vegetation Management (CSVM), commissioned a foresighting study on remnant vegetation to help improve the framework within which management, policy and investment decisions can be made. This built on an earlier study that evaluated the usefulness of foresighting techniques for planning and managing future expenditures on R&D into Australia's natural resources. In addition to identifying R&D priorities, the main aims of the remnant vegetation foresighting study were to examine a range of scenarios for remnant vegetation, identify appropriate management strategies and ways to implement them, and to learn more about foresighting as a technique.

While it is sometimes hard to see beyond the challenges of today, this exercise has demonstrated the value in placing ourselves in the future and considering how we got there. Doing this could change the way we approach things now. Foresighting acknowledges a range of possible futures and has the potential to identify problems and solutions that would not arise if the focus was only on current issues. Participants in the remnant vegetation study found their minds were opened to a broader range of possibilities and that the use of scenarios was particularly appropriate for remnant vegetation which requires a long-term management approach. Given the increasing rate of change, rapid development of information technology and new trading regimes, foresighting helps address the uncertainties faced by resource managers and the community more generally.

The study reported in the following pages demonstrates the usefulness of foresighting as a planning tool for complex natural resource management issues. The document is divided into two sections: the first deals with the main content outcomes, and for those interested in the details of the approach, the second section focuses on the process of the foresighting study. The results of the study will be used by participants in developing policy and programs. EA, CSVM and LWRRDC will use them to help guide future activities in vegetation management. Comments from readers, about either the content or process of the foresighting study, would be welcome.

Phil Price
Executive Director
LWRRDC

Summary

This paper reports the process and results of a 'foresighting' exercise commissioned by the Land and Water Resources Research and Development Corporation and Environment Australia, in conjunction with the Council for Sustainable Vegetation Management, to help identify future information and research needs, and the accompanying planning and investment frameworks, for the management of remnant native vegetation. The exercise involved two workshops held in 1998. Three different scenarios are described for the use and management of remnant vegetation in the year 2025. These are accompanied by the key strategies, R&D priorities and means of implementation applicable to all three future outcomes and most valuable for current planning. A detailed explanation of the foresight concept is provided. The processes and information exchange involved in devising, running and evaluating the foresighting exercise are given in detail. Foresighting is found to be a highly stimulating and productive technique for examining such issues.

Acknowledgments

The study team acknowledges the input of the Phil Price (LWRRDC), Kathy Tracy (EA), Peter Blackwell (EA) and Jann Williams (Coordinator, EA/LWRRDC Remnant Vegetation R&D Program, c/- LWRRDC) for their assistance with a number of aspects throughout this exercise. The recording of much of the workshop proceedings by Peter Blackwell is particularly acknowledged.

Thanks are due to the participants in the two workshops for their contributions and dedication of time. Lists of participants for each of the workshops are included in Appendices B and G.

Abbreviations used

ACIIC	Australian Centre for Innovation and International Competitiveness Ltd
ASTEC	Australian Science and Technology Council
BRS	Bureau of Rural Sciences
CIE	Centre for International Economics
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSVM	Council for Sustainable Vegetation Management
EA	Environment Australia
LWRRDC	Land and Water Resources Research and Development Corporation
NHT	Natural Heritage Trust
OECD	Organization for Economic Cooperation and Development
R&D	Research and Development
RIRDC	Rural Industries Research and Development Corporation
S&T	Science and Technology

Introduction

Background

In early 1997, the Land and Water Resources Research and Development Corporation (LWRRDC) decided to experiment with the application of the process of foresighting across a range of its programs. The purpose was to improve the framework within which management, policy and investment decisions were made in dealing with Australia's natural resources. The specific objectives of the foresighting exercises were to:

- identify future scenarios for the use and management of Australia's natural resources (land, water and vegetation);
- consider the implications of these scenarios for changes in the value, condition and frameworks (political, legal, organisational and socioeconomic) for sustainable management of these resources;
- identify strategies for the future management of LWRRDC's research and development (R&D) programs to accommodate likely future needs; and
- identify appropriate R&D directions and priorities within these programs to anticipate future information needs.

Initially LWRRDC commissioned a general foresighting exercise to develop broad scenarios relevant to natural resource management issues. This was conducted by the Centre for International Economics (CIE) and the exercise and its results are briefly reported below (see 'The Starting Point'). LWRRDC then pursued foresighting exercises to help identify future information and research needs in three specific areas. These areas were (i) dryland salinity, (ii) irrigation and river health and (iii) remnant native vegetation. The remnant vegetation exercise is the last of the three exercises.

Previous exercises are reported in LWRRDC Occasional Papers 08/98 'Foresighting Sustainable Irrigation and River Health' (ISBN 0 632 26721 9) and 22/98 'Dryland Salinity R&D Foresighting Analysis ' (ISBN 0 642 26738 3) both of which should be available by end March 1999 through the AFFA Shopfront on freecall 1-800-020157. An earlier Occasional Paper already available is 10/97 'Using Foresighting to Identify R&D priorities for LWRRDC' (ISBN 0 642 26697 2, Price $20.00).

An introduction to foresighting

The key aspect of foresight is its forward looking orientation. Foresight attempts to capture the dynamics of change by placing today's decisions into a context that includes the possible developments of tomorrow. It is not intended to replace more traditional methods of analysis, rather it seeks to add a new dimension to traditional thinking.

The foresighting process has a number of important characteristics. In particular, it is:

- a way of thinking about the longer term future and how it could differ from the present;
- a means for testing our current views and policy settings; and
- one way of overcoming the difficulties of a static or backward looking analysis.

Foresight acknowledges a range of possible futures. It provides an opportunity to think seriously about significant technical trends and their relationship to socioeconomic needs. Unlike 'forecasting', it does not attempt to estimate or predict what the future will be. Foresight implies an active approach to the future and reflects the belief that the future can be influenced through actions we choose to take today. Many decisions involving investment in science and technology (S&T) have long lead times, which make it important to have an informed view about the future.

The term foresight can refer to, among other things:

- attempts to predict the substantive outcomes of the independent research work of scholars;
- the activities of research funding agencies in giving priority funding and institutional recognition to specific fields and subfields of research;
- attempts to predict and influence the transfer of basic S&T and to identify technologies considered critical to the general welfare; and
- the process by which public and private stakeholders seek to improve communication between the various sources of innovation, research and development.

The key components of effective foresighting have been identified, on the basis of experience, to be:

- the role of a facilitator, who needs to be experienced in managing the many tacit elements of the process;
- selection and engagement of the commitment of a wide range of stakeholders;
- involvement of, but not reliance on, appropriate technical experts;
- the generation of scenarios through processes in which the stakeholders are involved, rather than the 'identification' or imposition of scenarios;
- customisation of the foresight process for each application; and
- effective processes to integrate scenarios into strategic planning.

Further details on foresighting are included in Appendix A.

The starting point

The CIE study was completed in May 1997 and identified a number of future scenarios for Australian agricultural production and natural resource trade-offs. These futures were influenced by three major driving variables:

- projections of demand for Australian agricultural products;
- physical constraints on agricultural production (availability of land and water), bearing in mind the deterioration in the resource base as well as technical change; and
- the level to which environmental costs are factored into production decisions.

The CIE report provides a range of views on global economic growth which in turn influence the world demand for agricultural products, and can be translated into demand for Australian agricultural products. Long-run aggregate world growth is predicted by CIE to be in the range of 2.3 to 3.9% per year and will be driven by population growth, the rate of new technological development and its adoption, and the potential of the developing world to 'catch-up' to the developed countries. This last driver of world economic growth is the most influential.

CIE expects the demand for particular agricultural commodities produced in Australia to increase in the future. CIE reports that Australia has sufficient availability of land and water to meet world demand for agricultural products over the next 30 years. Future decisions regarding agricultural production will depend upon the level of importance placed upon environmental issues by producers including the cost of land and water to the producer and the external environmental cost associated with production (ie. the cost of reduced biodiversity and environmental degradation).

Within the CIE report, three scenarios were developed reflecting the variable importance of environmental issues. The first scenario was 'economic growth' which assumed greater importance would be placed upon production objectives in the future by the government as a result of community pressure. The second scenario was 'conservative development' which is similar to the current directions being taken to address environmental and production objectives, such as sustainable development. The third scenario developed by CIE was 'post-materialism' which envisages massive change in Australian agricultural production systems. The post-materialism scenario would involve directing considerable resources to improving the environment at the cost of reduced agricultural production.

These three scenarios provided the starting point for scenario development in the remnant vegetation foresighting exercise.

Objectives of the remnant native vegetation exercise

The objectives of the foresighting exercise on remnant native vegetation were:

- to examine likely scenarios for the extent and ecological status of remnant native vegetation, focusing particularly on the highly-cleared southern parts of Australia;
- to identify management strategies appropriate for different scenarios, with the aim of maintaining remnant native vegetation through active management to promote its health, re-establishment and rehabilitation;
- to identify the information needs and the planning and investment frameworks required to support the implementation of those strategies; and
- to identify appropriate R&D priorities to be supported under the Environment Australia (EA)/ LWRRDC joint R&D program.

As with the other two foresighting exercises (dryland salinity, and irrigation and river health), the remnant vegetation exercise was intended to be a major learning exercise regarding foresighting for the LWRRDC Board and management as well as for stakeholders associated with the maintenance and management of remnant native vegetation. The objective was to involve members of the newly constituted Council for Sustainable Vegetation Management (CSVM) as key participants in the

exercise. The exercise was conducted in a manner that allowed maximum exposure to a range of foresight components and contained a significant evaluation component in order for LWRRDC to be able to assess the value and role of such an exercise for the future.

Principal outcomes from the exercise were envisaged to include both a content and a process dimension. The *content outcome* was to assist EA/LWRRDC and the CSVM in decision-making by providing a framework for development of strategy and priorities for the joint R&D program focusing on remnant vegetation management. The *process outcome* was to involve stakeholder participants in a greater degree of lateral thinking about the uncertain future and to provide greater understanding and communication between researchers from different disciplines, and between researchers and policy/management personnel. In addition, the process outcome was expected to engender overall ownership of the process of organising and planning for uncertain futures.

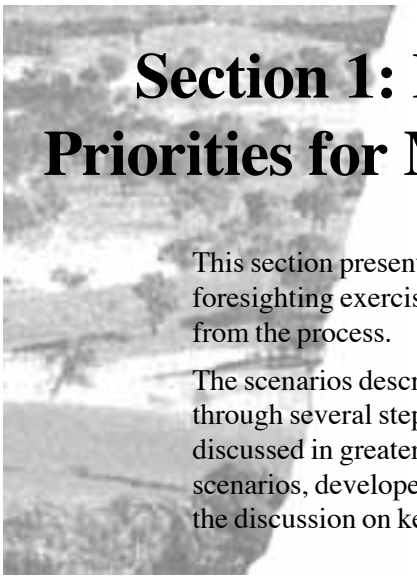
Overview of methods used

The methods used to pursue these objectives and outcomes included:

- preparation of an 'Issues Paper' on remnant native vegetation;
- preparation of initial scenarios based on the CIE report;
- a preliminary half day foresighting workshop with 24 participants, aimed at introducing the concepts of foresighting and initiating analyses of scenarios and strategy development;
- preparation of refined scenarios emerging from the first workshop;
- preparation of information sets on key aspects of potential strategies emerging from the first workshop;
- a one-and-a-half day foresighting workshop with 17 participants, aimed at identifying key drivers and uncertainties for the future of remnant vegetation, further refinement of scenarios, development of strategies and research priorities for each scenario, development of strategies and research priorities that were robust under all scenarios, and the initiation of the development of implementation plans;
- evaluation questionnaires at the beginning of the first workshop and the end of the second workshop; and
- assembling all the outputs, strategies and research priorities into a report to EA/LWRRDC.

Layout of the report

This report is divided into two main sections. Section 1 presents the three final scenarios that were developed during the foresighting exercise, and the key R&D strategies and priorities that arose from the process. For readers interested in the detail of the foresighting exercise, Section 2 focuses on the inputs, processes and outputs of the Introductory and Principal Workshops and provides an evaluation of the process and output performance of the foresighting exercise. There are several appendices. Two of these (C and H) contain the background papers on remnant vegetation management used to guide discussions at the workshop.



Section 1: Future R&D Strategies and Priorities for Managing Remnant Vegetation

This section presents the three final scenarios that were developed during the foresighting exercise, and the key R&D strategies and priorities that arose from the process.

The scenarios describe vegetation management in the year 2025. Each went through several steps of refinement, with the different stages and versions discussed in greater detail in the second section of this report. The final scenarios, developed from the Principal Workshop, are presented here to put the discussion on key future R&D strategies and priorities into context.

Vegetation Management Scenarios

Scenario 1: Economic growth

Australian agriculture under the economic growth scenario

Corporate agriculture has long since retracted from the more marginal arable soil types, land affected by dryland salinity, and salinised irrigated areas. These areas are owned by a second tier of agriculture, comprising semi-subsistence farming families who are employed part-time in other industries. The marginal areas are able to swing back into production under contract farming when global market models indicate years of higher demand. Production is of lower quality, but suitable for feed grains and for human consumption in poorer countries.

The complete move to corporatise agriculture has provided a flood of small business opportunities, as all crop management, harvesting, value adding and product sale is outsourced. Farmers whose enterprises were marginalised by soil quality problems and poor financial returns have found many options for employment, and are able to retain their land but control only a very minimal production base. As full globalisation of world markets and environmental responsibility became reality, these part-time farmers found many niches for small production runs of highly specialised food and fibre products.

The influence of governments has steadily declined. One impact of the rapid demise of government agencies is that Australia has reduced its quarantine capability. Corporate agriculture has responded by bulking up its production areas, excluding small parcels of land and enforcing strict boundary control. Marginal farm areas suffer many disease problems and plant invasions, which in turn increase their marginality.

The demand for high quality land in agricultural and horticulture industries has inevitably claimed the best soil types. Since most land is under private ownership, the presence of remnant vegetation or threatened species has had little effect on this outcome. If the land is available at a price, then it can be bought. Private conservation foundations have invested in purchasing and retaining parcels of land that are accessible and attractive to the predominantly urban populace. Most farming zones are profit driven and the obvious link of local production, local jobs and per capita affluence are usually enough to roll over any local resistance to further development. Rangelands vegetation is generally improving with destocking under a carbon credits scheme, except in areas where water is hard to control and feral animals are out of control.

The effect of implementation of the economic growth scenario has not been without its social costs. The family farm has been replaced by the agricultural conglomerate in most productive parts of Australia. Thus the family farm ethos has disappeared and been replaced by industrial food production, the character of which is indistinguishable from any other Organization for Economic Cooperation and Development (OECD) country. In fact, globalisation ensures that a consumer is never quite sure of where a product is sourced, only that it meets the quality and price parameters embedded in its brand name. The lower tier of Australian land use is seldom seen, but sometimes noticed when a back road takes the driver through the marginalised and degraded lands that are economically beyond repair, and thus left to subsist at continuing environmental and social costs.

All land in Australia is held as private tenure except large parts of northern Australia which are either Aboriginal land or defence training areas. Productive zones are well managed by the linked interests of corporations who control access to water rights and the commodity sectors which use that water. The problems of marginal lands or damaged lands are ignored, except if they impact on key sectoral interests such as water quality or production. This impact is dealt with by acquisition, retirement and, if necessary, engineering solutions which seal off the problem rather than fix it.

National parks in the main are privately managed, and are now run as business ventures which attract their clientele on the basis of their environmental resource and quality. The market determines what is attractive, rather than claims of original biodiversity or threatened species. Rights to clean air, clean water, and access to semi-natural landscapes are dealt with primarily by the market mechanism.

Much of the lower quality grazing land is now used for carbon offset arrangements, a good source of cash flow to large pastoral companies who retained their extensive land holdings from the late 1990s. Land cover is increasing on these large holdings, and original environmental problems such as woody weed encroachment are now seen as a plus in the world of carbon offsets. Many of the smaller pastoral holdings which were economically marginal in the 1990s were purchased en masse by carbon offset brokers on the world market. Weed invasion remains a significant problem.

Feral animals are controlled primarily by management of waters but uncontrolled river frontages in many areas continue to maintain many environmental sores. Periodic harvesting of multiple protein sources (rabbits, goats, cattle, horses, kangaroos etc.) does produce cash flow, but the rangelands are seen as a 'wild' resource which looks after itself, augmented by improved mechanisms of biological control. The environmental quality of rangelands and marginal pastoral lands is thus internalised, with no national or corporate responsibility taken.

In areas of high agricultural productivity, remnant vegetation has largely disappeared. In the marginal agricultural lands there is a significant number of semi-subsistence farmers who have maintained and expanded remnant vegetation, largely for personal interests.

Salinisation has developed apace throughout the wheatlands of South-Eastern and South-Western Australia, and many remnants have disappeared. Private conservation foundations are seeking to purchase specialised niches to be made available as a nostalgic (for the old) and learning (for the young) experience for urban dwellers. The high cost of productive land has forced these foundations to concentrate on marginal lands. As a result of all these developments, the representation of the continent's original biodiversity in remnant vegetation is highly biased towards the least productive landscapes.

Scenario 2: Planned development[1]

Australian agriculture under the planned development scenario

Under the planned development scenario, the institutional framework recognises the effectiveness and right of society to intervene strongly to achieve social and environmental goals. It recognises unemployment as the major cause of socioeconomic inequality. It focuses on achieving a high rate of economic growth but only to the extent that this does not detract from achieving major improvements in environmental quality and social equity.

There has been a very strong shift to regional government, with a new set of 'bio-regions' replacing the previous historical distribution. The role of State governments has been substantially reduced, with the Commonwealth and regional governments taking on many of the previous responsibilities of the States.

The main components of the planned development strategy are:

- a focus on careful long-term planning with quantified outcome-oriented targets;
- consideration of government as a facilitator, formalising objectives with the community;
- establishment of a system of incentives and regulations (for individuals and organisations) that promotes improved environmental quality, backed up by independent audits;
- a strong focus on understanding ecosystem function and social processes with attention to equity;
- establishment of employment-creation programs centred on increasing tax revenues and using these to finance jobs directed towards environmental protection and enhancement; and
- a high degree of access to information for all parties.

Agricultural industry operates under a comprehensive, but supportive regulatory regime, which addresses:

1. Note that the CIE title of scenario 2 – 'conservative development' was changed to 'planned development' after the Introductory Workshop, based on feedback from participants.

- future market-generated cost/price/technology trade-offs and opportunities;
- a range of outcome-focused prescriptions of nominated products, technologies and required practices, defined on a region-by-region basis;
- changes in cost/price/technology regimes, with cost-sharing arrangements created by government programs, such as levies, subsidies, property rights markets and research; and
- self-imposed constraints on production, such as ethical considerations.

International trade agreements require that full environmental costs are built into product prices.

Policies in 2025 include:

- periodic review and serious enforcement of all regulations;
- defined codes of practice backed by legislation;
- a moratorium on further broadacre clearing of native vegetation, and a requirement of no net loss;
- selective re-establishment of trees in areas where this would have maximum effect on reduction of the spread of dryland salinisation and waterlogging;
- purchase of cropping rights in marginal areas;
- imposition of erosion-retarding cropping practices;
- transferable rights in carbon, water, clearing, wildlife use etc.;
- a network of evaporation basins;
- water sold at full cost including amortisation of headworks;
- no new cities and carefully controlled expansion of existing regional centres;
- property rights regimes that allow separation of ownership of trees, water, access etc. from land;
- strong industry-wide environmental standards;
- skills-based licenses for agriculture practice, renewed every five years, and requiring (among other things) an approved farm plan;
- environmental targets set, and delivered, at community level;
- two-sided contracts where government is required to deliver on contracts with resource users (and vice versa), based on performance audits;
- detailed environmental impact assessment of all proposed, new, resource-using activities;
- projects involving irreversible devaluation of natural capital to be offset by projects to conserve other natural resources under significant threat; and
- a major land allocation exercise undertaken which covers conservation, recreation, tourism, timber plantations, industrial infrastructure etc.

However, natural resource output under a planned development, agricultural strategy has remained high for the following reasons.

- Government-funded research has increased substantially under a planned development strategy. This in turn has increased the rate of technical progress, the basic source of productivity increases, at a higher level than otherwise.
- Product quality is segmented, leading to higher unit prices for some products targeted at agricultural exports into niche markets, thus tending to offset lower quantities of exports.
- Real environmental costs are reflected in product price.
- Land degradation leading to declining productivity and output in some regions has been halted, and in some cases reversed.

The state of remnant vegetation has been substantially improved through planned programs to halt further clearing, to limit total grazing pressure, to eradicate weeds, to control firewood harvesting and to improve management of farm chemicals.

A significant number of areas have been revegetated to produce 'synthetic' bushland; these are mainly located on discharge and recharge areas to combat dryland salinity and for production of specialty timbers and eucalyptus oil. In association with a vigorous program to eradicate feral animals, native wildlife has been introduced to large areas to supply a booming market demand.

Much revegetation has been conducted to build buffers around remnants of native vegetation, reducing the rate of salinisation in productive lands, and slowing the speed of extinctions among native plants and animals. The pace of revegetation has been considerable, as a result of government-supported programs and a significant reduction in costs as a result of technological advances.

The decline in biodiversity in remnants within the most productive agricultural lands continues to be high, however, because there is insufficient remaining vegetation to prevent ongoing extinctions. In addition, the effects of salinisation continue to develop as replanting was not instituted in time to prevent large slugs of groundwater from beginning to move.

Scenario 3: Post-materialism

Australian agriculture in an ecologically sophisticated economy

The events associated with the Asian economies melt-down at the turn of the century, the subsequent collapse of the Japanese banking system, and the rise of ultra-nationalist political parties and governments across the region, produced crisis conditions in Australia sufficient to catalyse major structural change. Leading up to the proclamation of the Republic of Australia in 2010, there was an extensive community-driven re-writing of the Constitution. Among the major changes were (i) the almost complete transfer of powers from state governments to twenty 'bio-region' based, local governments, (ii) the incorporation of the value of biodiversity, and (iii) the need for all so-called 'external' costs to be internalised.

Each bio-region has a degree of self-sufficiency within explicit regional population targets. Some bio-regions are largely under Aboriginal control. The national government retained its powers in international affairs including defence and trade. Domestically, it sets frameworks and minimum standards within which regions are free to develop autonomously. Encouragement of substantial decentralisation has been a national budget priority. Internationally, Australia actively defends its protective stewardship of a fragile land acknowledged to be a major part of the world's heritage.

The impact on the agricultural sector flowed from the adoption of a set of principles aimed towards the creation of ecological sustainability. The key mechanism was the community and industry acceptance of a planning and stewardship ethic, in return for government provided incentives and compensation (through a special levy). This saw a substantial conversion of freehold land to leasehold with binding covenants, integrated management of real biophysical units such as catchments, a variety of controls on environmental quality, community assessment of new agricultural proposals, and major innovations in public and private interest research.

This has produced a situation in which the per capita demand for land is high because each person is placing a large but light footprint on the landscape. Patterns include: wind farms and solar farms, timber plantations, land devoted to producing renewable substitutes for non-renewable mineral and energy resources, native forests committed to light, selective logging, widespread ownership of hobby farms and rural retreats, dedicated (single use) water catchments, more parks, reserves and wilderness areas, more low-intensity agriculture, more urban forests and garden cities, and more 'half acre' urban residential blocks supporting low-energy houses, productive gardens and solar, water collecting and sewage composting technologies.

Commercial agriculture continues, and indeed thrives, within a regime of sustainability, minimum impact, and high-value production. Exports carry the prized 'eco-label' which guarantees consumers that production has not caused any loss of biodiversity. Annual crops are now substantially replaced by perennial polycultures on an arrayed basis. Pest control by combinations of polycultures and biological control methods has replaced widespread use of chemicals, although new generations of 'natural' treatments are available. Perennial tree and pasture crops have begun to be seen as not only valuable for soil, salinity, and water management, but also as a way of increasing profits through lowering fuel use. Broadacre grain farming has retreated from all marginal areas, notably closing much of the Western Australian wheat industry. Land thus left vacant is actively returned to native vegetation or grazing.

Revegetation of up to half the area of all farms reduces salinity and acidity problems and erosion, provides shelter for native and farm animals, is a source of valuable timber crops, stabilises nutrient flows, maintains water quality, and is seen as just as valuable as other forms of agriculture. Farm-level planning continues the bio-regional approach adopted by the State and local communities, using soil type and landscape boundaries, 'keyline' principles, and integrated, diverse production systems.

Healthy, functioning, and evolving ecosystems are seen as valuable for their own sake. They are also widely understood to be essential for the maintenance of production systems. Management is focused on the long view, using techniques such as new forms of no tillage farming to actively improve soil condition. Other new features of farming include the dramatic improvement in the knowledge base about our land, and transfer of all sorts of technologies (social, industrial, and agricultural) to regions, local communities, and individuals.

Animal rearing becomes much more diverse, and includes the farming of native animals such as kangaroo, emu, and wombat. Emphasis is placed on quality and value-added production, rather than on volume. Feral pests are a problem of the past because of biological control. Massive increases in native plant production have occurred, with bush foods supplying a major collection of domestic and export niche markets. Pharmaceutical crops have emerged as significant, niche export income earners. Seasonal production and consumption patterns are re-adopted.

Weed management remains a continuing problem, however, with substantial efforts being made to eradicate these invasions.

In northern Australia, settlements are widely scattered and self-sufficient, but thoroughly integrated into the production systems of southern Australia. Grazing is restricted to small, highly productive and managed locations with intensive use of tropical legumes, perhaps only 10% of the area of a farm, with the remainder set aside for native drought pasture and other crops. This in turn has reduced pressure on biodiversity over large areas.

Dramatic improvements in biodiversity quality have been achieved through effective retreat of grazing and cropping practices from large areas. Active rehabilitation of specific habitats was also undertaken under government and community-sponsored schemes. Water quality remains a problem because of inheritance of historical problems, but is being dealt with by research, revegetation, lower extraction and use, pricing, and massive environmental quality programs.

Remnant vegetation, which is viewed as an integral component of landscape management, has been substantially increased, both through natural processes following retreat and through intensive rehabilitation and revegetation programs. Bio-regional plans have identified the extent and location of each vegetation formation required to achieve a comprehensive and representative network of reserves, containing a secure sample of Australia's biodiversity. In addition, the widespread use of native plants has supported increases in the numbers of native animals able to survive in the agricultural landscape.

Identifying Key Strategies and Priorities for Future R&D on Remnant Vegetation

Overview

The three highly developed, robust scenarios for the future described above are relevant to future remnant vegetation management in Australia. They are also in a form which can be used to consider the use and management of other Australian natural resources.

The implications of these scenarios for changes in the value, condition and framework for sustainable management of these resources have been extensively examined in the foresighting exercise. Different, but quite substantial, changes were required under each of the scenarios. The changes ranged from a reconstitution of regional governance to a much enhanced commitment to environmental sustainability.

A start was made to identify and detail the type of strategies necessary to shape EA and LWRRDC's future focus and directions, and broad structural and thematic priorities for R&D associated with remnant vegetation were developed to provide an appropriate knowledge base for future decisions and investments.

A variety of both process and content outcomes has been achieved, as detailed below and in Section 2.

Content outcomes

Strategies

The participants in the foresighting study identified three broad areas to be considered when developing strategies for remnant vegetation management.

1. A recognition that any program or policy addressing remnant vegetation management needs also to take account of revegetation.
2. A set of common themes in preliminary consideration of strategy implications. These include:
   - the use of market-based mechanisms in different forms to allocate resources or manage transactions, eg. trading of land and other rights, in the internalisation of external environmental costs, or in the dominance of commercial perspectives;
   - recognition of the health of the environment as an inescapable constraint, whether to be taken full account of, or to limit the possibilities of exploitation;
   - an identified role for governments; and
   - the need for improved information capture and management systems.

3. The three scenarios—'Economic Growth', 'Planned Development', and 'Post-Materialism' projected substantially different futures, but were confirmed to represent realistic possible futures, which needed to be taken into account in long-range strategic planning and priority setting.

Nine key elements of an appropriate strategy were also agreed upon by workshop participants.

1. Obtain government commitment to an ongoing level of resource commitment for national protection of the environment including remnant vegetation.
2. Develop wide stakeholder support for remnant vegetation and revegetation; this will require diversification of the support base through institutional reforms with regard to:
   - political parties, the different tiers of government and through industry/ community interactions;
   - innovative regional structures and regional management; and
   - development of ideas and structures associated with land ownership, rights and obligations.
3. Create a comprehensive and consistent information system, including mapping, inventory and monitoring of the remnant vegetation resource.
4. Define property rights and duty of care, and ensure there are proper procedures for vegetation management in development control regulations.
5. Identify full environmental costs of economic activity.
6. Integrate remnant vegetation management into landscape design and management.
7. Integrate best practice into regional-based planning and management.
8. Acknowledge the threat of invasive species in all components of the program but recognise it is only one, albeit important, component of a group of threatening processes.
9. Recognise that strengthening extension and information transfer, including communication, is an overarching strategy across all other strategies.

These recommended components of strategy contrast quite markedly with those identified by participants in the pre-workshop questionnaire. Firstly in the level of detail and precision with which they were expressed; and secondly, in their actual focus—the emphasis on government responsibility for action through incentives, sanctions and protective legislation was replaced by a greater emphasis on stakeholder engagement, and in providing the information and management tools which would assist in pursuing remnant vegetation maintenance and revegetation objectives.

R&D priorities

At the Principal Workshop, participants broke into three groups to identify the R&D priorities detailed in Section 2. The following consolidated set of seven R&D priorities for remnant native vegetation, robust across all scenarios, was then agreed upon.

1. Continental, dynamic mapping of native vegetation linked to trends in land and water use and farm economics to develop inventories and indicators of sustainability.
2. Enhanced extension and information transfer to land managers and the community, focusing on behaviour change and adoption of appropriate new principles.
3. Enhancing the economic and commercial value of remnants by developing new products, alternative uses of existing products, and non-damaging extraction methods (eg. timber extraction, plant production, grazing strategies, wildlife harvesting).
4. Development of new technologies for remnant vegetation management and revegetation, including disturbance regimes, enhancement, containment, management of livestock movement etc.
5. Landscape design principles and processes for sustainability including research into minimum size, extent, location, shape, connectivity etc. required to maintain ecosystem function and viability.
6. Analysis of internal and external costs of production.
7. Institutional arrangements including a number of socioeconomic and management areas such as
   - cost sharing,
   - resource allocation,
   - priority setting,
   - auditing strategies and funds allocation,
   - linkages with carbon credit investigations outside the EA/LWRRDC program, and
   - integration of landscape design and vegetation management issues with restructuring policies at a regional level.

Again, the set of priorities generated through the scenario planning process provided a much more detailed articulation of operational priorities than identified by participants in the pre-workshop questionnaire (see Section 2).

The most significant shift in R&D priorities (from before the exercise to after) was the dramatic increase in the importance of regional/catchment landscape design and management.

Summary of the key strategies

An attempt is made below to summarise the overall workshop outcomes in terms of the key strategies that emerged. This is drawn from the specific outcomes of both workshops, the evaluation exercise and the focused outcomes reported in Section 2.

At the beginning of the exercise, the principal strategies to manage remnant vegetation held by participants were associated with incentive mechanisms and improving and enforcing legislation and regulations. Institutional change was also seen as important. In addition, strategies for developing management methods for remnants and threatening processes were frequently mentioned, including revegetation and extension strengthening. Constraints to implementing these strategies were identified as being strongly related to government and institutional issues, lack of resources, lack of knowledge and the perceptions of both community and landholders.

The key strategies emanating from the foresighting exercise can be grouped into strategies at the macro, regional and technical levels. At the macro level, a key strategy will be to elicit the commitment by governments to resource sustainability with an even stronger emphasis than exists at present. This will need to be accompanied by a level of resource commitment by governments to the environment that is continuous and stable. In this regard the strategy should enlist bipartisan support across the major political parties, the three tiers of government, and across industry and environmental groups. Such a commitment may require further development of ideas and development of structures associated with land ownership, and the rights and obligations associated with that ownership. Likewise, strategies associated with ascertaining the full environmental costs associated with economic activity, and measures of recovering those costs from producers or consumers, may be part of gaining commitment from governments.

At a regional level, and perhaps requiring institutional reform, there is a need for strategies that identify innovative regional structures and regional management models for native vegetation.

Integrating desirable native vegetation outcomes at a regional level with desirable outcomes from other regional activities such as property management planning and structural adjustment would be essential, but was recognised as being difficult.

Planning at a landscape level that integrated native vegetation management was recognised as being important and most effectively approached on a regional basis. This would require an information system that utilised up-to-date technology for mapping and monitoring various characteristics of native vegetation. Such an information system would not only assist planning but also would be used for auditing the impact of various activities and innovations associated with change in the native vegetation status. This information system, plus clearer definition of roles and responsibilities regarding property rights, would ensure that native vegetation would be given appropriate consideration in land development applications. In turn this may require the improvement of native vegetation valuation tools to ensure that best use is being made of the land resource.

At the technical level, while there was recognition that invasive species are a major threat to remnant vegetation, it was recognised as being only one of a number of threatening factors that also included firewood harvesting, grazing and modified fire regimes. No specific strategies emerged to combat invasive species or any other threatening forces, although the research priorities reported later address some of these threats.

Communication and information transfer was recognised as a strategy that needed to be incorporated into all other strategies defined. Alternative strategies for highly cleared versus less highly cleared land were not developed despite this issue being brought to the attention of the participants a number of times. This may have been because the strategies developed were considered robust for all geographic regions, that the emphasis on regional structures would accommodate geographical and vegetation diversity, or that the notion of priority setting which was promoted would address the issue.

The key strategies nominated by participants in the final evaluation exercise reflected the mainstream strategies as defined above. This was so particularly for the critical role of government and the issue of institutional reform. However, the strategy of promoting the benefits of remnants was given considerable weight in the evaluation exercise but did not rate highly in the strategies emanating from the Principal Workshop.

Summary of R&D priorities

Structural aspects of R&D that emanated from the different scenarios stressed the role of government in ensuring an attractive environment for private sector research for one scenario, but in the other two scenarios the government was perceived to be also heavily involved in funding research. Issues that arose were the need to define gaps to direct philanthropic research resources, the need for strong user/community involvement in R&D, and the need for stronger networking between the R&D corporations.

Before the foresighting exercise, research priorities were viewed by the participants (in order of importance) as:

1. management of remnants;
2. changing landholder and manager behaviour;
3. establishing the economic value of native vegetation;
4. revegetation and rehabilitation techniques and costs; and
5. resource assessment and monitoring.

The foresighting exercise elicited research priorities associated with socioeconomics (eg. cost sharing, external costs of production, targeting and funds allocation) as well as socioeconomic aspects of integrating landscape design and vegetation management issues with restructuring policies at a regional level. The socioeconomic research area was linked with the strategy on institutional change, as well as with the regional and landscape design and management emphasis evident in the key strategies.

Important technical and management research areas also focused to some extent at a landscape level, including the key design principles (extent, shape, connectivity etc.) for maintaining ecosystem function. This was associated with another important research area for managing remnants encompassing both containment and disturbance regimes. While research into enhancing the economic and commercial value of remnants through the development of new products and non-damaging extraction methods was given a high priority, the area of promoting conservation goals through their integration with revegetation for other sustainability or productive purposes was given less emphasis.

Research on further development of mapping and inventory and indicator capabilities was given a high priority and linked with the strategy in this area already defined. The area of information transfer to land managers and the community was emphasised in terms of changing behaviour of landholders and adoption of conservation principles.

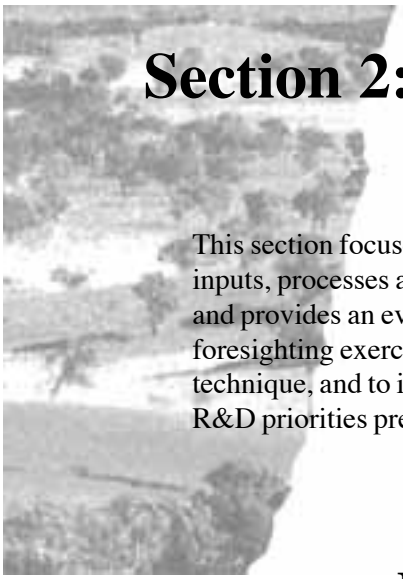
There is clearly a need to further develop valuation tools for resources such as native vegetation. While not specifically targeted as a research priority, the importance was implicit in some of the key strategies identified such as cost-sharing arrangements, the support of trading mechanisms (eg. carbon) and in identifying the cost of externalities in economic activities.

The research priorities elicited from individual participants from the evaluation process at the end of the Principal Workshop were as follows (in order of importance):

1. regional/catchment landscape design and management;
2. resource allocation/cost of externalities/cost sharing;
3. value of native vegetation;
4. resource assessment and monitoring; and
5. management of remnants and integration of knowledge/extension.

The priorities set by the participants at the workshop reflected reasonably well the individual research priorities as assessed in the final evaluation process.

It seems that the foresighting exercise has facilitated a shift from issues associated with vegetation management and changing behaviour, to a position where targeting and integration of knowledge and its delivery, the mechanics and levels of incentives, and the potential for improvement through change in institutional arrangements, including a stronger regional approach, were given greater prominence.



Section 2: The Foresighting Exercise

This section focuses on the details of the foresighting exercise. It discusses the inputs, processes and outputs of the Introductory and Principal Workshops, and provides an evaluation of the process and output performance of the foresighting exercise. It is provided for those interested in foresighting as a technique, and to illustrate the steps taken to identify the key strategies and R&D priorities presented in Section 1.

Introductory Workshop

Preparation for the Introductory Workshop

The objectives of the Introductory Workshop were:

- to discuss an Issues Paper prepared for the workshop;
- to familiarise participants with the ideas and mechanisms associated with foresight;
- to develop and refine three scenarios for the future of remnant vegetation management; and
- to gain the commitment of the participants to the foresight exercise and process.

Potential participants in the Introductory and Principal workshops were invited. The focus group of participants was the membership of the Council for Sustainable Vegetation Management (CSVM), a Council appointed in 1997 to advise the Minister for the Environment on matters pertaining to vegetation management in Australia. The Council members included a wide group of stakeholders including private landholders, personnel from non-government organisations, personnel from government organisations (policy and research) and independent researchers.

Also invited were a second group to complement the Council members with further skills and experience in such areas as natural resource policy, economics, landscape visions, social processes, and commercial agroforestry. In addition, several personnel from LWRRDC and EA associated with the joint R&D program as well as with biodiversity policy in EA participated in the exercise. A full list of participants attending the Introductory Workshop is provided in Appendix B.

The Issues Paper (Appendix C) was drafted and distributed to the participants before the workshop, together with introductory written material on foresight (Appendix A). As a principal starting point for the workshop, three scenarios, based on the initial CIE scenarios as described in the Introduction, were drafted and circulated to participants (Appendix D). In addition, a pre-workshop questionnaire was circulated for completion by each participant before the workshop commenced (Appendix E).

Description of the Introductory Workshop

The Introductory Workshop was held in Sydney for a half day in July 1998. Foresighting and the objectives of the exercise were explained and some discussion took place on the scope of remnant vegetation that was to be the main focus. It was concluded that emphasis would be on highly cleared remnants but that modified landscapes and rangelands were also to be included. Urban remnants were to be excluded.

The Issues Paper was subjected to some general discussion and accepted as a useful summary of the key issues facing remnant vegetation. The participants were divided into three working groups and each group was allocated one of the scenarios with the objective of 'living the scenario' and eventually critiquing and refining the allotted scenario. After reporting back on refinements to the scenarios, groups were asked to start to develop strategies that would have to be put in place over the next 25 years or so for each of the scenarios to become 'real' in the year 2025.

Outputs from the Introductory Workshop

There were three substantial outputs from the Introductory Workshop:

i. The first (and perhaps most important) output arose from the experience of engagement with the scenario planning-based foresight process itself. This workshop generated a high level of enthusiasm for the process and the different perspectives that were generated. This led to a decision to expand the second workshop from one day to one-and-a-half days.

ii. The second output was a substantial revision of the scenarios which had been developed by the consultants based on the CIE scenarios, adapted to remnant vegetation issues (Appendix D). The working groups identified a range of gaps and weaknesses in these scenarios and proposed major modifications. These suggestions were used by the consultants to substantially redraft the scenarios for the second workshop (Appendix F).

iii. The third output was a preliminary identification of strategy and policy implications of each of the scenarios. The five most important strategies and policies for each of the scenarios are presented below.

Scenario 1—Economic growth (market rules)

- Continue freeing up of global trade and investment.
- Restructure government—identify core responsibilities, and then pursue outsourcing, adoption of purchaser/provider model, and corporatisation/privatisation.
- Remove assistance to industry/land managers (eg. diesel rebate).
- Remove vegetation controls.
- Create tradeable property rights.

Scenario 2—Planned development

- Develop a strong information management capability, including 'paddock scale' information available on the Internet, conservation status for every ecosystem established, community-based monitoring and evaluation.
- Develop a strong planning and decision-making process, devolved to the regional level, iterative processes to develop and define natural resource outcomes via an integrated systems approach.
- Develop a strong, market-based mechanism, including policy framework, for tradeable rights separated from land, and fully-costed externalities reflected in prices, including producer's share.
- Establish legislative continuity across jurisdictions; make public and enforce government responsibilities.
- Develop an environmental protection regime, in which all agricultural land is subject to environmental impact statement/environmental impact assessment process, and develop internationally accepted and enforced standards for environmental management systems, product quality and natural resource condition.

Scenario 3—Post-materialism

- Rewrite the constitution to incorporate a Republic and with resource sustainability as a key element. Abolish State governments in favour of regional governments responsible for service delivery and based on bio-regions. Make central government responsible for defence, national economic policy etc.
- Recognise the failure of the market to properly price according to sustainability requirements. Establish a system of tradeable 'eco-rights' supported by appropriate regulation that internalises most of the externalities. Accept some specific externalities as requiring public funding to correct.
- Provide substantial public investment in sustainability areas such as R&D, education, compensation, resource capability assessment, and monitoring and reporting. Recognise the major information needs of such a system.
- Manage natural resources within the limits of capability, taking into account environmental constraints. Attach conditions to entitlements for property rights in natural resources such as land and water which constrain use and require reporting against specified performance criteria. Resume marginal and degraded lands (with appropriate compensation) and manage as a common property resource for the regional governments.
- Create a strong public natural resource stewardship ethic—for example landcare and watercare—shared by both urban and rural communities.

While the key strategies proposed were different for each scenario, as would be expected, there were some interesting common themes:

- the use of market-based mechanisms, in different forms, to allocate resources or manage

transactions (eg. in trading of land and other rights) in the internalisation of external environmental costs, or in the dominance of commercial perspectives;

- recognition of the health of the environment as an inescapable constraint, whether to be taken full account of, or to limit the possibilities of exploitation; and
- an identified role for governments.

The level of commitment generated by the process and the participants, the revised scenarios, and to a lesser extent the preliminary consideration of strategy and policy implications, provided the basis for the second workshop (the Principal Workshop).

Principal Workshop: Overview and Specific Scenario Outputs

Preparation for the Principal Workshop

Participants invited to the Principal Workshop were those who attended the Introductory Workshop. A full list of those attending the Principal Workshop is given in Appendix G. Participants were sent before the workshop:

- the refined scenarios developed by participants at the Introductory Workshop; and
- a resource document that evolved from the embryonic strategies that started to emerge at the Introductory Workshop.

The resource document contained a series of answers to ten questions. The questions were relevant to the emerging strategies from the first workshop. The purpose of the material was to familiarise participants with the state of existing information across a range of issues so that strategies worked back from the futures could be more easily linked to the state of current information.

The ten questions and a summary of the answers follow. The resource document is reproduced in its entirety in Appendix H, including a disclaimer about the material provided.

1. (a) What is the status of information available to landholders on:

- **methods of protecting and enhancing remnant vegetation and the associated costs?**
- **methods of revegetation and associated costs?**

(b) What kind of new technical information would need to be generated in the future to improve the availability of existing knowledge relevant to landholder management?

The amount of material accessible on methods of protecting and enhancing remnant vegetation, and of methods of revegetation is extensive. The material comprises pamphlets, leaflets, booklets, guidebooks, and toolkits. It seems to cover everything from local, on-farm activities to regional planning guides; information available includes a massive range of topics, from details of such activities as direct-drill seeding through to broad-scale considerations such as regional biodiversity management.

Three attributes of the vast array of information, however, are seemingly less than adequate. The first is in the area of 'associated costs', where advice for landholders appears to be much thinner than it is in the area of technical information about carrying out vegetation management. Secondly, it seems likely that the range of information available to urban landholders and groups is narrower than that accessible to farming communities. The third inadequacy concerns the backup support required to enhance full use of the information accessible in the vast array of printed material on vegetation management.

The technical information that is lacking is in the area of integrated knowledge of vegetation management. Until we tackle the system-wide implications of vegetation management, perhaps through catchment-scale examples, we may continue to see efforts at improved vegetation management fall short. Also, it seems probable that a major impediment to better vegetation management lies in putting a human face to provision of integrated extension support.

2. What incentives are currently provided by governments to landholders to protect and manage remnant and other native vegetation?

There is a substantial array of incentives available to landholders from Government. They include various forms of statutory covenants such as voluntary conservation agreements, declaration of wildlife refuges, land for wildlife schemes, native vegetation management agreements, heritage agreements, remnant vegetation protection schemes, and stewardship agreements. The amounts of public money supporting these incentives do not appear sufficient compared either to the demand for them from landholders, or from the perspective of the need for conservation activity. Further, it has not always been possible to target the effort involved in providing incentives according to wider conservation or land management objectives. Nevertheless, the growth of interest at landholder, community and government levels suggests considerable room for wider and more effective use of this method of bringing about change in remnant vegetation management.

3. (a) What level of public investment ($) is currently in place for protection and enhancement of remnant vegetation and/or revegetation by Commonwealth, State and local governments?

(b) In your opinion, will this have to be significantly increased to make a significant impact on the status of native vegetation? What are the scenarios for how this investment might be delivered in future?

Estimates of investment by Commonwealth, State and local government are included in Appendix H. There are considerable difficulties in estimating investment by State Governments and it is almost impossible to estimate investment by local government. However, based on knowledge of current levels of investment, unless there is a significant increase in public investment, remnant vegetation will continue to decline. Nevertheless, before calling for increased investment it seems imperative to maximise the effectiveness of the current funding. In order to do so, several considerations need to be taken into account, and particularly the factors underlying questions 4 and 5. Hence, the most desirable patterns of investment are discussed below in relation to questions 4 and 5.

4. (a) What legislation is currently in place for the protection and enhancement of remnant vegetation? What legislation is currently being considered?

(b) Is the current legislation sufficient if enforced? In your opinion, is it the legislation itself or its enforcement that is most lacking? Are political arguments inconclusive due to lack of information or are different value systems among stakeholders, and their reconciliation, the major constraint?

A detailed account of State and Commonwealth programs as at June 1996 can be found in 'Nature Conservation on Private Land: Commonwealth, State and Territory Legislation and Programs — A Report of the Working Group on Nature Conservation on Private Land Prepared for the Australian and New Zealand Environment and Conservation Council, Standing Committee on Conservation' (ANZECC 1996).

There is sometimes a certain level of incompatibility between Acts with different objectives at Commonwealth and State or Territory level, for example between legislation concerning natural resource use and resource conservation. Commonwealth, State and Territory agencies and Statutory Authorities tend to focus on a relatively narrow segment of natural resource use, reflecting the intent of the legislation under which they operate. Our society is struggling to work out means of incorporating the wider consequences of natural resource use into legislation and governmental practice. Legislation concerning natural resource management is more likely to succeed in its intent when it finds means of encouraging and providing incentives for desired actions than when it prohibits and proscribes.

Local government is becoming a more important player in the field of natural resource management, and so more frequently has to filter the various Acts at State and Commonwealth levels. At the same time, State and Territory Governments may be side-stepping local government by setting up alternative regional institutional structures, such as regional vegetation committees. In short, vegetation management represents a good example of a natural resource issue that integrates and reflects the wider consequences of resource use. It is not surprising, therefore, to see considerable debate over the effectiveness of legislation and governmental action.

5. (a) What are the present tiers of government involved in providing incentives or legislation associated with remnant vegetation?

(b) How is this likely to change in the future and what changes are likely? What would need to occur to initiate improvements?

Australia has complex arrangements in place for the management of natural resources generally, and native vegetation specifically. The Commonwealth has major influence through the development of nationwide approaches to environmental issues, with reference to international trends, the regulation of specific environmental issues of national significance, and the provision of funding for natural resource management activities. The Commonwealth has sought to develop cooperative arrangements with State Governments, first through the Intergovernmental Agreement on the Environment and more recently through the proposed review of Commonwealth environmental legislation. Overall, the Commonwealth influences natural resource management at State Government level primarily through provision of funding via the Natural Heritage Trust (NHT).

State and Territory Governments have primary statutory responsibility for natural resource management. A substantial array of legislation has arisen in response to three broad areas—land-use planning and environmental protection, rural land management, and nature conservation and heritage protection.

Local governments were originally established to deal with and manage infrastructure for their regions. Their roles have gradually expanded, such that they no longer are responsible just for the provision of infrastructure, for the management of Council-owned land, and for waste collection. Now, Councils have a primary role also in land use and planning and in the management of environmental risks. This latter expansion is leading Councils into the areas of planning and incentives for vegetation management.

6. (a) Are there control mechanisms in place for exotic pests or build up of native wildlife in native remnant vegetation areas?

(b) What is the likelihood of key technologies being developed to control such forces?

Rabbits, foxes and wild pigs are controlled to varying degrees by landholders. The Cooperative Research Centre for Vertebrate Biocontrol aims to develop novel fertility control agents as practical, humane and species-specific means of reducing the populations of vertebrate pests. The key concept is to use immunocontraceptive vaccines delivered by bait or through the agency of a virus that spreads naturally through the target pest population. Application of these research findings is still at least five years away.

Weed control remains a major problem in remnant vegetation management. In the longer term, the most effective response to this problem may be to institute better control over plant introductions.

7. (a) What educational material is currently available in schools regarding the value and management of native remnant vegetation? Is the amount of material increasing?

(b) Are there more educational and training opportunities becoming available to landholders and other community members?

Contacts in both Greening Australia and the World Wide Fund for Nature indicated that they receive very many requests for material on vegetation management—schools appear exceedingly hungry for information about environmental management in general. Given that Greening Australia has probably the widest spread of contacts across the country, it appears that they are doing more than any other group in feeding material into the school system.

Increased opportunities for training by landholders and community members have emerged over the past few years as nationally-accredited Landcare courses have become available at most non-urban TAFE colleges.

8. (a) What is the extent and scope of information on current conditions and trend of native vegetation? With what frequency, and at what level, is any monitoring carried out? How public is the information?

(b) Are sufficient and appropriate criteria being used in monitoring? How would monitoring need to be improved in future to be more effective in evaluating status changes?

The first attempt to assemble comparable, continental data about the status of native vegetation rested upon satellite data, and principally considered the period of the 1980s. The studies focused on clearing of native vegetation but also addressed the problem of analysing the condition of uncleared vegetation.

Subsequently, the Bureau of Rural Sciences (BRS) has been engaged in examining clearing rates of native vegetation from 1990–1995, also using satellite data. The estimates of clearing are now being tested for accuracy, a process not yet complete. The information is being analysed at the scale of 1:100,000 map sheets, and according to several processes by which vegetation is modified. The data are under the joint control of the Australian Greenhouse Office and BRS; they have not yet been released.

The Queensland Department of Environment and Natural Resources is building on the BRS studies by

examining clearing rates for the period 1995–1997. Other State agencies may also be preparing to extend the BRS work.

Monitoring of the rate of clearing of vegetation is rapidly becoming effective. Although the remote-sensing process of monitoring is expensive, it should shortly prove possible to target that monitoring towards those regions where change is rapid.

Monitoring of the condition of vegetation appears to be proving more problematic. Much work remains to be done before the status or condition of vegetation remnants could be reliably monitored through remote sensing. The benefits of the monitoring of vegetation condition at the broad scale need to be closely thought out and the questions to be asked of it carefully defined, because the cost of instituting such monitoring may well be substantial.

9. (a) What information is currently available on the harvesting of remnant vegetation for firewood?

(b) If current gathering and harvesting levels are projected into the future, what impact will this have on remnant vegetation? What are the likely future scenarios for use and sources of firewood?

Firewood is presently the third largest source of energy used in Australia after electricity and gas. Firewood use consequently totals a consumption rate of about one tonne per capita wood user per year.

Firewood harvesting is restricted almost entirely to the use of dead trees resulting from the modification of native vegetation for agricultural purposes. Firewood demand seems almost universally to be outstripping supply. Some estimates suggest that 33–45% of the annual firewood supply is removed from remnant vegetation stands, equivalent to a clearfell of about 70 hectares per day.

In light of the magnitude and the operational inadequacies of Australia's firewood industry, concerns have been expressed for more than a decade regarding sustainability and ecological impacts. Ecological impacts include modification to vegetation composition and structure, loss of habitat for native fauna, changes to nutrient cycling and organic matter turnover, and soil erosion. The impact of firewood harvesting on already severely stressed remnants of native vegetation is likely to be profound.

10. (a) Are there any inventories of commercial products that have been derived in Australia from native vegetation, either from native stands or exploited externally (eg. plantings, chemical synthesis)?

(b) Apart from uses and products identified some time ago (eg. timber, tannins, fodder, tea tree oil, eucalypt oil), have there been any significant findings more recently that can provide visible and tangible benefits to society? In your opinion, are there likely to be significant findings of such a nature in the future and would they be diminished if remnant vegetation on private land is not protected or enhanced?

The agency most active in supporting this type of commercial activity is the Rural Industries Research and Development Corporation (RIRDC).

Potentially valuable new products continue to emerge. Further, one can detect a growing trend towards more active commercialisation of native Australian wildlife. It seems more than likely that economically successful uses of native vegetation and wildlife will emerge gradually and tentatively, rather than with a sudden flurry.

It would be foolish to conclude that there are no more valuable industries to be discovered among Australia's native species. The difficulty lies in calculating the curve describing a relationship between the current value of remnant vegetation and the potential for economic return should further useful native species be discovered. In the main, current landholders clearly believe that this curve leads to placement of a relatively low economic value on remnant vegetation.

Description of the Principal Workshop

The Principal Workshop was held in mid-September 1998 in Canberra and extended over one-and-a-half days.

Some time was spent during the first morning presenting and discussing the resource material. Participants reacquainted themselves with the scenarios that they had worked with previously and which had been further refined by the consultants. Key drivers and uncertainties for the future of remnant vegetation were identified and the revised scenarios then tested in three small groups to ensure that the scenarios contained elements of the key drivers and uncertainties identified. Most of the remaining time in the first day was devoted to small group work where each of two working sessions pursued the following objectives for each of the three scenarios:

- identification of events and strategies that would have been necessary to produce the specified future; and
- identification of research priorities that would need to have been addressed under each scenario.

The second day also featured small group work where members of the specific scenario groups from the first day were mixed to produce new groups. The first task set for the new groups was to develop strategies and research priorities that would be robust under all three futures. A second task undertaken by participants was to identify implementation activities that would support the strategies and priorities developed. A final plenary session was used to identify common elements of the strategies and priorities identified by the three working groups.

Outputs relevant to the three scenarios

There were four major outputs from the first day of the Principal Workshop. As described earlier, the first day focused on material relevant to each of the three scenarios. The outputs were:

- an agreed set of drivers of the future of remnant vegetation, together with a set of major potential uncertainties;
- thoroughly tested scenarios which achieved a high level of credibility from, and ownership by, the participants;
- a list of historical events that must have occurred for the scenario to 'come true'; and
- a set of strategies and priorities for R&D under each scenario.

Details of these outputs follow.

Major drivers and uncertainties

The major drivers of the future state of remnant native vegetation were identified as (not necessarily in order of importance):

- Groundwater encroachment
- Invasive species
- Governance/regionalism
- The 'growth is good' mentality
- Demand for food and fibre (world markets)
- Changes in land ownership
- Australian population growth
- Ecosystems/land systems collapse
- Globalisation of environmental responsibility
- Restoration values
- Improved information/knowledge.

The significant uncertainties identified were (not necessarily in order of importance):

- Climate change
- The potential response to climate change
- Reconstruction of the landscape—operationalising sustainability
- A world economic depression
- Fashion/values
- Genetic and other technologies
- Collapse of Indonesia
- Conflict in the region
- The physical capacity of the landscape to recover.

Testing the scenarios

Participants in each working group 'tested' their scenarios against the full set of drivers, and a different selection of the uncertainties that were specified for each working group. The scenarios were found to address or incorporate the issues underlying almost all of the drivers and uncertainties, thereby generating a high level of credibility for the scenario, and commitment from the participants. A minor refinement of the three scenarios was made (see Section 1), largely to deal with invasive species.

Reverse histories

A chronological list was developed, in the form of a 'reverse history', of the various changes that must have occurred and the decisions that must have been made, over the period 1999–2025 for each scenario to have been realised. The history for each scenario was as follows:

Scenario 1—Economic growth

- No restrictions on foreign investment or wealthy migrants;
- government has removed restrictions on commercial wildlife;
- re-definition of property rights accompanied by trade-off in duty of care;
- establishment of international carbon market and tradeable rights to pollute;
- new institutional structure to enshrine property rights and integrity of markets;
- global recession and resultant financial pressures have led to private goods being valued more highly than public goods;
- national agreement on cost sharing with government defining where public expenditure should be directed;
- all government expenditure required to achieve a predetermined rate of return, subject to public scrutiny;

- government withdraws all subsidies;
- environmental tax reform, eg. donation of land is now tax deductible;
- reduction of national parks and wildlife budgets have led to commercialisation of parks and wildlife services aided by successful models of private management;
- government obligations and environmental costs are internalised, eg. water reform; and
- increased demand for eco-products in international markets.

Scenario 2—Planned development

- Intellectual/economic revolution (1998–2000):
  - economic collapse of key countries;
  - paradigm change from economic rationalism to managed economies; and
  - example of successful planned economy through charismatic leadership.
- Shift to regional government (2000–2010):
  - 'bulking up' (3:1) mergers of local government (2000–2005); and
  - full bio-regionalisation (2005–2010).
- Pricing full cost of production into the product by 2010.
- Revegetation:
  - move from NHT ad hoc model to investment sharing including better targeting of particular investments and degradation processes;
  - fully integrated revegetation projects (2000–2005);
  - evidence of collapse in systems and resulting public concern invigorating the revegetation movement;
  - current momentum continues towards major revegetation (plantation and biodiversity); and
  - positive feedback of investment/media exposure/public interest.
- Research:
  - integrated outcomes focus of research, multidisciplinary approach;
  - community/user involvement in R&D;
  - amalgamation of all R&D corporations (2000–2005);
  - amalgamation of research efforts in government departments and agencies (2000–2005); and
  - translation of research into technical advice (2000–2005).
- Information and knowledge (2000–2025):
  - major environmental crises leading to prominent news in mass media;
  - provision of interpretive/integrated technical advice; and
  - technological development to provide information, eg. the World Wide Web.

Scenario 3—Post-materialism

- Constitutional convention in Year 2000 leads to referendum in 2005 and new Constitution in 2010;
- bio-regional planning begins in 2000 leading to the development of bio-regional frameworks, benchmarking, visions and management plans by 2005;
- vigorous regional restructuring begins in 2002, including tenure changes such as freehold replaced by leasehold titles, industry restructuring, legislation on duties of care and covenants on leasehold;
- results are achieved quickly in rangelands and savanna and complete by 2005, marginal agricultural lands by 2010 and high rainfall agricultural lands by 2015;
- Government substantially increases funding for R&D in 1999; case studies in adaptive management of agriculture and ecosystem management including pest management in 2005; policy, R&D and tax incentives established for Australian production in 2015; network of ecosystem extension officers by 2020; and
- high-value, low-volume produce from land, subject to eco-labelling schemes and some public stewardship payments to landholders.
- Together these strategies have provided for massive revegetation and redesign of production.

Structural and thematic R&D priorities

A set of structural and thematic R&D priorities appropriate to each scenario was developed as follows:

Scenario 1—Economic growth

Structural

1. The role of government in research is to create an attractive environment for private R&D, as government is small and public resources for research are limited compared to private sector.
2. Any philanthropic resources for research need gaps clearly defined.
3. Private research resources are involved in many niche areas but committed only where there is opportunity to capture benefits.

Thematic

1. R&D to underpin property rights regimes and the internalisation of environmental costs.
2. Screening of native plants for pharmaceuticals.

3. Adaptive screening and genetic development of species for tolerance of salinity.
4. Better definition of biodiversity priorities (necessary for property rights obligations).
5. Research on what is needed to encourage uptake of remnant vegetation outcomes.
6. Monitoring—necessary for private R&D.
7. Quantification of commodities (eg. carbon) and property rights.

Scenario 2—Planned development

Structural

1. Integrated outcome focus required through multidisciplinary research and translation of research into implementable outcomes.
2. Strong community/user involvement in R&D priority setting and implementation.
3. Establishment of stronger networking between rural R&D corporations.

Thematic

1. Expand basic data, eg. farm landscape design, habitat requirements (where, how much).
2. Establish conditions for effective investment sharing and incentive mechanisms which achieve environmental outcomes, eg. who has duty of care, who are beneficiaries, who are polluters?
3. Expand 'blue sky' research and develop new paradigms; ensure a diverse profile of projects from basic research to extension-driven research.
4. Establish the cost of environmental damage from commodity production (implications for international treaties).
5. Model and trial alternative approaches to environmentally sustainable development on a regional scale.
6. Methodologies for remote sensing of cover and condition of vegetation.
7. Develop new crops and products.

Scenario 3—Post-materialism

Structural

1. Publicly funded R&D is still very significant.
2. Purchaser–provider model is still an effective way of allocation and organisation of research resources and is capable of fostering not only short term and applied research, but also long term and strategic research.
3. Amalgamation of R&D corporations considered but rejected on ground of loss of focus.
4. Environmentally sustainable R&D corporation also considered but rejected on grounds of sidelining sustainability issues for other R&D corporations.

Thematic

1. Revegetation—farm forestry, new commercial options (big drivers plus many small possibilities), product development and market research, cost-effective firewood plantations, maximisation of hydrological impact, crop rotation, new harvest technologies; how new enterprises can be integrated into agricultural systems.
2. Revegetation for natural habitat reconstruction—fill knowledge gaps with regard to reconstruction of biodiversity, cost-effectiveness of restoration, priority setting (eg. on threatened species and threatened ecological communities), design parameters (corridors, connectivity), catchment-scale research to meet specific targets (eg. salinity reduction, biodiversity), survivorship of revegetation.
3. Remnant vegetation—inventory/classification/threatened status, condition assessment and monitoring, threatening processes/disturbance ecology, enhancement of remnants leading to survival (eg. how much, spatial patterns).
4. Invasives (ferals and weeds)—assessment of 'sleepers' here already, control technology (not just biological control), priority setting.
5. Social/institutional factors influencing take-up of technology—review of what has succeeded and why (eg. structural adjustment, agro-forestry take-up), role of and maximisation of private investment, exploring legal options and costs/benefits of devolution of government functions (eg. to community groups).
6. Overarching themes—monitoring, evaluation and adaptive management are required, as is an integrated approach overall.

This concluded the first day of the Principal Workshop. The second day of the workshop focused on developing strategies and priorities that were robust across the three scenarios. Outputs from these sessions are reported below.

Principal Workshop: Strategies and Priorities

Management strategies

The participants, now organised into groups which included members from each of the original scenario groups, were given the task of identifying strategies for the future management of remnant vegetation. The strategies were to be robust under all three scenarios. The following are the individual group responses.

Group A strategies:

- achieve bipartisan support from political parties, different tiers of government, producers/ community movement etc. to allocate resources for the long term;
- create a comprehensive and consistent information base—to support inventory and monitoring;
- better define property rights and duty of care;
- develop mechanisms to inform markets of the full environmental costs of economic activity, including quantifying intangible and intrinsic values of factors such as biodiversity;
- audit and quantify public investment, make conditions of cost sharing more transparent;
- integrate remnant vegetation management into landscape analysis; and
- ensure that information is used in decision-making (eg. extension).

Group B strategies:

- make land cover change (BRS 1:100,000) information accessible (inventory of extent, type, condition, change) for all institutions;
- strategies are needed to ensure that, in considering permits for development processes, there are proper procedures for vegetation management built-in (eg. retention is first priority, choice of seed material etc.);
- use private funds for development of new products but develop partnerships to achieve the goal of enhancing the economic value of remnants; and
- community education and communication.

Group C strategies:

Strategies were divided into institutional reform strategies and management strategies.

Institutional and policy reform strategies were associated with diversifying the support base as well as with ownership:

- who pays, determining public and private benefits;
- does philanthropy fit into the agenda?
- internalising environmental costs;
- tax reform;
- cost sharing;
- ensuring best value for investment of public funds;
- how high do incentives have to be before they are taken up?
- definition of rights and responsibilities (eg. custodial rights, absolute ownership, tradeable rights, component of stewardship); and
- long-term commitment is required, overcoming annual funding cycles, and ensuring continuity of funding and field presence of support personnel over a long period.

Management strategies included:

1. Information monitoring and indicators:
   - deliver information on extent, condition, status, type and threats,
   - add data iteratively as required, and
   - more depth to data is required at landscape level and with regard to what factors are driving the process.
2. Regional process:
   - integration of all best practice examples (eg. in structural adjustment),
   - agreed regional vision, and
   - understanding landscape processes.
3. Management output:
   - need to drive duty of care (ownership rights and obligations), and
   - need to understand invasive species and impact on remnants.

From these lists produced by the three groups, nine key elements of an appropriate strategy were agreed upon:

1. Governments to commit to an ongoing level of resource commitment to national protection of the environment including remnant vegetation.

2. Develop wide stakeholder support for remnant vegetation and revegetation. This will require diversification of the support base through institutional reforms with regard to:
   - political parties, the different tiers of government and through industry/community interactions,
   - innovative regional structures and regional management, and
   - development of ideas and structures associated with land ownership, rights and obligations.
3. Create a comprehensive and consistent information system, including mapping, inventory and monitoring of the remnant vegetation resource.
4. Define property rights and duty of care, and ensure there are proper procedures for vegetation management in development of controls and regulations.
5. Identify full environmental costs of economic activity.
6. Integrate remnant vegetation management into landscape design and management.
7. Integrate best practice into regional-based planning and management.
8. Acknowledge the threat of invasive species in all components of the program but recognise that it is only one, albeit important, of a group of threatening processes.
9. Recognise that strengthening extension and information transfer, including communication, is an overarching strategy across all other strategies.

R&D priorities

A similar small-group exercise was used to identify future R&D priorities. The responses from each group were as follows.

Group A priorities:

- how to work out where to put resources—priority setting for remnants and revegetation (eg. which remnants, what for, where);
- continental, dynamic mapping of native vegetation linked to land and water trends and capable of being integrated with farm economics;
- valuation tools to support trading (eg. carbon, water, pollution rights);
- analysis of internal and external costs of production;
- more efficient revegetation techniques, including fencing or fencing alternatives;
- commercial development of a wider range of products from a wider range of native species;
- how to manage remnants (eg. disturbance, enhancement regimes); and
- how to deliver better extension and ensure information is accessible and used by local government, landholders, leaseholders, indigenous communities, utility easements etc.

Group B priorities:

- basic ecological research to provide knowledge and tools for further applied research and new ways of seeing the 'problem';
- map the condition of remnant vegetation (eg. heath forests, woodlands, grasslands) throughout Australia;
- establish landscape design principles for sustainability (research into minimum size, extent, location, shape, connectivity) required to maintain ecosystem function and viability depending on state of the landscape;
- examine the socioeconomic aspects of implementing improved landscape design, taking into account incentives etc.;
- manage to maintain the condition of existing remnants (including regeneration);
- improve technologies for management of livestock movement (eg. containment, watering, riparian zones);
- enhance the economic value of remnants by developing non-damaging extraction methods (eg. timber extraction, pharmaceuticals, plant production, grazing strategies, wildlife harvesting);
- assess carbon credits associated with 'new' vegetation; and
- develop information transfer and educational processes for land managers (focus on behaviour change, adoption, information delivery).

Group C priorities:

- appropriate institutional reform (range of research areas associated with institutional reform as defined in strategies for Group C);
- alternate uses for remnants (eg. pharmaceutical);
- adaptive species—salt tolerance;
- how to internalise environmental costs and who should do it;

- techniques for monitoring and evaluation (eg. remote sensing, field);
- indicators of sustainability in terms of management; and
- good data sets—accessing and utilising existing data, doing the mapping, delivering to users, and landscape processes.

These three lists were refined into a consolidated set of priorities, agreed to be robust under all scenarios:

1. Link continental, dynamic mapping of native vegetation to trends in land and water use and farm economics to develop inventories and indicators of sustainability.
2. Enhance extension and information transfer to land managers and the community, focusing on behaviour change and adoption of appropriate new principles.
3. Enhance the economic and commercial value of remnants by developing new products, alternative uses of existing products, and non-damaging extraction methods (eg. timber extraction, plant production, grazing strategies, wildlife harvesting).
4. Develop new technologies for remnant vegetation management and revegetation, including disturbance regimes, enhancement, containment, management of livestock movement etc.
5. Examine landscape design principles and processes for sustainability including research into minimum size, extent, location, shape, connectivity and so on required to maintain ecosystem function and viability.
6. Analyse internal and external costs of production.
7. Examine institutional arrangements including a number of socioeconomic and management areas such as
   – cost sharing,
   – resource allocation,
   – priority setting,
   – auditing strategies and funds allocation,
   – linkages with carbon credit investigations outside the EA/LWRRDC program, and
   – integration of landscape design and vegetation management issues with restructuring policies at a regional level.

Implementation

There was only a short period of time available for workshop participants to consider key implementation issues. The individual reports on the key implementation aspects varied with the three groups as each group used a different approach. One group identified broad areas for implementation and a second group prioritised the research priorities they had already developed. The key elements identified by each group were:

Group A—implementation:

1. Establish widely agreed principles of duty of care.
2. Develop an adequate information base for monitoring and evaluation of programs and actions relating to remnant vegetation.
3. Commit public investment in support of new native woody plant products.
4. Develop and strengthen an appropriate extension framework.
5. Promote ecological constraints on market forces (eg. consider land-use change is in the direction of ecological sustainability).
6. Define precisely the criteria and priorities for investment in remnant vegetation.
7. Conduct a more detailed assessment of the external costs of land use.
8. Conduct regional case studies of effective integration of resource management through trade-off and structural readjustment.

Group B—implementation (areas of research priorities identified earlier):

1. Landscape design principles for sustainability.
2. Socioeconomic aspects of implementing improved landscape design.
3. Managing to maintain the condition of existing remnants.
4. Research into information transfer and educational processes for land managers.

Group C—implementation (broad actions required):

1. Treat the environment as a cross-sectoral issue and ensure that the environment is treated as a mainstream consideration. Entrench sustainability principles and the need for their recognition into all decision-making.
2. The thrust towards bilateral agreements between the Commonwealth and the States and Territories should be foreshadowed by a template of these agreements (eg. agree on standards and performance measures). Also, establish a statutory framework for consideration of rights/obligations/duty of care.

3. Review the appropriate level of funding for environmental protection and instigate measures for long-term funding.
4. Make a commitment to information generation in many areas including the definition of 'regional outcomes' as part of any regionalisation process, and particularly for structural adjustment. Information would also include specific R&D needs on adding value to vegetation.
5. Need for reform to incorporate environmental costs into decision-making.

These three lists were condensed into an overall set of implementation activities. This list is as follows.

1. Treat the environment as a cross-sectoral issue and ensure that the environment is treated as a mainstream consideration. Entrench sustainability principles and the need for their recognition into all decision-making.
2. Establish widely agreed principles of duty of care, which may include a statutory framework.
3. Review the appropriate level of funding for environmental protection and make a commitment to long-term funding.
4. The thrust towards bilateral agreements between the Commonwealth and the States and Territories should be foreshadowed by a template of these agreements (eg. agree on standards and performance measures). Also, establish a statutory framework for consideration of rights/obligations/duty of care.
5. Make a commitment to information generation in many areas including the definition of 'regional outcomes' as part of any regionalisation process, and particularly for structural adjustment. Information would also include specific R&D needs on adding value to vegetation.
6. Develop an adequate information base for monitoring and evaluation of programs and actions relating to remnant vegetation.
7. Conduct regional case studies of effective integration of resource management through trade-off and structural readjustment.
8. Commit public investment in support of new native plant products.
9. Develop and strengthen an appropriate extension framework.
10. Define precisely the criteria and priorities for investment in remnant vegetation.
11. Conduct a more detailed assessment of the external costs of land-use and incorporate environmental costs into decision-making.
12. Promote ecological constraints on market forces eg. land-use change to achieve ecological sustainability.

Evaluation

Methods

The method used to evaluate both the process involved and the outcomes of the foresighting exercise consisted of a pre-workshop and a post-workshop questionnaire. A copy of the pre-workshop questionnaire is provided in Appendix E and of the post-workshop questionnaire in Appendix I. Participants filled in the pre-workshop questionnaire before the Introductory Workshop and the post-workshop questionnaire at the completion of the Principal Workshop.

One series of questions concerning strategies, constraints and R&D priorities was asked in both questionnaires to assess any change in the views of participants before and after the workshops. The second questionnaire focused also on questions relating to the process as well as eliciting opinions of the usefulness of outcomes from the foresighting exercise.

Results of evaluation exercises

Pre-workshop views

The views elicited here related to key strategies, constraints to implementing these strategies and R&D priorities.

Strategies

Respondents' views on the most important strategies were classified into a number of categories as shown in Table 1. Government policy was viewed as by far the most important general strategy focus. However, with regard to specific strategies, responses were highly dispersed; even the most popular strategy

attracted only 12 votes out of a possible 76. The most highly ranked strategies were:

1. Develop appropriate incentives; and

2. Improve and enforce regulations and legislation.

Constraints

There was a much higher level of consensus on constraints (Table 2). The most important constraints were identified as:

1. Government and institutional structures (51%);
2. Lack of knowledge/information (12%);
3. Economics and finance (10%); and
4. Community perceptions (10%).

R&D Priorities

With regard to R&D priorities (Table 3), a weighted ranking of first, second and third priorities produced the following consolidated ranking of priorities:

1. Management of remnants (21% of possible total score);
2. Changing landholder and manager behaviour (19%);
3. Establishing the economic value of native vegetation (16%);
4. Revegetation and rehabilitation costs (11%); and
5. Resource assessment and monitoring (10%).

Table 1. Most important strategies as nominated by 24 respondents before the Introductory Workshop.

Strategy	First	Second	Third	Total
Government policy				
– development of incentives	7	2	3	12
– regulation and legislation	6	3	2	11
– development of stewardship and ethics	2	1	1	4
– information systems and frameworks	1	1	2	4
– other specific policies	2	6	1	9
Subtotal for government policy	18	13	9	40
Develop better management methods for remnants and threatening processes including extension strengthening	1	3	4	8
Institutional changes	2	1	4	7
Improve revegetation processes	2	3	2	7
Education	1	3	2	6
Provision of technical information and knowledge	2	1	3	6
Promote benefits of remnants	0	1	1	2
Total	26	25	25	76

Table 2. Most important constraints as nominated by respondents before the Introductory Workshop.

Constraint	Number of times mentioned	Percentage times mentioned
Government and institutional structures	35	51
Lack of knowledge/information	8	12
Economics and finance	7	10
Community perceptions	7	10
Landholders actions/perceptions	5	7
Extension/communication/integrated delivery	3	4
Other	2	3
Total	67	97

Post-workshop views

The opinions of the respondents offered via the questionnaire after the second workshop was completed were extremely positive. All participants described the outcomes as very useful, or of some use. Almost 95% described the scenario planning-based foresight as interesting, or stimulating consideration of the future in a more 'free-thinking' manner; there was also strong accord that the process had "introduced future possibilities in a realistic manner".

All respondents agreed that the exercise would influence future policy and R&D priorities with respect to remnant vegetation, however there was considerable variation about how the influence would be manifest. Influence mechanisms mentioned included the following.

- Will help to focus key R&D issues including human systems.
- Highlighted areas needed to be addressed whatever the future.
- EA/LWRRDC are committed to using the process for guidance.
- Is dependent on opportunity to modify existing NHT agenda and political commitment.
- Will feed into program policy review by government.
- Will feed into bigger programs and make a positive contribution.
- Will be factored into decision-making process by direction of R&D, principally through the EA/LWRRDC funding programs.
- Will give directions to recommendations made to EA/LWRRDC by CSVM.
- Is dependent on political process and bipartisan and bilateral commitment.
- EA/LWRRDC have specific agendas in this area which require strong direction.
- Will guide the direction of R&D and policy.
- By EA and LWRRDC adopting recommendations arising out of the foresighting exercise.
- Expect it should have most impact on R&D priorities and possibly some impact on strategies.
- Is dependent to a large extent on what the clients (EA and LWRRDC) do with the outcomes generated and what CSVM does in its advisory role.
- Will input into consideration of a second phase of the EA/LWRRDC program.
- Participants will hopefully take new ideas away with them.

A clear 80% of the participants considered that the exercise would have some significant influence through leading them to perform their work activities differently. Understandably, only one saw it as having a major impact in this direct way. The changes in activities likely to be made included:

- focus on a more targeted network and reassess R&D directions;
- make more strategic submissions for consideration based on a range of possible outcomes;
- keen to run a similar exercise for my own group;
- reinforced my interest in regional institutional reform;
- keep pressing for broader structural reform;

Table 3. Most important research and development priorities as nominated by respondents before the Introductory Workshop.

Priority area	First priority	Second priority	Third priority	Total
Management of remnants	5	5	3	13
Changing behaviour	5	3	4	12
Value of native vegetation	4	4	2	10
Revegetation and rehabilitation techniques and costs	2	3	3	8
Resource assessment and monitoring	2	3	2	7
Understanding of ecological processes	1	3	1	5
Institutional change	3	0	2	5
Other	0	1	3	4
Assessment, control/eradication of exotic species	0	0	3	3
Integration of knowledge and extension	1	0	1	2
Total	23	22	24	69

- focus more on institutional and delivery issues;
- better perspective on difficulties/complexity of nationwide position;
- more confident in presentation of visions to others;
- more free-thinking and breadth in my research group's work;
- think about vegetation as one component of landscape in the future, rather than as a critical driver;
- changed thinking on reactions to property rights proposals;
- view policy advice in 'real world' scenarios, and more technically aware of constraints;
- will be used as reference in future in CSVM deliberations;
- may implement some different communication exercises with land managers;
- will try to implement policies, strategies and programs that are as robust as possible across a range of future political, economic and social scenarios;
- help formulate thinking on policy and R&D into remnant vegetation; and
- better long-term view of outcomes, better perspective on priorities and greater emphasis on training for staff and access to information.

All respondents saw some value in the participants reconvening at a future date, but there was considerable variation in when that date should be: more than 25% within a year, 20% in two years, and 20% in five years. The predominant view appeared to support reconvening to review progress at a future time when a need was perceived.

Changes in views

A before-and-after comparison of views concerning strategies, constraints and priorities was carried out for the 16 participants who had attended both workshops. This was effected by comparing the pre-workshop and post-workshop answers for each individual. The results are provided in Tables 4, 5 and 6.

Table 4 shows that the perceived importance of government policy fell after the workshop. Part of this was offset by an increase in the importance of strategies directed at institutional change that included regional and landscape planning. Further, within the government policy areas, there was a noticeable shift from regulation and legislation to the use of mixed incentives and, in particular, cost sharing.

There was a significant increase in the importance ascribed to the promotion of the benefits of remnants, admittedly on the basis of small numbers. In addition, there was an increased focus on information and knowledge generation, including (in several cases) ascertaining specific costs of externalities so that cost sharing could occur more effectively. There was a fall in the importance ascribed to revegetation issues.

Table 5 shows the most important constraints perceived by respondents had not changed significantly after the exercise, except that government policies and institutional structures, as well as a lack of vision and leadership, had both increased slightly in importance, as had extension and integrated delivery of information.

The most significant changes in R&D priorities (Table 6) were the lesser priority given to:

- remnant management;
- revegetation and rehabilitation techniques;
- changing behaviour of landholders; and
- incentives.

Table 4. Changes in the most important strategies as nominated by 16 respondents following the Principal Workshop.

Strategy area	Number of times mentioned pre-workshop	Number of times mentioned post-workshop
Government policy	21	15
Education	4	3
Information and knowledge generation	4	7
Institutional change	4	9
Management of remnants and threatening processes	8	8
Revegetation issues	6	2
Promotion of benefits of remnants	2	8
Total	49	52

The areas where priority had increased were associated with:

- regional and catchment landscape design and management; and
- resource allocation and targeting, and the cost of externalities and cost-sharing arrangements.

Table 5. Changes in the most important constraints as nominated by respondents following the Principal Workshop.

Constraints	Number of times mentioned pre-workshop	Number of times mentioned post-workshop
Government policies and institutional structures	8	11
Lack of vision/leadership/commitment	6	8
Availability of financial resources	11	9
Landholders' actions/perceptions	4	3
Community perceptions	4	2
Lack of knowledge/information	6	5
Extension/communication and integrated delivery	2	4
Other	1	2
Total	42	44

Table 6. Changes in the most important research and development priorities as nominated by respondents following the Principal Workshop.

Research and development priority	Frequency pre-workshop	Frequency post-workshop
Resource assessment and monitoring	5	5
Understanding of ecological processes	3	2
Management of remnants	8	4
Changing behaviour	5	2
Value of native vegetation	3	5
Assessment, control/eradication of exotic species	1	0
Revegetation and rehabilitation techniques and costs	6	3
Institutional change	1	1
Integration of knowledge and extension	2	4
Incentives	3	0
Regional/catchment landscape design and management	2	11
Resource allocation/priorities/cost of externalities/ cost sharing	1	6
Other	3	1
Total	43	44

Process Outcomes

One of the objectives for conducting the foresighting exercise was to examine its potential usefulness as a framework for making management, policy and investment decisions about remnant vegetation. The following points summarise the key process-related outcomes of the approach.

1. The scenario planning approach was seen to be effective in generating new possibilities for the future.
2. The outcomes were seen as influencing future policy and R&D priorities for remnant vegetation in a variety of ways. These varied from using the process for guidance through to influencing priorities and feeding into program policy review.
3. The majority of individuals considered the exercise would have some significant impact in leading them to work differently.
4. The importance of 'ownership' in the development and application of scenarios was emphasised by the extent of the transformation of the scenarios by each group.
5. There was resistance to the initial CIE-based scenarios, and they were only accepted as valid after extensive reworking. Returning to the scenarios at a second workshop and testing them against drivers and uncertainties provided a strong demonstration, and reinforcement, of the robustness of the scenarios that had been developed by the participants.
6. The two-workshop structure proved particularly effective, and was also a relatively efficient means of engaging a wide range of stakeholders in serious consideration of future strategies and priorities. The first workshop provided an introduction to scenario planning and built familiarity and comfort with the process. After an eight week gestation, the participants returned to the scenarios with ease and energy, and were able to use the scenarios to construct reverse histories, and consider appropriate strategies and priorities.
7. A level of difficulty was found in developing strategies. While the necessary considerations and supportive material were recognised and available, translation into strategies proved somewhat difficult. In some cases there was uncertainty about what constituted a strategy. It was apparent that an additional structured process is necessary to move from the scenarios and the reverse histories to strategies.
8. There was also some difficulty in addressing the issue of implementation. It may have been that the level of detail required for consideration of implementation was not appropriate to a scenario workshop. In addition, this was included in the final sessions of the Principal Workshop, and the participants were exhibiting understandable 'workshop fatigue'.
9. The Issues Paper was found to be valuable in providing a common framework and relevant data about various aspects affecting remnant vegetation.
10. The development of a second 'Information Set', which provided analysis and data relevant to the key aspects of potential strategies raised in the first workshop was particularly effective in providing an authoritative basis for consideration of a range of complex issues in the Principal Workshop.
11. One important feature of scenario-based foresight is drawing on the insights and experience of a wide range of stakeholders. While there was considerable breadth of representation among the participants, the results, and the level of ownership, may have been improved by a wider participant cross-section, particularly of private landholders.

Appendix A

Important Aspects of Foresighting

Understanding foresight

> If we do not explore the consequences of our choices, our freedom to choose is an illusion. Exploring consequences requires logic and analysis, and the rigour to follow through the implications of current or perceived future behaviour. There is a large range of forces which play a role in determining our possible futures: the forces of nature, social, political, and economic dynamics, scientific discovery, the development and application of technology, and the fundamental capacity of our resource base. However, with our enormous capacity to alter natural systems, human choice increasingly shapes the future we actually spawn. Futures methods, such as scenarios, systematically explore, create and test possible futures in this context.
>
> P. Schwartz, *The Art of the Long View*. Doubleday, New York 1991.

Perhaps the most common use of these ideas is to identify what you don't know, but need to know, to make intelligent and informed decisions. The scenarios outlined in this report have been developed for exactly this purpose. They are simply aids to help us make better decisions today through the construction of plausible images of the future. This exploratory forecasting has been carried out in a quantitative/qualitative combinatorial manner which takes best advantage of available information and expert knowledge to develop three plausible futures. It must be emphasised that the 'word pictures' presented here are only the first step in a complex, multi-stage process of scenario development. An ongoing development and analysis of these broad themes must take place with stakeholders to fully define important implications and key relationships.

Foresighting is not designed to deliver one 'best bet' picture, rather it delivers a range of possible future outcomes. Foresighting gives explicit recognition to the uncertainty of the future. It is seen as an ongoing process, where the pictures of the future will change over time, partly in response to changes that may be due to the foresighting outcomes, and partly due to the inherent dynamic and chaotic nature of the future which brings new information.

Both the process and the outcome—the pictures of the future—are the products of the foresighting process.

- The process of developing and achieving ownership of the outcome develops flexibility in thinking that can translate into greater creativity. It also improves understanding between different divisions of a firm or between workers working on different sections of a broader project, or between different sectors of industry or government.
- The outcome of the process is a number of descriptions of the future. These provide information that can be used for planning production, investment, training and R&D. The focus might be commercial—maximising the expected return, looking for the best pay-off based on some weighted sum, or it might be on public policy—how to best meet the needs that are most likely to arise.

Overview of scenario planning

> Scenarios are not about predicting the future; rather they are about perceiving the future in the present.
>
> P. Schwartz, *The Art of the Long View*. Doubleday, New York 1991.

That foresight is not an exercise in forecasting cannot be over-emphasised. Rather, it is a mechanism for envisaging possible futures, and for managing in the face of the unavoidable uncertainty.

On the basis of the Australian Science and Technology Council (ASTEC), and other foresight studies, the following generalisations have emerged:

What are scenarios?

- Scenarios are coherent pictures of alternative futures;
- scenarios are not predictions or forecasts of the future, nor are they science fiction stories;
- scenarios are stories about the future which comprise a number of plots which bind together the elements of the scenario;
- plots within a scenario are based on the key variables and critical uncertainties in the organisation's external environment; and
- in good scenarios, plot lines intercept.

Scenarios address:

- issues, trends and events in the current environment that are of concern to the organisation's decision-makers;

- elements in the environment that are determinable and somewhat predictable—pre-determined events or variables; and
- elements in the environment that are more uncertain—trend breakers that affect a system in unpredictable ways, but with understandable dynamics—turning points in the business, political or social environment, identifiable in the present, though often as early, weak signals of change.

Tests of a good scenario:

- it is plausible to a critical mass of managers and/or stakeholders;
- it is internally consistent;
- it is relevant to the topic or issue of interest;
- it is recognisable from signals of the present—weak signals of change;
- it is challenging, containing some elements of surprise or novelty in directions where the organisation's vision needs to be stretched;
- it is linked to existing organisational mental maps; and
- it should not be novel in every respect.

The box on the next page provides a general description of the characteristics and use of scenario analysis, written by one of the pioneers of the technique with the Royal Dutch/Shell group of companies.

Stages of scenario analysis

Stage One—Identify the **focal issue**, **objectives** of the exercise, **timeframe** and appropriate **participants**.

The selection of participants is a crucial component of the process, as it is their collective knowledge, experience, and willingness to consider alternative futures which provides the major resource for scenario analysis. It is important to include a sprinkling of 'outsiders', whether by employment, expertise or interest, to provide a breadth of perspective.

Stage Two—Environmental analysis.

This stage is designed to engage participants to identify the many possible issues and factors that might have some influence on the topic, to develop a shared knowledge of available data relevant to the topic, and of issues and trends in the current environment which might be relevant.

The key to this stage is education for the team. The subsequent scenario development is shaped by what is in the team's heads, not the material available on paper. The choice of assumptions is strongly shaped by this stage.

Stage Three—Identify and characterise key predictable variables.

On the basis of the discussion in the previous stage, the task is one of developing a substantial list of the sorts of factors (or variables) which, within the time frame, are likely to have a significant impact on the topic and which are, at least in principle, predictable.

The sort of question that might be asked is "What are the crucial factors in 2010 I need to know about in order to be able to formulate an effective strategy *now*?"

Some general categories, identified in the ASTEC study, were:

- demography—population and its characteristics;
- resources—food, water, energy, materials, human;
- environment—sustainability, pressures, disasters;
- governance and geo-political trends—globalisation, regionalisation, national sovereignty, role and structure of governments;
- economics—regional economies, debt and savings, living standards, finance and trade;
- industry and employment—rise of service industries, multi-national, multi-domestic and global operations, information and communication technology in business, changing form and location of work; and
- social trends in inflation, employment, crime and security, tolerance, multi-culturalism, gender equity, education, and health care.

There are two particular challenges:

- to free participants from their preconceptions and to cast their focus far enough beyond their current concerns; and
- to focus on the **external** environment rather than factors inside the organisation, and its future.

Stage Four—Identify critical uncertainties.

What are the critical uncertainties, representing possible discontinuities, or step changes, which could have a major impact on the topic? One approach is cast forward to 2010, and imagine what might be the '*if only I had known that*' factors.

This can be effectively approached by a combination of wide environmental analysis (what political, technological, social, economy, environmental etc. changes might be important; what if...?) and fast brainstorming.

Using scenarios to navigate the future

By Peter Schwartz

Today's organisations face tremendous structural change and uncertainty: globalisation, multiculturalism, internal diversity, technological revolution, and decisions with huge consequences and risks. Anticipating the future in this volatile environment calls for more than systematic analysis; it also demands creativity, insight and intuition. Scenarios—stories about possible futures—combine these elements into a foundation for robust strategies. The test of a good scenario is not whether it portrays the future accurately but whether it enables an organisation to learn and adapt.

A scenario is a tool for ordering one's perceptions about alternative future environments in which today's decisions might be played out. In practice, scenarios resemble a set of stories, written or spoken, built carefully around constructed plots. Stories are an old way of organising knowledge; when used as planning tools, they defy denial by encouraging—in fact, requiring—the willing suspension of disbelief. Stories can express multiple perspectives on complex events; scenarios give meaning to these events.

Scenarios are powerful planning tools precisely because the future is unpredictable. Unlike traditional forecasting or market research, scenarios present alternative images instead of extrapolating current trends from the present. Scenarios also embrace qualitative perspectives and the potential for sharp discontinuities that econometric models exclude. Consequently, creating scenarios requires decision-makers to question their broadest assumptions about the way the world works so they can foresee decisions that might be missed or denied. Within the organisation, scenarios provide a common vocabulary and an effective basis for communicating complex—sometimes paradoxical—conditions and options.

Despite its story-like qualities, scenario planning follows systematic and recognisable phases. The process is highly interactive, intense, and imaginative. It begins by isolating the decision to be made, rigorously challenging the mental maps that shape one's perceptions and hunting and gathering information, often from unorthodox sources. The next steps are more analytical: identifying the driving forces (social, economic, political, and technological); the pre-determined elements (ie. what is inevitable, like many demographic factors that are already in the pipeline); and the critical uncertainties (ie. what is unpredictable or a matter of choice, such as public opinion). These factors are then prioritised according to importance and uncertainty.

These exercises culminate in two or three carefully constructed scenario 'plots'. If the scenarios are to function as learning tools, the lessons they teach must be based on issues critical to the success of the focal decision. Moreover, only a few scenarios can be fully developed and remembered; each should represent a plausible alternative future, not a best case, worst case and 'most likely' continuum. Once the scenarios have been fleshed out and woven into a narrative, the team identifies their implications and the leading indicators to be monitored on an ongoing basis.

Good scenarios are plausible and surprising; they have the power to break old stereotypes; and their creators assume ownership and put them to work. Using scenarios is rehearsing the future; by recognising the warning signs and the drama that is unfolding one can avoid surprises, adapt and act effectively. Decisions which have been pre-tested against a range of what fate may offer are more likely to stand the test of time, produce robust and resilient strategies, and create distinct competitive advantage. Ultimately, the end result of scenario planning is not a more accurate picture of tomorrow but better decisions about the future.

Stage Five—Clustering of variables.

A large number of variables are simply unmanageable in scenario analysis. The next stage is to reduce this large number to a more manageable set through clustering those variables which describe different aspects of the same core factor.

Examine the lists of determinable and uncertain variables, and group them together whenever they have a common focus. This will require the development of a suitable label for a cluster of variables.

Stage Six—Ranking of variables to establish key driving forces.

The first part of this stage is to rank the predictable variables according to their relative importance. The second, and more difficult, challenge is to rank the critical uncertainties according to the degree of importance for the outcome of the topic and the degree of uncertainty surrounding these factors and trends.

It is important to note that in scenario analysis, it is the degree of uncertainty rather than the degree of likelihood that is crucial. Highly certain factors should be included in the predictable list. It is the small set of high impact, high uncertainty factors around which the alternative scenarios can be formulated.

On the basis of those considerations a set of key driving forces can be established.

Stage Seven—Selection of scenario logics.

In this highly creative stage the objective is to develop a set of scenario logics that will assist in determining the number and characteristics of scenarios to be developed.

One approach is to identify the key areas along which the scenarios could differ, with an emphasis on issues basic to the success of the local decision, and which offer decision-makers significantly different potential strategies. A useful device can be to consider the combination of high/low positions on each axis.

Stage Eight—Development of scenarios.

The development and fleshing out of a scenario can be effectively achieved by the following sequence of steps:

- using the key driving forces, develop strings of causally linked events *that might happen*;
- continue this process examining each key factor and trend identified in Stages Two, Three and Four, not just the driving forces;
- a useful approach is to identify events as a series of dated newspaper headlines;
- weave the process together in the form of a narrative, considering questions such as how would the world get from here to there, or what events might be necessary to make the endpoint of the scenario plausible; the aim is to produce the outline of a plot, not a full script. Do not include, at this stage, considerations for your own organisations;
- develop a short (200–300 word) description of the scenario, and some appropriate, preferably catchy, title.

Stage Nine—Assessment of scenario coherence.

Assessment of the coherence of the scenario is carried out by critical examination of its logic, identification of key events or tuning points, and linkages with the greatest weakness. The scenario should also be checked against the full set of critical variables to ensure coverage and consistency. Under each scenario, each variable should have a clear and logical outcome which is different from that in the other scenarios.

Stage Ten—Assessment of the implications of scenarios for strategic planning.

Implications are examined by returning to the focal issue. What emerge as the consequences under each scenario? What vulnerabilities have been revealed? What kind of strategies might be robust under all scenarios?

At this point, the organisation's interests and capabilities are introduced. The scenarios can be integrated with the strategic planning process by carrying out the traditional SWOT analysis for the organisation in the topic area against each scenario. This analysis, together with one of potential competitor positioning, may be used to generate a series of options.

Appendix B
List of Participants at the Introductory Workshop

Exploring the Future R&D Requirements for Managing Australia's Natural Resources
Remnant Native Vegetation

Workshop 1—Introductory Workshop

Monday 13 July 1998 and Tuesday 14 July 1998
at Wynyard Vista Motel,
7–9 York St, Sydney

Name		Organisation
Bartle	John	Department of Conservation and Land Management, Western Australia
Blackwell	Peter	Environment Australia
Bonyhady	Tim	The Australian National University
Campbell	Andrew	Environment Australia
Chudleigh	Peter	Consultant/Facilitator—Agtrans Research
Dunbabin	Tom	Council for Sustainable Vegetation Management
Gilfedder	Louise	Tasmanian Parks and Wildlife Service
Goldney	David	Charles Sturt University
Hooy	Theo	Environment Australia
Johnston	Ron	Consultant/Facilitator—Australian Centre for Innovation and International Competitiveness Ltd (ACIIC), University of Sydney
Mattiske	Libby	Council for Sustainable Vegetation Management
McColl	Jim	McColl Associates
McGown	Gus	Council for Sustainable Vegetation Management
McIntyre	Sue	Council for Sustainable Vegetation Management
McNamara	Keiran	Department of Conservation and Land Management, Western Australia
Monteith	Nigel	Council for Sustainable Vegetation Management
Pittock	Jamie	Council for Sustainable Vegetation Management
Price	Phil	Council for Sustainable Vegetation Management
Rae	Jeff	ACIL Economics
Sattler	Paul	Council for Sustainable Vegetation Management
Saunders	Denis	Consultant/Facilitator—CSIRO Wildlife and Ecology
Teese	Alison	Council for Sustainable Vegetation Management
Tracy	Kathy	Environment Australia
Trevethan	Paul	Council for Sustainable Vegetation Management
Vanclay	Frank	Charles Sturt University
Williams	Jann	Coordinator, EA/LWRRDC Remnant Vegetation R&D Program, c/- LWRRDC
Young	Mike	Council for Sustainable Vegetation Management

Appendix C
Issues Paper: Management of Australia's Remnant Vegetation

What is remnant vegetation?

Remnant vegetation is native vegetation occurring within fragmented landscapes. Remnants are generally small to medium-sized patches of vegetation surrounded by highly modified land that is usually dedicated to agricultural purposes. Remnants are most often patches of native bush—trees and shrubs—but also include other fragmented native ecosystems such as grasslands and wetlands.

What regions are characterised by remnant vegetation?

Clearing and modification of the original cover of vegetation lead to the creation of remnants. As clearing has been most extensive in the temperate regions of south-east and south-west Australia, the vegetation of these regions is largely fragmented and now consists of remnants. Clearing for sugar cane in tropical eastern Queensland has resulted in native vegetation becoming confined to remnants. In more recent years clearing has accelerated in sub-tropical eastern Queensland in order to allow pastoral activity, thereby fragmenting drier tropical ecosystems. Remnant vegetation exists in urban areas, but constitutes a small proportion of the total.

In short, the native ecosystems most suitable for agriculture are those characterised today by remnant vegetation. They can broadly be described as follows:

- temperate woodlands of south-east and south-west Australia;
- mallee shrublands of south-east and south-west Australia;
- temperate grasslands of south-east Australia;
- heathlands of south-east Australia and the kwongan of south-west Australia;
- brigalow shrubland of south-east Queensland;
- wet sclerophyll forest and tropical rainforest of north-east Queensland; and
- sub-tropical woodlands of eastern Queensland.

In what regions is native vegetation most confined to remnants?

The 'State of the Environment Report 1996' provided information about the degree of clearing in those Interim Biogeographic Regions containing the ecosystems mentioned above. If we assume that proportion of a Biogeographic Region cleared is a rough inverse measure of the proportion of vegetation now confined to remnants, then the following list (from 'Australia State of the Environment 1996', CSIRO Publishing, Melbourne, 1996, p. 4–25) can be used as a summary:

- Avon Wheatbelt (88% cleared)
- Geraldton Sandplains (52%)
- Mallee (44%)
- Esperance Plains (43%)
- Eyre and Yorke Blocks (76%)
- Lofty Block (81%)
- Naracoorte Coastal Plain (78%)
- Victorian Midlands (78%)
- Victorian Volcanic Plain (78%)
- Riverina (72%)
- Darling Riverine Plains (51%)
- New South Wales South-West Slopes (80%)
- Nandewar (74%)
- New England Tablelands (74%)
- South-East Queensland (60%)
- Brigalow Belt South (64%)
- Brigalow Belt North (60%)

Clearing continues today, particularly in Queensland and New South Wales as shown by the following mean annual rates between 1991 and 1995:

- Queensland 262,000 ha
- New South Wales 150,000 ha
- Victoria 1,828 ha
- Tasmania 4,000 ha
- Western Australia 8,000 ha
- South Australia (a trace)
- Northern Territory (a trace)

These data are from: 'National Greenhouse Gas Inventory 1995 with Methodology Supplement', National Greenhouse Gas Inventory Committee, Environment Australia, Canberra, 1997; modified for Queensland according to 'The Statewide Landcover and Trees Study Interim Report October 1997', Queensland Department of Natural Resources, Brisbane, 1997.

Unfortunately, for most regions information is lacking on the precise amounts and distributions of remnant vegetation, and on the vegetation communities comprising these remnants. Prominent examples of the communities most reduced in area and now most confined to remnants are:

- white box woodlands of New South Wales;
- box–ironbark woodlands of Victoria;
- lowland native grasslands of Victoria, New South Wales and Tasmania; and
- york gum, wandoo and salmon gum woodlands of Western Australia.

Most remnant vegetation exists in a matrix of cropping and grazing lands on private tenure, as this is where agricultural development has been focused.

Does remnant vegetation vary in character across the country?

Remnants are comparatively discrete and readily definable in the Avon Wheatbelt, the Eyre and Yorke Blocks, the Lofty Block, the Naracoorte Coastal Plain, the Victorian Midlands, the Victorian Volcanic Plain, the Riverina, and the Brigalow Belt. In contrast, remnants do not necessarily possess abrupt boundaries and so tend to grade into the surrounding agricultural matrix in the New South Wales South Western Slopes, Nandewar, and the New England Tablelands. This latter case is described as comprising a 'variegated landscape' rather than a landscape with remnant vegetation; nevertheless, the issues at stake are identical. The ultimate remnant is the individual tree isolated from other elements of native flora. In this situation, we are faced with vast areas of these 'living dead', ie. aging trees with no replacements.

What threats confront remnant vegetation?

Concern has arisen about remnant vegetation because the species that they contain and the ecosystems that they represent (ie. biodiversity) are at serious risk of further decline. The forces likely to bring about further decline can be grouped as follows.

1. *Habitat loss and fragmentation*. Habitat destruction is the most serious threat to biodiversity and the primary cause of extinctions in Australia. Extinctions occur firstly because of the direct effect of clearing, when the only habitats occupied by particular organisms are removed. As clearing for agriculture is focused on especially fertile parts of the landscape, it is not surprising that certain species that through evolutionary time have come to depend on such places can be made extinct rapidly. Extinctions also occur indirectly due to what is euphemistically known as 'relaxation', a phenomenon occurring as individual species find the area of habitat available to them insufficient for survival through tough times, such as drought or fire, and so gradually disappear from the remnants. The isolation stemming from fragmentation means that subsequently there is limited probability of the species recolonising from elsewhere, and so extinction gradually spreads. It is suspected that the process of relaxation may take decades, even centuries. Removal of native vegetation also results in changes to the pattern of wind flow across the landscape, such that species with less resistance that established themselves when the vegetative cover was continuous are exposed to wind-throw and wind-pruning. Further, clearing results in changes in radiation fluxes, with increases in solar radiation leading to higher temperatures during the day. There are also increases in re-radiation at night resulting in lower night temperatures. As a result of all these combined effects of habitat destruction and relaxation through fragmentation, remnants in the woodlands and grasslands have lost many species and many more are decreasing in abundance. For example, about 50% of birds in the woodlands of south-west Australia appear to be in decline.

2. *Grazing*. Stock grazing constitutes the main land use, along with cropping, in agricultural Australia. The levels of grazing by marsupials that were experienced by the vegetation in pre-European times were considerably lighter than those now being imposed. Commercial grazing by stock results in comparatively higher rates of defoliation of grasses, forbs and shrubs and a greater degree of trampling. The ground surface becomes more exposed, litter becomes scarcer, soil loss is increased, nutrient levels alter, and soil compaction can occur. Consequently, grazed remnants frequently experience loss of the understorey and shrub layers, arrested regeneration of trees, reduced water

percolation, and overall loss of structural and floristic diversity. These effects on plant life are mirrored among native animals. Those species dependent upon particular plants that decline under grazing, or upon structural complexity, or upon litter layers, may decrease to the point of disappearance from a remnant.

3. *Pests and weeds*. Weeds establish readily because remnants are exposed to the surrounding agricultural matrix; invasion by weeds is exacerbated by the changes brought about by grazing. The most significant influences flowing from grazing that enhance invasion are physical disturbance, disruption of the original canopy, and increased nutrient levels. Weeds of Mediterranean origin are, as a result, widespread in remnants. Further, rabbits are widespread in remnants, and they exacerbate the disturbance of grazing. Foxes too are abundant; they do not affect the processes operating in the remnants as do rabbits and weeds, but they may have dramatic effects on native vertebrate animals.

4. *Altered fire regimes*. Fire has been a major influence on most Australian vegetation through Aboriginal times. This is particularly true of the ecosystems originally containing substantial grassy elements that were preferentially cleared for agriculture, the fragments of which constitute much remnant vegetation today. The reduction in burning in most remnants since the surrounds were cleared has sometimes resulted in a form of senescence, as dominant trees and shrubs die and no fire-induced germination occurs. In addition, in some vegetation types the composition of the tree cover changes dramatically as fire-sensitive species are able to achieve dominance. Thus, continued absence of fire is likely to reduce diversity within small remnant areas.

5. *Firewood harvesting*. Remnant vegetation is the major source of timber for domestic firewood. Annual domestic consumption is estimated to be about six million tonnes, greater in volume than the five million tonnes of woodchips exported annually from Australian forests. The harvesting of firewood appears to be far more substantial in eastern than in Western Australia. Firewood is removed principally from box and box–ironbark woodlands. Its continued removal almost certainly has long-term detrimental effects on biodiversity by simplifying the structure of remnants. The removal of live and dead trees reduces species diversity and variation in tree sizes and ages, and so will reduce the capacity of the remnant to support certain types of organisms. For example, the red ironbark, a prime firewood source, provides a crucial food source for the endangered regent honeyeater in New South Wales.

6. *Chemical drift*. Farm chemicals, especially fertiliser, can drift via the wind into small remnants. These influences may compound those effects described above.

7. *Dieback*. In some places, remnant vegetation suffers from eucalypt dieback. On the southern New England Tablelands, for example, as much as a third of woodland is degenerating. The causes are manifold, but dieback appears to arise ultimately from changes in the nutrient status of soils in remnants and around isolated trees. Nitrogen and phosphorus increase because stock camp around trees, or because fertilisers are applied to crops and pastures; subsequently, insect herbivores find the leaves of the trees more palatable and defoliate them persistently. The introduced root-rot fungus *Phytophthora* is also a major cause of dieback, especially in Western Australia and Tasmania.

8. *Salinisation*. The clearing of native vegetation that led to the creation of a fragmented or variegated landscape has also resulted in an increasing problem of land degradation. In most agricultural areas annual pastures or crops have replaced the original native vegetation. In general, the plants of these systems grow principally during spring and summer, and so use groundwater only at those times, and in amounts lower than used by native vegetation. Consequently, the groundwater levels inexorably rise, to the point that watertables under agricultural land may be 7–8 m higher than under natural vegetation. The water that rises to the surface is frequently saline, and so soils are increasingly at risk of salinisation. Estimates of the areas at risk from this phenomenon are shown in Table A1. As a result, remnant vegetation is increasingly at risk of being affected by rising soil salinity. In Western Australia, Richard George (unpublished, via Denis Saunders, Consultant/Facilitator—CSIRO Wildlife and Ecology) has estimated that more than 80% of remnant woodlands on private land and up to 50% in the conservation estate are at risk because of rising salinity. South Australia, Victoria and New South Wales are likely to follow this trend. Risk of salinisation of the soil within remnants is highest where they are positioned such that groundwater drains downslope beneath them. However, even where remnants exist at the highest point of the landscape, watertables may still rise to dangerous levels. Rather than water

moving away, it may flow into the hydrological 'shadow' produced by the higher water use of the native vegetation within the remnant, thereby potentially reaching the root zone of the trees and shrubs. Overall, therefore, remnant vegetation may be threatened by one of the degradative processes set in train by its own creation.

Table A1. Areas affected and potentially at risk of salinisation.

State	Area salt-affected in 1996 (ha)	Potential area at equilibrium (ha)
Western Australia	1,804,000	6,109,000
South Australia	402,000	600,000
Victoria	120,000	Unknown
New South Wales	120,000	5,000,000
Tasmania	20,000	Unknown
Queensland	10,000	74,000
Northern Territory	Minor	Unknown
Total	2,476,000	>11,783,000

Source: 'Salinity: A Situation Statement for Western Australia', Agriculture Western Australia, Department of Conservation and Land Management, Department of Environmental Protection, and Water and Rivers Commission, Perth, 1996.

Why should we be concerned about the problems confronting remnant vegetation?

Two reasons are apparent for attempting to address the problems facing remnant vegetation.

1. *Land degradation*. To a considerable extent, the decline in remnant vegetation is an indicator that all is not well with the landscape. The agricultural matrix is at risk from a variety of types of degradation, and the problems of remnant vegetation at their root indicate the need for better landscape management.

2. *Loss of biodiversity*. Species are being lost from the agricultural landscape in which remnants exist at a rate probably greater than that in any other part of Australia. Achievement of our national strategies for reducing the rate of biodiversity loss therefore rest upon our ability to redress the problems faced by remnant vegetation. Biodiversity is important because it supplies vital ecosystem services; for example, maintenance of the hydrological system depends on the presence of a variety of deep-rooted plants. Further, biodiversity has the potential to provide us with alternative food, fuel, natural medicines and other natural products.

What can be done?

As Ken Wallace of Western Australia's Department of Conservation and Land Management has put it, we have the following choices:

- take no positive action and so allow remnants to continue declining;
- act to ensure that current threats do not get worse;
- act to slow the decline in biodiversity;
- act to conserve specific elements of biodiversity;
- act to conserve all remaining biodiversity;
- act to reconstruct the biota, as well as conserving all remaining biodiversity.

It is vital at the outset to think about these potential goals, as the choices of any particular activity must be closely related to the outcome that any individual or organisation has in mind. If any option other than the first is selected, then each threat listed previously needs to be considered. The options for better management of remnant vegetation, therefore, may be summarised as follows:

- limit further clearing;
- limit grazing;
- reduce impacts of weeds;
- reduce impacts of animal pests;
- improve fire management;
- improve management of firewood harvesting;
- improve management of farm chemicals and fertilisers;
- alter land management to limit spread of salinity; and
- revegetate to buffer small remnants, reconnect remnants and reduce salinity risk.

It is difficult to estimate reliably the relative importance of the threats listed above. Nevertheless, S.R. Morton (unpublished manuscript) has attempted to calculate the proportions of pre-European biodiversity at risk of extinction from four major threatening processes in the agricultural zone, with the following results:

- clearing and fragmentation—32% of species at risk;
- grazing—14% of species at risk;
- pests and weeds—5% of species at risk; and
- altered fire regimes—1% of species at risk.

Even if such calculations are reliable only to the nearest 10%, they demonstrate that clearing and

fragmentation together constitute the greatest threat to biodiversity.

Immediately, one can see that better management of remnant vegetation involves a complex set of issues relating to the agricultural matrix. Any management that ignores the surrounding agricultural land is doomed to failure, on both biophysical and social grounds. It is widely recognised that integrated approaches to landscape management, in which both production and conservation issues are considered, are necessary to reduce the threats to remnant vegetation. Inevitably, therefore, analysis of options for remnant vegetation must consider socioeconomic issues, which may be summarised as follows:

- economic realities favouring traditional grazing and cropping production rather than the low-impact, diversified enterprises that might reduce land degradation;
- the cost–benefit relationship between production enterprises and remnant vegetation;
- attitudes held by landowners to the value and management of remnant vegetation;
- the notion that landowners' rights and responsibilities should be built around a general 'duty of care' for the environment;
- incentives to enhance conservation management of remnants by landowners;
- complex relationships between private and public benefit and responsibility in management of remnant vegetation; and
- complex relationships among governmental institutions responsible for advising on various aspects of landscape management.

Arising from such considerations is also an increasing emphasis on revegetation, which has been widely recommended in recent years as at least a partial solution to the problems of hydrological imbalance, salinisation, declining productivity, and biodiversity loss. There is probably a significant potential contribution to be made to solution of these problems through farm forestry, planting for oil or biomass fuel purposes, and conservation plantings, if economically viable means can be found to encourage such revegetation.

What does the future hold?

Analysis of future scenarios should benefit from consideration of the issues raised herein.

Appendix D
Scenarios for the Introductory Workshop

Scenario 1: Economic growth

Australian agriculture under the economic growth scenario

In the year 2025 corporate agriculture has long since retracted from the more marginal arable soil types, land affected by dryland salinity and salinised irrigated areas. These areas are now owned by a second tier agriculture, of semi-subsistence farming families who are employed part-time in other industries. Some of the marginal areas are able to swing back into production under contract farming when global market models and climate forecasting models indicate years of higher demand. Production is of lower quality, but suitable for feed grains and for human consumption in poorer countries. Corporate conglomerates have moved mainstream production areas to virgin soil types as genetically engineered crops and other technologies have broadened production options.

The complete move to corporate agriculture has provided a flood of small business opportunities, as all crop management, harvesting, value-adding and product sale is outsourced. Farmers whose enterprises were marginalised by soil quality problems and poor financial returns have found many options for employment, and are able to retain their land but control a very minimal production base. As full globalisation of world markets became reality, these part-time farmers found many niches for small production runs of highly specialised food and fibre products.

One unforeseen impact of the rapid demise of government agencies is that Australia lacks a strong quarantine capability, as well as lacking the ability to implement protocols which deal with the introduction of new plants and genetically engineered organisms. Corporate agriculture has responded by bulking up its production areas, excluding small parcels of land and enforcing strict boundary control. Property rights allow this, and new plant and animal lines are always ahead of any disease scare anyway. Marginal farm areas suffer many disease problems and plant invasions, which in turn increase their marginality.

The demand for high quality land from the arable and horticulture industries has inevitably claimed the best soil types. Since most land and national parks are under private ownership, the presence of remnant vegetation or threatened species has had little effect on this outcome. If the land is available at a price, then it can be bought. Private conservation foundations are particularly effective in purchasing and retaining parcels of land that are near to, and attractive to, the predominantly urban populace. Most farming zones are profit driven and the obvious link of local production, local jobs and per capita affluence are usually enough to roll over any local resistance to further development. Rangelands vegetation is generally improving with destocking under a carbon credits scheme, except in areas where water is hard to control and feral animals are in abundance.

Australian corporate agriculture has finally become efficient in world terms, and productivity indices are always within 80% of what is technically feasible.

The effect of implementation of the economic growth scenario has not been without its social costs. The family farm has been replaced by the agricultural conglomerate in most productive parts of Australia. Thus the family farm ethos has disappeared and been replaced by industrial food production, the character of which is indistinguishable from any other OECD country. In fact, globalisation ensures that a consumer is never quite sure of where a product is sourced, only that it meets the quality and price parameters embedded in its brand name. The lower tier of Australian land use is seldom seen, but sometimes noticed when a back road takes the driver through the marginalised and degraded lands that are economically beyond repair, and thus left to subsist at continuing environmental and social costs.

All land is held as private tenure except large parts of central and northern Australia which are either Aboriginal land or defence training areas. The right to treat land, biodiversity and water resources as one's private fiefdom [that is, all natural resources are under total control of the landowner] has been upheld in the courts many times. Productive zones are well managed by the linked interests of corporations who control access to water rights and the commodity sectors which use that water. The problems of marginal lands or damaged lands are ignored, except if they impact on key sectoral interests such as water quality or production. This impact is dealt with by acquisition, retirement and, if necessary, engineering solutions which seal off the problem rather than fix it.

National parks in the main have been privatised, and are now run as business ventures which attract their clientele on the basis of their environmental resource and quality. The market determines what is attractive, rather than any pseudo-scientific ideals of original biodiversity, preservation of existing biodiversity, threatened species and so on. Rights to clean air, clean water, access to semi-natural landscapes and so on are dealt with primarily by the market mechanism.

Much of the lower quality grazing land is now used for carbon offset arrangements, a good source of cash flow to large pastoral companies who retained their extensive land holdings from the late 1990s. Land cover is increasing on these large holdings, and original environmental problems such as woody weed encroachment are now seen as a plus in the world of carbon offsets. Many of the smaller pastoral holdings which were economically marginal in the 1990s were purchased en masse by carbon offset brokers on the world market. Feral animals are controlled primarily by management of waters but uncontrolled river frontages in many areas continue to maintain many environmental sores. Periodic harvesting of multiple protein sources (rabbits, goats, cattle, horses, kangaroos etc.) does produce cash flow, but the rangelands are seen as a 'wild' resource which looks after itself. The environmental quality of rangelands and marginal pastoral lands is thus internalised, with no national or corporate responsibility taken.

In areas of high agricultural productivity, remnant vegetation has largely disappeared; where corporate agriculture dominates the landscape (eg. the tropical coastal areas), remnants have long since been cleared and the land brought into the production system. In the marginal agricultural lands, there are some semi-subsistence farmers who for reasons of personal interest have maintained and built upon remnant vegetation (eg. in the wheat belt), but these are in a minority because of the absence of any external support for such activities. Furthermore, salinisation has developed apace throughout the wheat lands of south-east and south-west Australia, and many remnants have disappeared through poisoning. The private conservation foundations have purchased some land to provide nostalgic experiences for older urban dwellers, and learning experiences for the young, or as part of the major privatised national parks, but the high cost of productive land has forced most of these foundations to concentrate on marginal lands. As a result of these forces, the representation of the continent's original biodiversity in remnant vegetation is highly biased towards the least productive landscapes.

Scenario 2: Conservative development[1]

Australian agriculture under a conservative development scenario

Under the conservative development scenario, the institutional framework recognises the effectiveness and right of government to intervene strongly to achieve social and environmental goals. It recognises unemployment as the major cause of socioeconomic inequality. It focuses on achieving a high rate of economic growth but only to the extent that this does not detract from achieving major improvements in environmental quality and social equity.

The main principles of a conservative development strategy are:

- to establish, for individuals and organisations, a system of behaviour rewards and punishments (eg. incentives and regulations) that promotes improved environmental quality; and
- to establish employment-creation programs centred on increasing tax revenues and using these to finance jobs directed towards environmental protection enhancement.

This is a scenario in which agricultural industry is free to produce what it chooses, where it chooses, subject to viability and feasibility considerations under:

- future market-generated cost/price/technology regimes;
- a range of direct regulations proscribing nominated products, technologies and locations region-by-region;
- changes in cost/price/technology regimes created by government programs, eg. levies, subsidies, property rights markets, research; and
- self-imposed constraints on production, eg. ethical considerations.

Policies in 2025 include:

- a moratorium on further clearing of native vegetation;
- selective re-establishment of trees in areas where this would have maximum effect on the spread of dryland salinisation and waterlogging;
- purchase of cropping rights in marginal areas;
- imposition of erosion-retarding cropping practices;
- transferable water rights;
- a network of evaporation basins;

1. Note that the title of scenario 2 – 'conservative development' was changed to 'planned development' after the Introductory Workshop, based on feedback from participants.

- water to be sold at full cost including amortisation of headworks;
- no new cities and carefully controlled expansion of existing regional centres;
- detailed environmental impact assessment of all proposed new industrial projects;
- projects involving irreversible devaluation of natural capital to be offset by projects to conserve other natural resources under significant threat; and
- a major land allocation exercise covering conservation, recreation, tourism, timber plantations, industrial infrastructure etc.

However, agricultural output under a conservative development agricultural strategy has remained high for the following reasons.

- Government-funded agricultural research has increased substantially under a conservative development agricultural strategy. This in turn has increased the rate of technical progress, the basic source of productivity increases, at a higher level than otherwise.
- Product quality is higher leading to increased unit prices for agricultural exports, thus tending to offset lower quantities of exports.
- Land prices in higher rainfall, more heavily settled areas are lower because of the lower population pressure to drive land prices up in peri-urban regions. Lower land prices imply higher profits and greater output. Production in Australia's high-rainfall zones has been increased to meet export targets in beef, dairy products, sugar, fruit and vegetables.
- Land degradation leading to declining productivity and output in some regions has been halted, and in some cases reversed.

The state of remnant vegetation has been substantially improved through government programs to halt further clearing, to limit grazing, to eradicate weeds, to control firewood harvesting and through legislation to improve management of farm chemicals. A significant number of native trees have been planted on farms but are mainly located on specific discharge and recharge areas to combat dryland salinity and for production of speciality timbers and eucalyptus oil. Much of this replanting has been conducted so as to build buffers around remnants of native vegetation, reducing the rate of salinisation in productive lands and slowing the pace of extinctions among native plants and animals. However, decline in biodiversity in remnants within the most productive and heavily cleared agricultural lands (eg. the coastal tropics and the well-watered cropping and grazing lands) continues to be high, because there is insufficient remaining vegetation to prevent ongoing extinctions. In addition, the effects of salinisation continue to develop as the necessary replanting was not instituted in time to prevent large slugs of saline groundwater from beginning to move.

Scenario 3: Post-materialism

Australian agriculture in an ecologically sophisticated economy

Post-materialism implies a highly decentralised society with a strong commitment to ecological integrity and social learning as means of developing and maintaining improved quality of life. Reduction of inequality and sociopathy (declining sense of community) feature as key social aims under this strategy.

This scenario's impact on the agricultural sector is primarily through the adoption of a set of key principles aimed towards the creation of an ecologically sustainable agricultural system. These principles are interpreted as requiring the conversion of freehold land to leasehold with binding covenants, integrated management of real biophysical units such as catchments, a variety of controls on environmental quality, community assessment of new agricultural proposals, and massive innovations in public and private interest research. New products, technologies, and attitudes, are best characterised by the word 'diversity'.

Local government is based on about 20 'bio-regions' across Australia. State governments have a minimal role. Each region has a degree of self-sufficiency, within explicit regional population targets. Some bio-regions are largely in Aboriginal ownership. The federal government retains strong control over international affairs including defence and trade. Domestically, it sets frameworks and minimum standards within which regions are free to develop autonomously. Encouragement of substantial decentralisation has been a national budget priority. Internationally, Australia actively defends its protective stewardship of a fragile land acknowledged to be a major part of the world's heritage.

This has produced a 'land hungry' scenario in which the per capita demand for land is high, because each person is placing a large but light footprint on the landscape. Patterns include: wind farms and solar farms, timber plantations, land devoted to producing renewable substitutes for non-renewable mineral and energy resources, native forests committed to light selective logging, widespread ownership of hobby farms and rural retreats, dedicated (single use) water catchments, more parks, reserves and wilderness areas, more low-intensity agriculture, more urban

forests and garden cities, and more 'half acre' urban residential blocks supporting low-energy houses, productive gardens and solar, water collecting and sewage composting technologies.

The post-materialist agricultural landscape is essentially different from anything we have contemplated over the past 200 years. Revegetation of up to half the area of all farms reduces salinity and acidity problems and erosion, provides shelter for native and farm animals, is a source of valuable timber crops, stabilises nutrient flows, maintains water quality, and is seen as just as valuable as other forms of agriculture. Farm level planning continues the bio-regional approach adopted by the state and local communities, using soil type and landscape boundaries, 'keyline' principles, and integrated, diverse production systems.

Healthy, functioning and evolving ecosystems are seen as valuable for their own sake. They are also widely understood to be essential for the maintenance of production systems. Management is focused on the long view, using techniques such as new forms of no tillage farming to actively improve soil condition. Other new features of farming include the dramatic improvement in the knowledge base about our land and vegetation, and transfer of all sorts of technologies (social, industrial and agricultural) to regions, local communities and individuals.

Major changes have occurred to the nature of food and fibre production systems under this scenario. Animal rearing has become much more diverse, and includes the farming of native animals such as kangaroo, emu and wombat. Emphasis is placed on quality and value-added production, rather than on volume. Feral pests are a problem of the past because of biological control. Massive increases in native plant production have occurred, with significant production of bush foods entering domestic and export niche markets. Pharmaceutical crops have emerged as significant niche export income earners. Seasonal production and consumption patterns are re-adopted.

Annual crops are now only seen as part of complex, mixed production systems. Pest control by combinations of polycultures and biological control methods has succeeded widespread use of chemicals, although new generations of 'natural' treatments are available. Perennial tree and pasture crops have begun to be seen as not only valuable for soil, salinity and water management, but also as a way of increasing profits through lowering fuel use. Broadacre grain farming has retreated from all marginal areas, notably closing much of the Western Australian wheat industry. Land thus left vacant is actively returned to grazing or native vegetation, some of which is producing eucalyptus oil.

In northern Australia, settlements are widely scattered and self-sufficient, but thoroughly integrated into the production systems of southern Australia. Grazing is restricted to small, highly productive and managed locations with intensive use of tropical legumes, perhaps only 10% of the area of a farm, with the remainder set aside for native drought pasture and other crops. This in turn has reduced pressure on biodiversity over large areas.

The Murray–Darling Basin was the first area which adopted post-materialist agriculture, driven by declining social conditions as well as agricultural yields. Its proximity to Australia's major markets assisted the transition. Sheep and wheat still occupy up to half the area previously farmed, but only provide 20% of farm income due to reduced stocking pressure and longer crop rotation cycles. Other income from a diverse range of animals and crops, value adding at local and regional levels, and a constant search for higher quality and small, discriminating new markets have made this region highly profitable again. Population is increasing in rural towns, farm sizes are smaller, and lifestyles and income streams diverse.

Dramatic improvements in biodiversity quality have been achieved, through effective retreat of grazing and cropping practices from large areas. Active rehabilitation of specific habitats was also undertaken under government and community-sponsored schemes. Water quality remains a problem because of inheritance of historical problems, but is being dealt with by research, revegetation, lower extraction and use, pricing, and massive environmental quality programs.

The extent of native vegetation has been dramatically increased. Bio-regional plans have identified the extent and location of each vegetation formation required to achieve a comprehensive, adequate and representative network of reserves, which contain within them a secure sample of the continent's biodiversity. Through intensive rehabilitation and revegetation programs these plans have been turned into reality, and those vegetation types that had been heavily cleared have increased in area to at least 25% of their original distribution. In addition, the widespread use of native plants in the production system has resulted in increases in the number of native animals able to persist in the agricultural landscape. Only in certain localised parts of the Western Australian wheat belt and the Murray–Darling Basin has it proved impossible to prevent the movement of saline groundwaters set in train by earlier over-clearing, and that remnant vegetation damaged by the resulting salinisation has been offset by nearby replantings.

Appendix E

Pre-workshop Questionnaire

Exploring the Future R&D Requirements for Managing Australia's Natural Resources
Remnant Native Vegetation—Workshop 1—Evaluation Questionnaire

Name (optional):

Please take a couple of minutes to complete this short questionnaire prior to the workshop in Sydney. Please hand your completed questionnaire to Peter Chudleigh at the dinner on the Monday night. It will assist the facilitators and will be useful to establish a baseline position for later assessment.

A. What do you think will be the three most important management strategies (in order of importance) that could be implemented to promote the re-establishment, rehabilitation and future health of remnant vegetation?

Strategy 1:

Strategy 2:

Strategy 3:

B. What do you consider to be the most constraining factor affecting the implementation of each of these three strategies?

Factor constraining Strategy 1:

Factor constraining Strategy 2:

Factor constraining Strategy 3:

C. What do you consider are the three most important R&D topics (in order of importance) to be supported in pursuing the objective of preserving and enhancing remnant vegetation?

Topic 1:

Topic 2:

Topic 3:

Appendix F
Scenarios for the Principal Workshop

Scenario 1: Economic growth

Australian agriculture under the economic growth scenario

Corporate agriculture has long since retracted from the more marginal arable soil types, land affected by dryland salinity, and salinised irrigated areas. These areas are owned by a second tier agriculture, of semi-subsistence farming families who are employed part-time in other industries. The marginal areas are able to swing back into production under contract farming when global market models indicate years of higher demand. Production is of lower quality, but suitable for feed grains and for human consumption in poorer countries.

The complete move to corporate agriculture has provided a flood of small business opportunities, as all crop management, harvesting, value adding and product sale is outsourced. Farmers whose enterprises were marginalised by soil quality problems and poor financial returns have found many options for employment, and are able to retain their land but control only a very minimal production base. As full globalisation of world markets became reality, these part-time farmers found many niches for small production runs of highly specialised food and fibre products.

One impact of the rapid demise of government agencies is that Australia has reduced its quarantine capability. Corporate agriculture has responded by bulking up its production areas, excluding small parcels of land and enforcing strict boundary control. Marginal farm areas suffer many disease problems and plant invasions, which in turn increase their marginality.

The demand for high quality land in the arable and horticulture industries has inevitably claimed the best soil types. Since most land is under private ownership, the presence of remnant vegetation or threatened species has had little effect on this outcome. If the land is available at a price, then it can be bought. Private conservation foundations have invested in purchasing and retaining parcels of land that are accessible and attractive to the predominantly urban populace. Most farming zones are profit driven and the obvious link of local production, local jobs and per capita affluence are usually enough to roll over any local resistance to further development.

Rangelands vegetation is generally improving with destocking under a carbon credits scheme, except in areas where water is hard to control and feral animals are out of control.

The effect of implementation of the economic growth scenario is not been without its social costs. The family farm has been replaced by the agricultural conglomerate in most productive parts of Australia. Thus the family farm ethos has disappeared and been replaced by industrial food production, the character of which is indistinguishable from any other OECD country. In fact, globalisation ensures that a consumer is never quite sure of where a product is sourced, only that it meets the quality and price parameters embedded in its brand name. The lower tier of Australian land use is seldom seen, but sometimes noticed when a back road takes the driver through the marginalised and degraded lands that are economically beyond repair, and thus left to subsist at continuing environmental and social costs.

All land is held as private tenure except large parts of northern Australia which are either Aboriginal land or defence training areas. Productive zones are well managed by the linked interests of corporations who control access to water rights and the commodity sectors which use that water. The problems of marginal lands or damaged lands are ignored, except if they impact on key sectoral interests such as water quality or production. This impact is dealt with by acquisition, retirement and (if necessary) engineering solutions which seal off the problem rather than fix it.

National parks in the main are privately managed, and are now run as business ventures which attract their clientele on the basis of their environmental resource and quality. The market determines what is attractive, rather than claims of original biodiversity or threatened species. Rights to clean air, clean water, and access to semi-natural landscapes are dealt with primarily by the market mechanism.

Much of the lower quality grazing land is now used for carbon offset arrangements, a good source of cash flow to large pastoral companies who retained their extensive land holdings from the late 1990s. Land cover is increasing on these large holdings, and original environmental problems such as woody weed encroachment are now seen as a plus in the world of carbon offsets. Many of the smaller pastoral holdings which were economically marginal in the 1990s were

purchased en masse by carbon offset brokers on the world market.

Feral animals are controlled primarily by management of waters but uncontrolled river frontages in many areas continue to maintain many environmental sores. Periodic harvesting of multiple protein sources (rabbits, goats, cattle, horses, kangaroos etc.) does produce cash flow, but the rangelands are seen as a 'wild' resource which looks after itself. The environmental quality of rangelands and marginal pastoral lands is thus internalised, with no national or corporate responsibility taken.

In areas of high agricultural productivity, remnant vegetation has largely disappeared. In the marginal agricultural lands there are a small number of semi-subsistence farmers who have maintained and expanded remnant vegetation, largely for personal interests.

Salinisation has developed apace throughout the wheatlands of south-east and south-west Australia, and many remnants have disappeared through poisoning. Private conservation foundations are seeking to purchase specialised niches to be made available as a nostalgic (for the old) and learning (for the young) experience for urban dwellers. The high cost of productive land has forced these foundations to concentrate on marginal lands. As a result of all these developments, the representation of the continent's original biodiversity in remnant vegetation is highly biased towards the least productive landscapes.

Scenario 2: Planned development[2]

Australian agriculture under a planned development scenario

Under the planned development scenario, the institutional framework recognises the effectiveness and right of society to intervene strongly to achieve social and environmental goals. It recognises unemployment as the major cause of socioeconomic inequality. It focuses on achieving a high rate of economic growth but only to the extent that this does not detract from achieving major improvements in environmental quality and social equity.

The main components of the planned development strategy are:

- a focus on careful long-term planning with quantified outcome-oriented targets;
- government as a facilitator, formalising objectives with the community;
- establishment of a system of incentives and regulations (for individuals and organisations) that promotes improved environmental quality, backed up by independent audits;
- a strong focus on understanding ecosystem function and social processes with attention to equity;
- establishment of employment-creation programs centred on increasing tax revenues and using these to finance jobs directed towards environmental protection and enhancement; and
- a high degree of access to information for all parties.

Agricultural industry operates under a comprehensive, but supportive, regulatory regime which addresses:

- future market-generated cost/price/technology trade-offs and opportunities;
- a range of outcome-focused prescriptions of nominated products, technologies and required practices, defined on a region-by-region basis;
- changes in cost/price/technology regimes, with cost-sharing arrangements created by government programs, eg. levies, subsidies, property rights markets and research; and
- self-imposed constraints on production, eg. ethical considerations.

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2. Note that the CIE title of scenario 2 – 'conservative development' was changed to 'planned development' after the Introductory Workshop, based on feedback from participants.

Policies in 2025 include:

- all regulations periodically reviewed and seriously enforced;
- defined codes of practice backed by legislation;
- a moratorium on further broadacre clearing of native vegetation, and a requirement of no net loss;
- selective re-establishment of trees in areas where this would have maximum effect on the spread of dryland salinisation and waterlogging;
- purchase of cropping rights in marginal areas;
- imposition of erosion-retarding cropping practices;
- transferable rights in carbon, water, clearing, wildlife use etc;
- a network of evaporation basins;
- water sold at full cost including amortisation of headworks;
- no new cities and carefully controlled expansion of existing regional centres;
- property rights regimes that allow separation of ownership of trees, water, access etc. from land;
- strong industry-wide environmental standards;
- skills-based licenses for agriculture practice, renewed every five years, and requiring (among other things) an approved farm plan;
- environmental targets set, and delivered, at community level;
- two-sided contracts where government is required to deliver on contracts with resource users (and vice versa), based on performance audits;
- detailed environmental impact assessment of all proposed new resource-using activities;
- projects involving irreversible devaluation of natural capital to be offset by projects to conserve other natural resources under significant threat; and
- a major land allocation exercise covering conservation, recreation, tourism, timber plantations, industrial infrastructure etc.

However, natural resource output under a planned development agricultural strategy has remained high because:

- Government funded research has increased substantially under a planned development strategy. This in turn has increased the rate of technical progress, the basic source of productivity increases, at a higher level than otherwise.
- Product quality is segmented, leading to higher unit prices for some products targetted at agricultural exports into niche markets, thus tending to offset lower quantities of exports.
- Real environmental costs are reflected in product price.
- Land degradation leading to declining productivity and output in some regions has been halted, and in some cases reversed.

The state of remnant vegetation has been substantially improved through planned programs to halt further clearing, to limit total grazing pressure, to eradicate weeds, to control firewood harvesting and to improve management of farm chemicals.

A significant number of areas have been revegetated to produce 'synthetic' bushland; these are mainly located on discharge and recharge areas to combat dryland salinity and for production of specialty timbers and eucalyptus oil. In association with a vigorous program to eradicate feral animals, native wildlife has been introduced to large areas to supply a booming market demand.

Much revegetation has been conducted to build buffers around remnants of native vegetation, reducing the rate of salinisation in productive lands, and slowing the pace of extinctions among native plants and animals. The pace of revegetation has been considerable, as a result of government-supported programs and a significant reduction in cost as a result of technological advances.

However, the decline in biodiversity in remnants within the most productive agricultural lands continues to be high, because there is insufficient remaining vegetation to prevent ongoing extinctions. In addition, the effects of salinisation continue to develop as replanting was not instituted in time to prevent large slugs of groundwater from beginning to move.

Scenario 3: Post-materialism

Australian agriculture in an ecologically sophisticated economy

The events associated with the Asian economies meltdown at the turn of the century, the subsequent collapse of the Japanese banking system, and the rise of ultra-nationalist political parties and governments across the region, produced crisis conditions in Australia sufficient to catalyse major structural change. Leading up to the proclamation of the Republic of Australia in 2010, there was an extensive community-driven re-writing of the Constitution. Among the major changes were the almost complete transfer of powers from State governments to twenty 'bio-region'-based, local governments, the incorporation of the value of biodiversity, and the need for all so-called 'external' costs to be internalised.

Each region has a degree of self-sufficiency, within explicit regional population targets. Some bio-regions are largely under Aboriginal control. The national government retained its powers in international affairs including defence and trade. Domestically, it sets frameworks and minimum standards within which regions are free to develop autonomously. Encouragement of substantial decentralisation has been a national budget priority. Internationally, Australia actively defends its protective stewardship of a fragile land acknowledged to be a major part of the world's heritage.

The impact on the agricultural sector flowed from the adoption of a set of principles aimed towards the creation of ecological sustainability. The key mechanism was the community and industry acceptance of a planning and stewardship ethic in return for government provided incentives and compensation (through a special levy). This saw a substantial conversion of freehold land to leasehold with binding covenants, integrated management of real biophysical units such as catchments, a variety of controls on environmental quality, community assessment of new agricultural proposals, and major innovations in public and private interest research.

This has produced a situation in which the per capita demand for land is high, because each person is placing a large but light footprint on the landscape. Patterns include: wind farms and solar farms, timber plantations, land devoted to producing renewable substitutes for non-renewable mineral and energy resources, native forests committed to light selective logging, widespread ownership of hobby farms and rural retreats, dedicated (single use) water catchments, more parks, reserves and wilderness areas, more low-intensity agriculture, more urban forests and garden cities, and more 'half acre' urban residential blocks supporting low-energy houses, productive gardens and solar, water collecting and sewage composting technologies.

Commercial agriculture continues, and indeed thrives, within a regime of sustainability, minimum impact, and high-value production. Exports carry the prized 'eco-label' which guarantees consumers that production has not caused any loss of biodiversity. Annual crops are now substantially replaced by perennial polycultures on an arrayed basis. Pest control by combinations of polycultures and biological control methods has replaced widespread use of chemicals, although new generations of 'natural' treatments are available. Perennial tree and pasture crops have begun to be seen as not only valuable for soil, salinity, and water management, but also as a way of increasing profits through lowering fuel use. Broadacre grain farming has retreated from all marginal areas, notably closing much of the Western Australian wheat industry. Land thus left vacant is actively returned to native vegetation or grazing.

Revegetation of up to half the area of all farms reduces salinity and acidity problems and erosion, provides shelter for native and farm animals, is a source of valuable timber crops, stabilises nutrient flows, maintains water quality, and is seen as just as valuable as other forms of agriculture. Farm level planning continues the bio-regional approach adopted by the state and local communities, using soil type and landscape boundaries, 'keyline' principles, and integrated, diverse production systems.

Healthy, functioning, and evolving ecosystems are seen as valuable for their own sake. They are also widely understood to be essential for the maintenance of production systems. Management is focused on the long view, using techniques such as new forms of no tillage farming to actively improve soil condition. Other new features of farming include the dramatic improvement in the knowledge base about our land, and transfer of all sorts of technologies (social, industrial and agricultural) to regions, local communities and individuals.

Animal rearing becomes much more diverse, and includes the farming of native animals such as kangaroo, emu, and wombat. Emphasis is placed on quality and value-added production, rather than on volume. Feral pests are a problem of the past because of biological control. Massive increases in native plant production occurred, with bush foods supplying a major collection of domestic and export niche markets. Pharmaceutical crops have emerged as significant niche export income earners. Seasonal production and consumption patterns are re-adopted.

In northern Australia, settlements are widely scattered and self-sufficient, but thoroughly integrated into the production systems of southern Australia. Grazing is restricted to small, highly productive and managed locations with intensive use of tropical legumes, perhaps only 10% of the area of a farm, with the remainder set aside for native drought pasture and other crops. This in turn has reduced pressure on biodiversity over large areas.

Dramatic improvements in biodiversity quality have been achieved, through effective retreat of grazing and cropping practices from large areas. Active rehabilitation of specific habitats was also undertaken under government and community-sponsored schemes. Water quality remains a problem because of inheritance of historical problems, but is being dealt with by research, revegetation, lower extraction and use, pricing, and massive environmental quality programs.

Remnant vegetation, which is viewed as an integral component of landscape management, has been substantially increased, both through natural processes following retreat, and through intensive rehabilitation and revegetation programs. Bio-regional plans have identified the extent and location of each vegetation formation required to achieve a comprehensive and representative network of reserves, containing a secure sample of Australia's biodiversity. In addition, the widespread use of native plants has supported increases in the numbers of native animals able to survive in the agricultural landscape.

Appendix G
List of Participants at Principal Workshop

Exploring the Future R&D Requirements for Managing Australia's Natural Resources
Remnant Native Vegetation

Workshop 2—Principal Workshop

Tuesday 15 September 1998 and Wednesday 16 September 1998
at Parliament House, Canberra

Name		Organisation
Bartle	John	Department of Conservation and Land Management, Western Australia
Binning	Carl	CSIRO Wildlife and Ecology
Blackwell	Peter	Environment Australia
Campbell	Andrew	Environment Australia
Chudleigh	Peter	Consultant/Facilitator—Agtrans Research
Dunbabin	Tom	Council for Sustainable Vegetation Management
Gilfedder	Louise	Tasmanian Parks and Wildlife Service
Goldney	David	Charles Sturt University
Johnston	Ron	Consultant/Facilitator—ACIIC, University of Sydney
McGown	Gus	Council for Sustainable Vegetation Management
McIntyre	Sue	Council for Sustainable Vegetation Management
McNamara	Keiran	Department of Conservation and Land Management, WA
Monteith	Nigel	Council for Sustainable Vegetation Management
Morton	Steve	Consultant/Facilitator—CSIRO Wildlife and Ecology
Pittock	Jamie	Council for Sustainable Vegetation Management
Sattler	Paul	Council for Sustainable Vegetation Management
Teese	Alison	Council for Sustainable Vegetation Management
Tracy	Kathy	Environment Australia
Trevethan	Paul	Council for Sustainable Vegetation Management
Williams	Jann	Coordinator, EA/LWRRDC Remnant Vegetation R&D Program, c/- LWRRDC

Appendix H
Questions and Answers Relevant to Emerging Strategies

Information to assist in the development of strategies for the second workshop[3]

Prepared by S.R. Morton

CSIRO Wildlife and Ecology

1. (a) What is the status of information available to landholders on:

- **methods of protecting and enhancing remnant vegetation and the associated costs?**
- **methods of revegetation and associated costs?**

(b) What kind of new technical information would need to be generated in the future to improve the availability of existing knowledge relevant to landholder management.

(a) Information available

The amount of material accessible on methods of protecting and enhancing remnant vegetation and of methods of revegetation appears huge. It has proved quite impossible, within the time frame available, to encompass and list this range of information. The material comprises pamphlets, leaflets, booklets, guidebooks and toolkits. It seems to cover everything from local, on-farm activities to regional planning guides; information covers a massive range of activity, from the detail of such activities as direct-drill seeding through to broad-scale considerations such as regional biodiversity management. It includes the 'Resource Directories' produced by Greening Australia, which provide key directories to location of published information and to organisational contacts for further information. In order to give a flavour I list a few characteristic items in Addendum 1. As a further example, I also append a list of pamphlets providing information about vegetation conservation and management (Addendum 2)—this list was prepared by Denise Elias of Environment Australia, and was passed on to me by Lyn Wilks, National Bushcare Facilitator for Environment Australia. This listing is described by Denise Elias as "unexhaustive", and as focusing on "generic" information while ignoring the "vast amount of regional information" that is also available. It provides an indication of the extent and array of information presently accessible in just one segment of the information spectrum.

(b) New information required?

Four attributes of the vast array of information are seemingly less than adequate, however. The first is that much of the material is fairly shallow, offering advice only in a generalised and non-specific manner. As a consequence, there is frequently little guidance to a landholder concerning the relative priority that might be placed on various potential activities, or of the degree to which the recommended approaches have been tested.

The second inadequacy is in the area of 'associated costs', where advice for landholders appears to be much thinner than it is in the area of technical information about carrying out vegetation management. On the one hand, it is likely that there is much more advice available to landholders on this topic, via extension personnel, than is evident from the written material discussed herein. On the other, though, it is also apparent that analysis of the costs and benefits to the production system and to the landholder is a vital but poorly known aspect of remnant vegetation management and of revegetation. The work of Michael Lockwood's group at Charles Sturt University on costs and benefits of revegetation, which is funded by EA/LWRRDC, is addressing some of these key issues (Miles *et al*. 1998). The fifth report from this group has (literally) just come to hand: it suggests that the economic costs associated with conservation management of remnant vegetation constitute a major barrier, because a large proportion of farmers cannot expect a positive return from investment in these activities.

Thirdly, it seems likely that the range of information available to urban landholders and groups is narrower than that accessible to farming communities. If true, this situation probably stems from the fact that

3. **Disclaimer:** The information contained herein is provided only for the purposes of background to the foresighting workshop. The material has been assembled to a tight deadline, and so may well be incomplete. Further, it is reflected through the prism of just one person's experience and viewpoint. Hence, it should be used cautiously and for guidance only.

Landcare, the primary stimulus for much of the presently available information, has largely been focused on rural Australia.

The fourth inadequacy concerns the backup support required to enhance full use of the information accessible in the vast array of printed material on vegetation management. Lyn Wilks expressed to me her opinion that one major barrier to more effective vegetation management is in the field of integrative extension. Presently, our society appears to be experiencing difficulties in:

- providing encouragement to landholders to stimulate them into considering options for alternative management;
- giving knowledgeable advice to help landholders through the maze of printed information;
- placing advice on vegetation management in the context of whole-farm management; and
- continuing to provide motivation and moral support after the initial investment of time, energy and money in vegetation management in order to maximise impact.

There are unquestionably many, many extension personnel doing an admirable job in this field, and the comments above are certainly not meant to detract from their efforts. Staff members of Greening Australia stand out here; the Bushcare facilitators are clearly also an important step forward in provision of integrated management advice. Nevertheless, two features strike me as I attempt to frame an answer to part (b) of question 1.

First, the technical information that is lacking is in the area of integrated knowledge of vegetation management. The relationships among and between remnant vegetation, revegetation, hydrology, salinity mitigation, acid-soil management, water quality in streams and rivers, regional biodiversity persistence, animal and crop production, farm forestry, economics, and environmental, production and social sustainability remain poorly explored and tenuous. Until we tackle the system-wide implications of vegetation management, perhaps through catchment-scale examples, we may continue to see efforts at improved vegetation management fall short.

Secondly, it seems probable that a major impediment to better vegetation management lies in putting a human face to provision of integrated extension support. Even when we do have clear understanding of the inter-connections between those features of land management mentioned in the previous paragraph, the sheer size of the task—100,000 farmers manage most of the remnant vegetation in Australia—will continue to pose serious problems for effective action.

Acknowledgments

I benefited very greatly from the advice of Lyn Wilks; any errors of interpretation remain mine, however.

Reference

Miles, C.A., Lockwood, M., Walpole, S. and Buckley, E., 1998, 'Assessment of the on-farm economic values of remnant native vegetation', Fifth report of the project Economics of Remnant Native Vegetation Conservation on Private Property, Johnstone Centre Report No. 107, Charles Sturt University, Albury.

Addendum 1

Examples of the types of publications available to land managers on vegetation management

Greening Australia,1995, 'New South Wales Local Greening Plans Resource Directory', Greening Australia, Sydney.

Hussey, B.M.J. and Wallace, K.J., 1993, 'Managing Your Bushland', Department of Conservation and Land Management, Perth.

Lefroy, E.C., Hobbs, R.J. and Atkins, L.J., 1991, 'Revegetation Guide to the Central Wheatbelt', Bulletin 4231, Department of Agriculture, Perth.

Murphy, R.G. and Dalton, G.S., 1995, 'Understorey Establishment Research', Technical Report 249, Primary Industries South Australia, Adelaide.

Nicholson, D., 1997, 'Managing Cypress Pine on Your Property', State Forests of NSW and North-West Catchment Management Committee, Dubbo.

Roadside Conservation Committee of Victoria, 1995, 'Roadside Management Planning Background and Guidelines', Roadside Conservation Committee of Victoria, Melbourne.

Save the Bush—Central West, 1997, 'Save the Bush Toolkit', Environmental Studies Unit, Charles Sturt University, Bathurst and Orange Agricultural College, University of Sydney, Orange.

Addendum 2

Pamphlets—prepared by Denise Elias (Environment Australia)

The following table lists pamphlets or leaflets that provide information relevant to vegetation conservation and management and land degradation issues on farm land and public land (ANCA = Australian Nature Conservation Agency; ANPWS = Australian National Parks and Wildlife Service; CSIRO = Commonwealth Scientific and Industrial Research Organisation; DEST = Department of Environment, Sport and Territories; EA = Environment Australia; NPWS = National Parks and Wildlife Service; NSW = New South Wales; Qld = Queensland; SA = South Australia; Vic DNRE = Victorian Department of Natural Resources and Environment; WA CALM = Western Australia Department of Conservation and Land Management; WWF = World Wide Fund for Nature).

Category/title	Organisation	Summary/comments
Weeds		
How weeds spread—Landcare note PP084	Vic DNRE	
How to manage weeds—Landcare note PP002	Vic DNRE	
Biological control of weeds—Landcare note BC029	Vic DNRE	
Control of vines and scramblers	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Control of weeds with underground reproductive structures	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Control of woody weeds	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Pest species—weeds	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Feral animals		
Pest species—feral animals	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Wetlands/Waterways		
Victoria's wetlands of international importance	Vic DNRE; Parks Vic; EA	Includes some generic information.
Trees at work: improving your farm dam	Greening Australia; DEST	Benefits of revegetating around dams; discusses water quantity, quality, salinity, algae, soil erosion, access, zones around dams (catchment, filter, shade, shelterbelt dam wall—with planting and management suggestions), planning (with suggested steps). Includes useful diagrams.
Seed collecting		
Native seed collection and storage	WA CALM	
How to collect native tree seed easily	Greening Australia	
Plant germinating		
How to germinate native tree and shrub seed enjoyably	Greening Australia	Steps for germinating plants; when to sow, techniques for disease prevention, germination trays, sowing mix, techniques for breaking dormancy, sowing, care of seedlings, treatment of disease.
Bushland regeneration		
Natural regeneration of bush areas in WA	WA CALM	Includes some weed control.
Revegetation/farm planting		
Tree planter's guide	WA CALM	Includes some weed control.
Farm birds; nature's pest controllers	Greening Australia	Birds need trees; trees need birds; insect pest controllers—farm health; establishing woodlots (how, where, what species, shrubs); wetlands; riparian strips.
Direct seeding; a cost effective way of broadacre revegetation	Greening Australia	Steps for direct seeding. What it is, advantages, methods, site preparation (including weed control), seed collection and treatment, when and how to sow, post germination care. (Note: many grammatical and other errors—a rewrite would be good.)

Category/title	Organisation	Summary/comments
Revegetation/farm planting (cont'd)		
Guidelines for large tree growing projects	Greening Australia	Guidelines: site selection and analysis, project outline and planning, contacting relevant bodies, sponsorship, publicity, managing people and operations, project monitoring and maintenance. (Note: dated—good concepts which could be developed for facilitators/project managers, but not particularly good as is.)
One billion trees	Greening Australia	Dated, but includes information on factors contributing to tree decline, benefits of trees, and what the community can do.
Greening Australia	Greening Australia	Includes information on the need for good vegetation management, and the benefits of trees and other plants.
Grow a green web	DEST; Farmers Federation Farm Tree and Land Management Program	What a green web is: part of whole farm plan; places where farmers and urban dwellers may revegetate; benefits—urban, ecological, habitat (wildlife as pest controllers); types of plants; how to plant—things to consider, whole farm plan, neighbour cooperation; guidelines for establishing corridors—dimensions, components, sites; financial questions; an example (note: would be good to expand an example to include benefits so far to landowners).
Farm trees: the basics	Greening Australia	Detailed guide for remnant conservation and revegetation on farm land. Includes: planning (steps in planning—planning steps accord with Potter Farm project); benefits of trees; species selection; techniques (fencing, natural regeneration, direct seeding, transplanting); site preparation; maintenance; financial issues. Includes useful suggestions and inexpensive activities, and useful references. Note: 8pp., but clearly written and layed out.
National corridors of green	Greening Australia	Introduces corridors and the Greening Australia 'corridors of green' program. Text is minimal, but graphics are good—could use this style for farm and catchment planning information.
Whole farm planning		
Whole farm planning (two versions)	Potter Farmland Plan	Provides steps for developing a whole farm plan using detailed illustrations and sample plans. Includes suggestions and contacts for assistance (Victoria).
Roadside vegetation		
Roadsides…the vital link	WA CALM	
Salinity		
Halt the salt	WA CALM	Generic information, including farm forestry and biodiversity, mixed with regional information.
Dryland salinity	Department of Agriculture, SA	What dryland salinity is, how it affects us and what we can do. Very brief; good diagrams; in context of SA.
Detecting soil salinity	CSIRO Div. Water Resources—Seeking Solutions No.5	Explains electromagnetic induction and how this can assist landholders with mapping soil salinity, which can then guide tree planting.
What's what about salinity and the River Murray	SA Dept. Environment and Natural Resources	Explains what salinity is, how it affects us, how it occurs, and what can be done. Goes beyond just agricultural focus—useful for urban dwellers
Pucinellia: perennial sweet grass	Primary Industries SA	Provides case studies of agricultural use of pucinellia—useful as the first step in rehabilitating salt affected areas. Note: Several pages; regional application, but a good idea for other regions to develop.

Category/title	Organisation	Summary/comments
Salinity (cont'd)		
Dryland salinity: the catchment approach	Primary Industries SA	A series of 18 information sheets covering many aspects of salinity: causes, catchment management, salinity tests, assessments, rapid field tests, groundwater monitoring, data interpretation, recharge areas, drainage, salt tolerant plants. Note: Regional information but could apply to all salinity affected regions.
Establishing trees and shrubs on saline seeps	Primary Industries SA	Detailed bulletin (19 pp.) on strategies and techniques used to revegetate salty discharge areas. Includes: saline seep characteristics, revegetation strategies, species selection, site preparation, establishment techniques, lowering watertables, useful references.
Urban		
Planting for wildlife near Brisbane	Qld NPWS	Very short and basic—could be used for generic purposes.
Wildlife		
Wildlife on rural land	Qld NPWS	Very basic.
Small native animals; nature's farmhands	Greening Australia	Benefits of animals to vegetation and vice versa; litter & humus—value to soil, what it's made up of; consequences of plant removal; insects, ground and tree dwelling mammals, reptiles, frogs, birds—their use of trees and benefits they may provide, eg. pest control; value of riparian plants; benefits of wildlife to farmland; ways to encourage habitat, eg. fencing, planting.
Nature conservation		
Rural nature conservation	Qld NPWS	Advantages to landowners of conservation.
Threatened species and ecological communities in Australia	Environment Australia	Covers a range of ecosystems—benefits of conservation; consequences of habitat alteration; who is responsible for conservation; effects of introduced species.
Nature conservation	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Threatened species	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Grasslands		
Australian grasslands	ANCA	
Native grasslands and the Plains Wanderer	Birds Aust.; Bushcare; *et al.*	Supplement to *Wingspan*.
Identification and management of native grasslands	WWF; EA; *et al.*	Some generic information.
Remnant vegetation		
Remnant vegetation in Australia	ANCA	Biodiversity loss; remnant vegetation—what it is; types; benefits (including salinity issues and sustainable agriculture); management; actions to take.
Ecological appraisal: a guide for assessing remnant bushland	ANPWS—DEST	Explains major components of a rapid appraisal. Suggests getting assistance from appropriate experts.
What is remnant vegetation?	ANCA; NPWS Info. sheet no.1	What remnant vegetation is; why conserve it; ways to conserve including planning. Note: dated (Save the Bush)—needs updating to Bushcare.
Why we are losing our native flora and fauna	ANCA; NPWS Info. sheet no.2	Species loss; fragmentation—why species may not persist in fragments; edge effects including suggestions to increase remnant area; local plants; fencing; types of degradation, eg. weeds, salinity.
Where is the remnant vegetation in your area?	ANCA; NPWS Info. sheet no.3	Steps on mapping remnant vegetation using aerial photos; includes importance of grasslands.
How good is that patch of bush?	ANCA; NPWS Info. sheet no.4	Straightforward table listing healthy and degraded habitat features; provides advice for more detailed assessment; suggests priorities for management/restoration depending on level of degradation; includes importance of understorey.

Category/title	Organisation	Summary/comments
Remnant vegetation (cont'd)		
Protecting your remnant vegetation	ANCA; NPWS Info. sheet no.5	Protection/management methods: fencing (why?—issues to consider); weed control (issues to consider, guidelines, herbicide use and mechanical methods); revegetating (guidelines—collecting seed, planning, plant selection, site preparation, when to plant, monitoring plants); suggestions for other conservation measures on property (conservation agreements, farming practice impacts, vegetation retention, habitat and firewood, burning); further assistance.
Monitoring your remnant vegetation project	ANCA; NPWS Info. sheet no.6	Monitoring: why; techniques (photographs, guidelines for recording physical attributes and species); things to keep records of (activities, vegetation changes); further assistance.
Expanding your remnant vegetation area	ANCA; NPWS Info. sheet no.7	Guidelines for revegetation: natural regeneration; planting; direct seeding (includes fencing, monitoring, weed removal, soil disturbance, fire, species selection, planning, site assessment and preparation, propagation, fencing, species, record keeping, follow up care).
Economic benefits of native vegetation for agriculture	ANCA—Fact sheet	Discusses economic benefits of conserving remnant vegetation (including grasslands) and planting using extracts from relevant research. Provides references.
Understorey		
The understorey	Greening Australia	What understorey is; benefits to farmers (including food, shelter for livestock, habitat for pest controllers, soil nutrients and stability); management (including how to manage regeneration, weeds, fencing, planting, sowing, burning).
Community		
Guidelines to organising a farm tree group creatively	Greening Australia	Benefits of trees; farm tree group—what it is; why (local knowledge, information, equipment and responsibility sharing, support, more effectively apply for grants); how to form the group; types of people to have; getting assistance; setting goals; suggested activities for the group.
Guidelines to organising successful conferences about trees	Greening Australia	Guidelines for planning, organising, executing, evaluating and following up a conference.
Information		
Greening publications and other things	Greening Australia	Lists Greening Australia publications. May be useful to have a reference list such as this with relevant publications if people want to explore topics further.
Resources for land managers integrating native vegetation management into sustainable agriculture	ANCA	List of good, relevant references with a glossary of terms probably used in them (A4 sheet).
Children		
Protecting your patch	ANCA; CSIRO	Discusses the bush and why to bother saving it; provides guidelines for studying the bush; discusses threats. Note: appears to be aimed at children, but includes complex words and sentences. The format also does not seem appropriate for taking children stepwise through exercises. The concept is very good and a rewrite would be useful.
Conservation incentives		
Voluntary conservation agreements	NSW NPWS	(Listed in publications list—have not viewed leaflet.)
Local council		
Local greening plans	Greening Australia	Promotes a 150pp. guide on local greening plans; discusses local greening plans and local government role in nature conservation; provides examples of successful local government initiatives.

2. What incentives are currently provided by governments to landholders to protect and manage remnant and other native vegetation?

A detailed account of State and Commonwealth programs as at June 1996 can be found in 'Nature Conservation on Private Land: Commonwealth, State and Territory Legislation and Programs—A Report of the Working Group on Nature Conservation on Private Land Prepared for the Australian and New Zealand Environment and Conservation Council, Standing Committee on Conservation' (ANZECC 1996). The following precis is extracted from Binning and Young's (1997) summary, which in turn was based upon the ANZECC document.

New South Wales

- Voluntary Conservation Agreements are statutory covenants created under the *National Parks and Wildlife Act, 1974*. Limited financial support exists for costs associated with the Agreements.
- Wildlife Refuges are non-binding voluntary agreements under the *National Parks and Wildlife Act, 1974;* they may be revoked by either party at any time.
- A scheme based upon the Victorian Land for Wildlife scheme is under consideration.
- It is intended that property agreements developed under the *Native Vegetation Conservation Act* will qualify landholders for financial support from a Native Vegetation Management Fund.

Queensland

The *Nature Conservation Act, 1992* provides for establishment of statutory covenants on private land. Incentives are provided from government, and in some cases also in the form of rate relief from local councils.

Victoria

The Department of Natural Resources and Environment offers two programs:

- Land Management Cooperative Agreements, which provide covenants; and
- Land for Wildlife agreements, which are non-binding arrangements for managing land for conservation, and can be revoked at any time by either party (this scheme is widely regarded as the most successful in Australia, with over 3,500 properties registered).

In addition, the Trust for Nature is an independent body established under the *Victorian Conservation Trust Act, 1972* to promote conservation on private land. It undertakes land purchases; establishes covenants on land purchased as well as on other private land; and sells covenanted land in order to return money to a revolving fund.

South Australia

Heritage agreements are statutory covenants aimed at protecting areas of native vegetation. The cost of fencing such areas is paid for in full from a Native Vegetation Fund, and it appears that the State Government will be obliged to pay for maintenance of these fences.

Western Australia

A Remnant Vegetation Protection Scheme provides assistance to landholders to fence remnant vegetation. Funding is tied to entry to a 30-year contract deed for the protection and management of nature conservation value. Funding assistance is close to 100% of the cost of the materials. Further, the *Conservation and Land Management Act, 1984* provides for landholders to enter into covenants; this scheme is still under development.

Tasmania

Covenants are available under the *National Parks and Wildlife Act* and the *Conveyancing and Law of Property Act*, and are being actively encouraged; Forest Stewardship Agreements for the conservation of private forest land may be covenanted as part of the comprehensive regional assessment (CRA) forest process. Proposals for Private Wildlife Sanctuaries similar to those found in New South Wales, and for a Land for Wildlife scheme based on the Victorian model, are under voluntary development.

Northern Territory

Covenants may be entered into under the *Territory Parks and Wildlife Act, 1993*, and the Territory Government is actively pursuing voluntary partnership arrangements for conservation with Aboriginal groups and non-indigenous landholders.

Conclusion

Overall, there are many fine initiatives under development. Nevertheless, Australia-wide the effort does not appear focused and one gains the impression that the incentives are cumbersome to bring into operation. Further, as noted under question 1, there may be a dearth of information available about the costs inherent in entering into covenants.

Acknowledgments

This information has been directly abstracted from Carl Binning and Mike Young, 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, Environment Australia, Canberra.

3. (a) What level of public investment ($) is currently in place for protection and enhancement of remnant vegetation, and/or revegetation, by Commonwealth, State and local governments?

(b) In your opinion, will this have to be significantly increased to make a significant impact on the status of native vegetation? What are the scenarios for how this investment might be delivered in future?

(a) Public investment

Commonwealth

Current plans for Commonwealth expenditure on vegetation management were obtained from the Australian National Audit Office's Audit Report No. 36 1996–97, 'Commonwealth Natural Resource Management an Environment Programs: Australia's Land, Water and Vegetation Resources'. On page 15, the Audit Report notes anticipated expenditure through the Natural Heritage Trust, over six years beginning in the 1996/97 financial year, as follows:

- Bushcare (National Vegetation Initiative)—$328.6 million;
- National Rivercare Initiative—$97.0 million;
- Landcare—$264.0 million.

State and Territory governments

Financial data on investment in vegetation management by State and Territory governments were summarised from the Fortech Report, 'Review of Vegetation Programs 1989–1995', prepared for the Australian Nature Conservation Agency, November 1996. In section 3 of the report, available data on government investment are tabulated. The information suggested that the following annual sums had been spent on average during the period covered by the report:

State or Territory	Mean annual investment
Western Australia	$6.57 million
Northern Territory	$1.56 million
South Australia	$5.03 million
Tasmania	$1.24 million
Victoria	$8.35 million
New South Wales	$6.47 million
Australian Capital Territory	$0.56 million
Queensland	$0.92 million

It is evident from the list of government programs listed by Fortech that the summary table shown above is a rough estimate at best. Some of the Programs include activities that probably would not be considered strictly as 'vegetation management' (for example, integrated catchment management), whereas many other programs that do include elements of this goal are not included (for example, Landcare activities). Given the uncertainties surrounding these data, therefore, they should be used with extreme caution, particularly given that State expenditure has been substantially underestimated. Carl Binning, who is undertaking contract work on vegetation management incentives for EA/LWRRDC at CSIRO Wildlife and Ecology, expressed to me his belief that it will prove difficult to accumulate accurate data on State and Territory expenditure on vegetation management, given the cross-cutting nature of much environmental investment.

Local government

It seems apparent that the difficulties in estimating expenditure by State and Territory governments are magnified when we consider local government. First, the large number of local governments (there are about 770 Councils in Australia) makes the task of accumulating estimates of expenditure problematic. Secondly, the multi-faceted nature of much environmental expenditure creates difficulties in dividing that investment among several objectives, only one of which may be vegetation management. In short, it is presently impossible to estimate reliably the expenditure by local governments on vegetation management.

(b) The future

Yes, in my opinion unless there is a significant increase in public investment then remnant vegetation will continue to decline. However, before calling for increased investment it seems imperative to maximise the effectiveness of the current funding. In order to do so, several considerations need to be taken into account, and particularly the factors underlying questions 4 and 5. Hence, the most desirable patterns of investment are discussed below in relation to questions 4 and 5.

Acknowledgments

Carl Binning provided me with a copy of the Fortech Report, and explained to me the complexities involved in estimating State, Territory and local government expenditure on vegetation management.

4. (a) What legislation is currently in place for the protection and enhancement of remnant vegetation? What legislation is currently being considered?

(b) Is the current legislation sufficient if enforced? In your opinion is it the legislation itself or its enforcement that is most lacking? Are political arguments inconclusive due to lack of information or are different value systems among stakeholders, and their reconciliation, the major constraint?

(a) Legislation

A detailed account of State and Commonwealth programs as at June 1996 can be found in 'Nature Conservation on Private Land: Commonwealth, State and Territory Legislation and Programs—A Report of the Working Group on Nature Conservation on Private Land Prepared for the Australian and New Zealand Environment and Conservation Council, Standing Committee on Conservation' (ANZECC 1996). The following precis is extracted from Binning and Young's summary (1997), which in turn was based upon the ANZECC document.

New South Wales

A State Environment Planning Policy (SEPP 46) to control clearing of native vegetation was introduced in 1995. The intent of the policy was to halt clearing while permanent legislative approaches were developed with stakeholders. However, the introduction of SEPP 46 was highly controversial, and its subsequent replacement with the *Native Vegetation Conservation Act* has still not allayed the concerns held by many in the farming community. The key features of the Act are:

- all clearing must be consistent with Regional Vegetation Management Plans, to be developed by Regional Committees;
- a range of exemptions exists for clearance;
- where a proposal to clear land is inconsistent with a Regional Vegetation Management Plan, the application will be considered by the Minister for Land and Water Conservation;
- a Native Vegetation Advisory Council is established to advise the Minister on the development of policies; and
- property agreements may be developed as incentives to landholders to adopt whole-farm approaches to the management of native vegetation.

Queensland

Clearing on leasehold land is controlled, but not that on freehold land. Leaseholders are obliged, under the *Land Act, 1994* to maintain the productivity of the land; allow development; prevent degradation; maintain biodiversity; maintain environmental amenity values; and secure public safety. Local guidelines are under development in order to prohibit clearing of endangered and vulnerable ecological communities, and to limit clearing of ecological communities of concern.

Victoria

Amendments (1989) to the *Planning and Environment Act, 1987* regulate clearing on blocks greater than 0.4 ha in area. Local councils are responsible for considering applications to clear, but must refer applications for areas of more than 10 ha to the Department of Natural Resources and Environment. Issues considered are:

- protection of habitat for native plants and animals;
- maintenance of ecosystem processes and genetic diversity;
- carbon storage;
- protection of soil from salinisation and erosion;
- minimising adverse effects on groundwater;
- protection of rivers, wetlands and water resources;
- sustainable use and management of land; and
- enhancement of visual amenity and landscape quality.

South Australia

Comprehensive clearing controls apply throughout the State under the *Native Vegetation Act, 1991*. A Native Vegetation Council vets applications to clear land. In effect, clearing in South Australia is banned.

Western Australia

Under the *Soil and Land Conservation Act, 1945–1988* landholders seeking to clear more than 1 ha of native vegetation have to apply to the Department of Agriculture. *The Soil and Land Act, 1994* introduced further controls on the amount of clearing that will be approved depending on the proportion of the farm covered with vegetation, and the proportion of the Shire so covered.

Tasmania

Tasmania does not have legislation regulating clearance or management of native vegetation, beyond those specifically addressing forestry operations.

Northern Territory

The Northern Territory has no specific land clearing legislation, although pastoral leaseholders must apply to the Pastoral Lands Board for permission to clear native vegetation.

Legislation under consideration

It would take an enormous amount of work to identify and list legislation that may be under consideration.

(b) Legislation, enforcement and values

Carl Binning, Mike Young and Emily Cripps of CSIRO have recently completed a report for EA/ LWRRDC entitled 'Beyond Roads, Rates and Rubbish: The Potential for Local Government to Use Incentive-based Instruments to Conserve Native Vegetation'. Several themes pertinent to the issues of legislation, enforcement and values run through this document, and through their previous report, Carl Binning and Mike Young, 1997, 'Motivating People: Using Management Agreements to Conserve Remnant Vegetation.' I attempt to summarise these threads here; undoubtedly, though, my own biases intrude into this account.

- There is sometimes a certain level of incompatibility between Acts with different objectives at Commonwealth and State or Territory level, for example between legislation concerning natural resource use and resource conservation. Tension between different societal objectives is not necessarily a bad thing, as it allows for debate and gradual resolution in a democratic fashion, but it can lead to the following dilemma.
- Commonwealth, State and Territory agencies and Statutory Authorities tend to focus on a relatively narrow segment of natural resource use, reflecting the intent of the legislation under which they operate. Our society is struggling to work out means of incorporating the wider consequences of natural resource use into legislation and governmental practice.
- Legislation concerning natural resource management is more likely to succeed in its intent when it finds means of encouraging and providing incentives for desired actions than when it prohibits and proscribes.
- Local government is becoming a more important player in the field of natural resource management, and so more frequently has to filter the various Acts at State and Commonwealth levels.
- At the same time, State and Territory governments may be side-stepping local government by setting up alternative regional institutional structures, such as regional vegetation committees.
- In short, vegetation management represents a good example of a natural resource issue that integrates and reflects the wider consequences of resource use. It is not surprising, therefore, to see considerable debate over the effectiveness of legislation and governmental action.

Binning, Cripps and Young (1998) believe that achievement of best practice in vegetation management is possible without fundamental change to the legislative framework. By implication, their attitude seems to be that enforcement is not the limiting factor, and that legislation is adequately tracking changes in overall societal values. They argue, nevertheless, that a fair deal of fundamental reform is required to the present bureaucratic process through which existing legislative frameworks are administered. The benchmarks that they suggest are as follows:

- clarify roles and responsibilities between organisations with an interest in natural resource management;
- put in place strong legislative frameworks;
- focus on outcomes rather than inputs or processes;
- provide for regional action plans;
- provide for flexible delivery of services;
- resource regional plans adequately;
- provide for monitoring and review of outcomes.

Beyond these points, it is also imperative that there be information available to those responsible for vegetation management in order to ensure that objectives designated by legislation are in fact technically achievable.

Acknowledgments

This information has been largely abstracted from Carl Binning and Mike Young, 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, Environment Australia, Canberra. I am also greatly indebted to Carl Binning for allowing me to look at the report by Carl Binning, Mike Young and Emily Cripps 1998, 'Beyond Roads, Rates and Rubbish: Opportunities for Local Government to Conserve Native Vegetation', CSIRO Wildlife and Ecology, Canberra. Any errors of interpretation are mine, however.

5. (a) What are the present tiers of government involved in providing incentives or legislation associated with remnant vegetation?

(b) How is this likely to change in the future and what changes are likely? What would need to occur to initiate improvements?

(a) Present arrangements

Australia has complex arrangements in place for the management of natural resources generally, and native vegetation specifically.

The Commonwealth has major influence through the development of nationwide approaches to environmental issues, with reference to international trends, the regulation of specific environmental issues of national significance, and the provision of funding for natural resource management activities. The Commonwealth has sought to develop cooperative arrangements with State governments, first through the Intergovernmental Agreement on the Environment and more recently through the proposed review of Commonwealth environmental legislation. Overall, the Commonwealth influences natural resource management at State government level primarily through provision of funding via the Natural Heritage Trust.

State and Territory governments have primary statutory responsibility for natural resource management. A substantial array of legislation has arisen in response to three broad areas—land-use planning and environmental protection, rural land management, and nature conservation and heritage protection. As noted under question 4, there is a substantial number of Acts bearing upon these complex issues, with an even larger number of Departments, Commissions, Authorities and advisory groups playing statutory functions.

Local governments were originally established to deal with and manage infrastructure for their regions. Their roles have gradually expanded, such that they no longer are responsible just for the provision of infrastructure, for the management of Council-owned land, and for waste collection. Now, Councils have a primary role also in land use and planning and in the management of environmental risks. This latter expansion is leading Councils into the areas of planning and incentives for vegetation management, but as Carl Binning, Mike Young and Emily Cripps (1998) point out in a report recently completed for EA/LWRRDC, much of this activity is discretionary rather than obligatory.

(b) The future

The scenarios outline three contexts in which change may occur! Rather than dwell on them, I abstract ideas from the work of Binning and Young for improving the effectiveness of current approaches to vegetation management. In 'Motivating People: Using Management Agreements to Conserve Remnant Vegetation', they present a list of policy opportunities that could be developed through:

- a National Land for Wildlife Program;
- mechanisms for development and implementation of Regional Vegetation Management plans;
- a Code of Practice defining duty of care for vegetation management;
- a series of Protected Area networks;
- management agreements for vegetation management when renewing leases;
- a Fencing Assistance Scheme;
- rate rebates for vegetation conservation;
- Vegetation Management Trusts for funding vegetation management;
- Revolving Funds for purchase and covenanting of land;
- a nationally agreed process for achieving consistency in principles for vegetation management;
- strategic alliances between governments and business;
- broadening of the legislation enabling covenanting in each State and Territory; and
- devolution of incentives for vegetation management to local government.

In their most recent work, Binning, Young and Cripps (1998) are exploring means by which the last of these recommendations might best be achieved.

Acknowledgments

As for question 4 (page 61)

6. (a) Are there control mechanisms in place for exotic pests or build up of native wildlife in native remnant vegetation areas?

(b) What is the likelihood of key technologies being developed to control such forces?

(a) Control mechanisms

In my preparation for the Workshop I presumed that vertebrate pests were intended to be the focus of the question, a summary of which is attempted below. After the event, it became clear that weeds were also meant to be examined; clearly weeds are a major issue in remnant vegetation, and require substantial consideration.

Rabbits

- Almost universal in native vegetation remnants.
- Controlled to varying degrees by landholders; most effective treatment is ripping of warrens.
- Recent successful introduction of rabbit calicivirus disease has provided opportunities for even more effective warren-ripping.

Foxes

- Almost universal in native vegetation remnants, except (fortunately) in Tasmania.
- Controlled to varying degrees by landholders; most effective treatment is poisoning with 1080.
- In Western Australia the 'Western Shield' program run by the Department of Conservation and Land Management is currently being expanded to incorporate large areas of the wheatbelt, the region containing most of the remnant vegetation in the state. This program is highly successful in allowing the recovery of many vulnerable and threatened native species of wildlife.

Cats

- Almost universal in native vegetation remnants.
- Uncontrolled.

Mice

- Principally a problem in farmland, rather than in remnants.

Pigs

- Widespread in remnants along rivers and floodplains, especially in eastern Australia (but not in Tasmania).
- Landholders may attempt control by poisoning, trapping or shooting.

Kangaroos

- Present localised problems in remnants in some regions.

Almost all these pests have substantial effects on the farming environment as well as on remnant vegetation.

(b) Future technologies

The Cooperative Research Centre (CRC) for Vertebrate Biocontrol aims to develop novel fertility control agents as practical, humane and species-specific means of reducing the populations of vertebrate pests. It is a partnership between Agriculture Western Australia, the Australian National University, CSIRO Wildlife and Ecology, and the Western Australian Department of Conservation and Land Management. The key concept is to use immunocontraceptive vaccines delivered by bait or through the agency of a virus that spreads naturally through the target pest population. The CRC is working on three target species—the fox, the rabbit, and the mouse. It also devotes considerable effort to evaluating the biosafety and social impediments to development and use of products according to the Australian GENHAZ requirements as well as international protocols.

The CRC has recently achieved four highlights:

- Ecologists have demonstrated, through field studies and modelling, the level of fertility control that would lead to a sustained reduction in the numbers of a target species.
- Reproductive biologists have demonstrated that immunocontraception is achievable in a target species.
- Virologists have demonstrated an immune response in mice to a foreign protein expressed by a candidate recombinant virus.
- Surveys undertaken indicate that there is broad public acceptance of immunocontraception as a pest management tool in Australia.

As I understand progress, we are still at least five years away from application of these research findings.

With respect to weeds, there is a strong argument to be made for using quarantine barriers to limit the introduction of potential weeds, instead of constantly turning to the expensive task of developing biological control after the weed has become established.

Acknowledgments

This information has been abstracted from Vertebrate Biocontrol Cooperative Research Centre, 'Controlling Australia's Major Pests', Vertebrate Biocontrol Cooperative Research Centre, Canberra, 1997.

7. (a) What educational material is currently available in schools regarding the value and management of native remnant vegetation? Is the amount of material increasing?

(b) Are there more educational and training opportunities becoming available to landholders and other community members?

(a) Current material

Contacts in both Greening Australia and the World Wide Fund for Nature indicated that they receive very many requests for material on vegetation management—the schools appear exceedingly hungry for information about environmental management in general. Given that Greening Australia has probably the widest spread of contacts across the country, it appears that they are doing more than any other group in feeding material into the school system. The amount of material being produced for this target group is almost certainly increasing, but assessment of this would require more extensive investigation than has been possible here.

Training opportunities

Increased opportunities for training by landholders and community members have emerged over the past few years as nationally-accredited Landcare courses have become available at most non-urban TAFE colleges. As an example of the types of training being offered, I append below information on three course areas being offered through the New South Wales TAFE system, as located at: < www.tafensw.edu.au/handbook/ >.

Land revegetation skills

Qualification: TAFE statement
Course no: 5536
Vocational area: Primary Industry and Natural Resources
Program area: Mining Forest Industry and Environment

Proposed metropolitan locations for semester 1: Blue Mountains
Proposed country locations for semester 1: Charlestown, Yallah
Hours: 8 hours/week—0.5 year (136 hours)

This course is for people who want to learn basic skills in weed eradication and tree planting so they can work with local councils or environment groups to re-establish natural areas.

Articulation: when you finish this course you may apply for entry to trade level horticulture courses.

This course is being revised.

Entry requirements: there are no formal educational requirements for this course.

Subjects/Modules		Hours
Core:		
5536A	Horticulture Introduction	12
5536B	Horticulture Equipment	12
5536C	Planting Skills	24
5536D	Construction Skills	32
5536E	Horticulture Systems	28
5536F	Natural Area Revegetation	28

Land management (conservation earthworks)

Qualification: Diploma (AQF)
Course No: 5597
Vocational Area: Primary Industry and Natural Resources
Program Area: Mining Forest Industry and Environment

Hours: 840 hours (Flexible)

This course covers planning, designing, pegging, constructing and implementing a wide range of conservation earthworks projects, such as farm dams, contour banks, waterways, gully restoration, land clearing, access tracks and soil erosion control works. You learn how to develop work plans, design conservation earthworks, estimate costs for conservation earthmoving projects and select and deploy earthmoving machinery. You will also learn how to monitor construction and develop contingency plans to achieve job outcomes and meet budgets.

Entry requirements: civil engineering, agriculture or related qualifications, or Conservation Earthworks Certificate III 5595 or Conservation Earthworks Certificate IV 5596 or equivalent.

Selection criteria (in order of priority)
1. Applicants who are in relevant employment.
2. Applicants who can demonstrate the relevance of the course to their business or employment intentions.
3. Applicants who are able to undertake practical work required by the course.
4. Applicants who can demonstrate a commitment to complete the course.

Subjects/modules	Hours	National module/s
Core:		
5598CA Conservation Earthworks 1	40	NAE012
5598CB Conservation Earthworks 2	40	NAE013
5598EA Levels and Levelling	20	NAE019
5598EB Earthmoving Principles	30	NAE020
5598EC Erosion Control and Design Principles	36	NEA021
5598ED Soils	36	NAE022
5598EE Bookwork and Maintaining Records	54	NAE023
5598EF Pipes and Earthworks	36	NAE024
5598FA Planning and Pegging Farm Dams	36	NAE025
5598FB Planning and Pegging Contour and Graded	36	NAE028
5598GA Construction Strategies for Farm Dams	40	NAE026
5598GB Construction Strategies—Difficult Sites	40	NAE027
5598GC Construction Strategies for Banks	40	NAE029
8979T Writing Workplace Documents	20	NCS006
Elective:		
5598FC Planning and Pegging Waterways	36	NAE030
5598FD Planning Land Clearing	36	NAE033
5598FE Planning Access Tracks	20	NAE034
5598GD Construction Strategies for Waterways	40	NAE031
5598GE Gully Fill and Shaping, Planning and Imp	40	NAE032
5598JA Rangeland Reclamation—Water Ponding	40	NAE041
5598JB Rangeland Reclamation—Contour Furrowing	40	NAE042
5598JC Rangeland Reclamation—Blade Ploughing	30	NAE043
5598JD Improved Catchments (Farm Dams)	20	NAE044
5598JE Beach Reclamation 1	40	NAE045
5598JF Beach Reclamation 2	40	NAE046
5598JG Flume/Chute Construction	40	
5598JH Sub Surface Field Drainage	40	
5598JJ Surface Field Drainage 1	40	
5598JK Surface Field Drainage 2	40	
5598JL Roadside Drainage, Erosion and Sediment	40	
5598JM Roadside Drainage, Erosion and Sediment	56	
8979H Negotiation Skills	20	NCS009
8979K Client Interaction	20	NCS011
8979S Dealing with Conflict	20	NCS005
8999B Tutorial Support (Optional)		

Primary industry and natural resources course list

Agriculture extensive
Agriculture intensive
Amenity horticulture
Mining forest industry & environment

Agriculture extensive

5831 Agribusiness—Certificate IV (AQF)
5842 Agribusiness—Diploma (AQF)
5543 Agricultural Skills—Statement of Attainment
5562 Agricultural Studies—Statement of Attainment
5877 Alpaca Production—Statement of Attainment
5578 Beef Cattle Production—Certificate IV (AQF)
5556 Broad Area Crop Production—Certificate IV (AQF)
5852 Cattle Artificial Insemination—Statement of Attainment
5878 Cattlecare—Short Course
5825 Dairying—Certificate II (AQF)
5826 Dairying—Certificate IV (AQF)
5554 F.A.R.M. Training Program—College Statement
5592 Farm and Life Skills—TAFE Statement
5833 Farm Chemical User—Statement of Attainment
5841 Farm Management—Certificate IV (AQF)
5834 Pastoral Production—Certificate IV (AQF)
5822 Rural Business Management—Diploma (AQF)
5821 Rural Business Management—Certificate IV (AQF)
5823 Rural Business Management—Advanced Diploma (AQF)
5593 Rural Business Studies—Statement of Attainment
5547 Rural Fabrication Techniques—TAFE Statement
5820 Rural Office Practice—Certificate III (AQF)
5584 Rural Operations—Certificate II (AQF)
5585 Rural Practice—Certificate III (AQF)
5586 Rural Skills—Certificate II (AQF)
5548 Rural Welding Techniques—TAFE Statement
5836 Shearing—Certificate II (AQF)
5539 Sheep and Wool Production—Certificate IV (AQF)
5577 Sheep, Wool and Fibre Studies—Statement of Attainment
5832 Tractor Operation and Maintenance—Short Course
5568 Wool Classing—Certificate III (AQF)
5570 Wool Commerce—Certificate IV (AQF)
5837 Wool Handling—Certificate II (AQF)

Agriculture intensive

6385 Animal Attending—Certificate
5589 Animal Care—Certificate II (AQF)
5590 Animal Care—Certificate III (AQF)
5830 Animal Science Studies—Short Course
6386 Animal Technology—Associate Diploma
5875 Aquaculture Practice—Certificate III (AQF)
5575 Aquaculture Production—Certificate IV (AQF)
535 Beekeeping—TAFE Statement
5553 Farm Mechanics—TAFE Statement
5573 Farm Tree Management—TAFE Statement
5567 Farming Small Areas—TAFE Statement
5854 Farriery—Certificate III (AQF)
5849 Fishing Industry, Recreational Services—Certificate III (AQF)
5551 Food Processing (Wine—Viticulture)—Certificate III (AQF)
5818 Horse Industry Applications—Certificate IV (AQF)
5838 Horse Industry Management—Diploma (AQF)
5814 Horse Industry Operations—Certificate II (AQF)
5815 Horse Industry Practice—Certificate III (AQF)
5813 Horse Industry Skills—Certificate I (AQF)
5819 Horse Industry Studies—Short Course
5817 Jockey Practice—Certificate III (AQF)
5535 Kennel and Cattery Operations—Certificate II (AQF)
5546 Organic Farming—Certificate III (AQF)
5565 Seafood Industry Studies—Short Course
5816 Trackwork Riding—Certificate II (AQF)
5588 Veterinary Nursing—Advanced Certificate
5587 Veterinary Nursing (Enrolled)—Certificate
548 Vigneron—TAFE Statement
5580 Wine Operations (Viticulture)—Certificate II (AQF)
5571 Zookeeping—Certificate III (AQF)

Amenity horticulture

5808 Floristry—Certificate I (AQF)
5809 Floristry—Certificate II (AQF)
5810 Floristry—Certificate III (AQF)
5811 Floristry—Advanced Design—Certificate IV (AQF)
5812 Floristry Shop Management—Certificate IV (AQF)
5545 Horticultural Skills—Short Course
5563 Horticultural Studies—Short Course
5862 Horticulture—Certificate II (AQF)
5861 Horticulture—Certificate I (AQF)
5863 Horticulture—Certificate III (AQF)
5864 Horticulture—Certificate IV (AQF)
5855 Horticulture (Amenity)—Certificate II (AQF)
5591 Horticulture Operations—Certificate II (AQF)
5860 Horticulture Operations—Certificate II (AQF)

Primary industry and natural resources course list — cont'd

1527 Horticulture Therapy Techniques—TAFE Statement
1567 Pest Control, Urban—Certificate
5566 Turf Management—Diploma (AQF)
5840 Weed Control—Statement of Attainment

Mining forest industry and environment

2143 Agricultural Blasting—TAFE Statement
5853 Australian Land Conservation and Restoration—Certificate II (AQF)
5806 Bushland Regeneration—Certificate II (AQF)
5807 Bushland Regeneration—Certificate IV (AQF)
5805 Bushland Weed Control—Statement of Attainment
5850 Chainsaw Operations—Statement of Attainment
5828 Coal Mining (Deputy)—Certificate IV (AQF)
5835 Coal Mining (Open-Cut Examiner)—Short Course
2901 Coal Mining (Undermanager)—Associate Diploma
5572 Coal Mining Induction—Short Course
2964 Coal Mining, Manager—Associate Diploma
2970 Coal Mining, Open-Cut (Manager)—Associate Diploma
5594 Conservation Earthworks—Certificate II (AQF)
5598 Conservation Earthworks—Statement of Attainment
5596 Conservation Earthworks—Certificate IV (AQF)
5595 Conservation Earthworks—Certificate III (AQF)
5829 Drilling Operations—Certificate II (AQF)
5824 Ecological Studies—Short Course
5801 Environmental Awareness—Statement of Attainment
5802 Environmental Practice—Certificate II (AQF)
5804 Environmental Practice—Certificate IV (AQF)
5803 Environmental Practice—Certificate III (AQF)
2133 Explosives—TAFE Statement
2177 Forest and Forest Products (Saw Doctoring)—Certificate III (AQF)
7961 Forest and Forest Products (Saw Doctoring)—Certificate IV (AQF)
5858 Forest Industries Studies—Statement of Attainment
5843 Forest Products Operations—Forest Growing—Certificate II (AQF)
5844 Forest Products Operations—Forest Harvesting—Certificate III (AQF)
5848 Forest Products Operations—Merchandising—Certificate II (AQF)
5847 Forest Products Operations—Panel Products—Certificate II (AQF)
5846 Forest Products Operations—Pulp and Paper—Certificate II (AQF)
5845 Forest Products Operations-Sawmilling & Processing—Certificate II (AQF)
5582 Forest Soil and Water Protection—TAFE Statement
5579 Geotechnical Field Operations—Certificate II (AQF)
5597 Land Management (Conservation Earthworks)—Diploma (AQF)
5536 Land Revegetation Skills—TAFE Statement
5559 Mining Explosives—Short Course
5564 Mining Studies—Short Course
5827 Mining Supervision—Certificate IV (AQF)
5800 Mining, Small Scale—Certificate III (AQF)
5859 Natural Resource Management—Diploma (AQF)
2985 Quarry Management—Advanced Certificate

8. (a) What is the extent and scope of information on current conditions and trend of native vegetation? With what frequency, and at what level, is any monitoring carried out? How public is the information?

(b) Are sufficient and appropriate criteria being used in monitoring? How would monitoring need to be improved in future to be more effective in evaluating status changes?

(a) Current information

The first attempt to assemble comparable, continental data about the status of native vegetation was conducted by Dean Graetz of CSIRO. It was reported in Dean Graetz, Rohan Fisher and Murray Wilson, 1992, 'Looking Back: The Changing Face of the Australian Continent, 1972–1992', CSIRO, Canberra, and Dean Graetz, Murray Wilson and Sue Campbell, 1995, 'Landcover Disturbance over the Australian Continent: A Contemporary Assessment', Biodiversity Series, Paper No. 7, Department of the Environment, Sport and Territories, Canberra. These analyses rested upon satellite data, and principally considered the period of the 1980s. The studies focused on clearing of native vegetation but also addressed the problem of analysing the condition of uncleared vegetation.

Subsequently, the Bureau of Rural Sciences (BRS) has been engaged in examining clearing rates of native vegetation from 1990–1995, also using satellite data. This project—the Agricultural Land Cover Change Project—has been a joint initiative of the State, Territory and Commonwealth governments. Michele Barson of BRS informed me that the estimates of clearing are now being tested for accuracy, a process not yet complete. The information is being analysed at the scale of 1:100,000 map sheets, and according to several processes by which vegetation is modified. The data are under the joint control of the Australian Greenhouse Office and BRS; they are not for release, and it is unclear when they will be publicly available (although it seems possible that they may be released after the election of October 1998). Details of the Agricultural Land Cover Change (ALCC) Project are available at www.brs.gov.au/apnrb/landcov/landcov.html. The ALCC project requires three data sets, as follows.

Vegetation change 1990–1995

A 1990–1995 vegetation change digital data set, with all changed areas of one hectare or greater attributed with 1990 land cover, the type of change, the cause of change, and estimates of the replacement vegetation. The cause of change is important to work out, as fire is a significant influence in several states.

1990 Land cover themes

A 1990 generalised digital land cover data set which includes 'woody' vegetation (>2 m and 20% crown cover) plus an attached attribute table defining land cover themes.

1990 Structural vegetation

A digital data set for all 'woody' vegetation (>2 m and 20% crown cover) with areas greater than 50 ha having attached attribute tables describing vegetation type and density.

The Queensland Department of Environment and Natural Resources is building on the BRS studies by examining clearing rates for the period 1995–1997 (see 'The Statewide Landcover and Trees Study Interim Report October 1997', Queensland Department of Natural Resources, 1997). Other State agencies may also be preparing to extend the BRS work.

Analysis of vegetation condition via remote sensing requires more detailed work than that used in estimating clearing rates. Michele Barson informed me of a technique developed by Norm Campbell and Jeremy Wallace of CSIRO, which uses multiple thematic mapper (TM) images in order to identify spectral changes in the vegetation through time. These spectral changes in turn may be correlated with increases or decreases in biomass, and therefore with changes in condition of the vegetation. However, it does not yet seem as though this monitoring technique for vegetation condition has been widely tested or firmly verified.

(b) The future

Monitoring of the rate of clearing of vegetation is rapidly becoming effective. Although the remote-sensing process of monitoring is expensive, it should shortly prove possible to target that monitoring towards those regions where change is rapid.

Monitoring of the condition of vegetation appears to be proving more problematic. Much work remains to be done here before the status or condition of remnants of vegetation could be reliably monitored through remote sensing. My own opinion is that the benefits of monitoring of vegetation condition at the broad scale need to be closely thought out and the questions to be asked of it carefully defined, because the cost of instituting such monitoring may well be substantial.

Acknowledgments

I am greatly indebted to Michele Barson for her advice; any errors of interpretation are mine, however.

9. (a) What information is currently available on the harvesting of remnant vegetation for firewood?

(b) If current gathering and harvesting levels are projected into the future, what impact will this have on remnant vegetation? What are the likely future scenarios for use and sources of firewood?

(a) Current information

The following summary is extracted primarily from a manuscript by Julian Wall, Division of Ecosystem Management, University of New England, Armidale, entitled 'Fuelwood in Australia: Impacts and Opportunities'. His work forms a chapter in the book 'Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration', edited by Richard Hobbs and Colin Yates, to be published shortly by Surrey Beatty and Sons, Sydney.

Until the 1950s, wood combustion in fireplaces was the main form of heating in Australia. Availability of cheap heating oil in the 1960s and 1970s suppressed firewood use to some extent, but the near doubling of domestic oil prices in 1978 and the development of more efficient closed wood heaters led to a resurgence in wood use on the 1980s. Wall notes that firewood is presently more cost effective for heating than is fossil fuel. In addition, wood heaters remain popular because of the ready supply of premium quality firewood from clearing and rural dieback, and due to the aesthetics of wood fires. Hence, the proportion of wood-using homes in Australia increased from 9% in 1976 to 25% in the late 1980s. Naturally, the proportions are higher in colder regions: more than half the residents of Hobart and 30% of Canberrans burn wood.

Firewood is presently the third largest source of energy used in Australia after electricity and gas. Wall reports estimates of volumes of firewood consumed, based on a document entitled 'Fuelwood Use and Supply in Australia', Forestry Technical Services and University of Tasmania, 1989, National Energy Research and Development Corporation Report No. 28, Department of Primary Industries and Energy, Canberra, as follows:

- annual domestic firewood use—4.4 million tonnes;
- annual industrial firewood use—1.7 million tonnes;
- for comparison, annual export of eucalypt woodchips—5.0 million tonnes.

Firewood use consequently totals a consumption rate of about one tonne per capita wood user per year. Julian Wall quotes the Resource Assessment Commission as estimating in 1992 that the Australian firewood industry was worth $390 million per year. There seems no reason to believe that consumption rates or economic value have declined in the few years since these estimates were made.

Wall reports that firewood harvesting is restricted almost entirely to the use of dead trees resulting from the modification of native vegetation for agricultural purposes. In South Australia, the product has mainly stemmed from mallee vegetation, but more recently has begun to switch to river red gum. In New South Wales, the Australian Capital Territory and Victoria, various species of box eucalypts are favoured. Firewood demand seems almost universally to be outstripping supply. Some estimates reported by Wall suggest that 33–45% of the annual firewood supply is removed from remnant vegetation stands, equivalent to a clearfell of about 70 hectares per day. In Victoria, increasing areas of public forest are now devoted to firewood production, the estimated volume of timber extracted annually being 200,000 tonnes. Allison Treweek's (1997) study of the Canberra firewood market—which was funded by EA/LWRRDC—showed that the 'catchment' has expanded to include areas approximately 500 km towards the north-west, into the cropping zone of the Central West of New South Wales. It seems highly likely that other major centres of firewood use are imposing similarly widening demands on the resource.

There are two principal mechanisms of firewood supply. Wall estimates that private supply—in which tens of thousands of residents collect dead wood from local forests and woodlands, private land, roadsides, and travelling stock reserves—constitutes about half the total firewood usage. Private supply is entirely unregulated, and illicit felling or scavenging is not policed. The second mechanism, commercial supply, is generated through the activities of numerous merchants. Most operate on an ephemeral or semi-permanent basis. Wall comments that many firewood merchants appear to be unscrupulous; he experimentally determined that, in one location, merchants delivered on average only 76% of the advertised weight of wood. He points out that, given this apparent propensity to deliver underweight loads in order to obtain easy money, it is unlikely that firewood merchants will be readily convinced by the ideals of responsible harvesting and ecological sustainability. Treweek was more polite about the Canberra wood merchants. She commented that all those she spoke to recognised that the industry as currently constituted had a limited life-span; they understood that the wood they were using was

becoming scarce; and they agreed that plantation timber would be needed if their businesses were to survive beyond about 10 years.

In light of the magnitude and the operational inadequacies of Australia's firewood industry, concerns have been expressed for more than a decade regarding sustainability and ecological impacts. Ecological impacts include modification to vegetation composition and structure, loss of habitat for native fauna, changes to nutrient cycling and organic matter turnover, and soil erosion. The impact of firewood harvesting on already severely stressed remnants of native vegetation is likely to be profound.

(b) The future

I have been unable to locate projections of future firewood use, but there seems little reason to predict anything other than increasing demand. Further, the reports of all commentators that I've read imply a rapidly escalating problem with supply; as noted above, Treweek indicated that Canberra's wood merchants believe their industry to have secure supplies for only 10 years more. Both Wall and Treweek argue for conscious development of forestry for firewood. I summarise Wall's proposals for farm firewood forestry in point form below:

- determine sustainable yields and rotation times;
- design green-cutting and stacking regimes;
- use coppicing and retention of some large trees to enhance structural complexity;
- harvest no more than 1% of above-ground woody biomass and 2% of the total area of firewood forest during any year;
- prevent grazing in wood lots;
- landowners to be paid a royalty for extraction of their trees;
- the economics of firewood forestry are already close to break-even;
- a Code of Practice to be developed;
- licences to be instituted for merchants, verifying quality, quantity and environmental standards; and
- public education instituted to advise users about the need for sustainability.

Acknowledgments

This information has been largely abstracted from Julian Wall, 1998, 'Fuelwood in Australia: Impacts and Opportunities', in 'Temperate Eucalypt Woodlands in Australia: Biology, Conservation, Management and Restoration', edited by R.J. Hobbs and C.J. Yates, to be published shortly by Surrey Beatty and Sons, Sydney; and Allison Treweek, 1997, 'Identifying Alternatives to Using Remnant Eucalypt Vegetation for Firewood in the ACT Region through Consultation with Residents and Farmers', Final Submission for Land and Water Research and Development Corporation, Applied Ecology Research Group, University of Canberra, Canberra. I am greatly indebted to these two people for assembling such useful information, but any errors of interpretation remain mine.

10. (a) Are there any inventories of commercial products that have been derived in Australia from native vegetation, either from native stands or exploited externally (eg. plantings, chemical synthesis)?

(b) Apart from uses and products identified some time ago (eg. timber, tannins, fodder, tea tree oil, eucalyptus oil) have there been any significant findings more recently that can provide visible and tangible benefits to society? In your opinion, are there likely to be significant findings of such a nature in the future and would they be diminished if remnant vegetation on private land is not protected or enhanced?

(a) Inventories

In the time available I have been unable to locate such an inventory. The agency most active in supporting this type of commercial activity, though, is the Rural Industries Research and Development Corporation (RIRDC). The following listing from the publications of the Corporation suggests the range of products under active development.

Doran, J.C., Baker, G.R., Murtagh, G.J. and Southwell, I.A., 1997, 'Improving Tea Tree Yield and Quality Through Breeding and Selection', RIRDC Research Paper No. 97/53, Canberra.

Essential Oils of Tasmania Pty Ltd and Rural Industries Research and Development Corporation, 1996, 'Proceedings of the Essential Oils Planning Workshop 14–15 June 1995, Hobart', RIRDC Occasional Paper No. 96/1, Canberra.

Evans, D., 1995, 'Workshop Proceedings: Commercial Potential of NSW Flora', RIRDC Occasional Paper No. 95/3, Canberra.

Gill, R., 1997, 'Beekeeping and Secure Access to Public Land: How it Benefits the Industry and Society', RIRDC Research Paper No. 97/26, Canberra.

Graham, C. and Hart, D., 1997, 'Prospects for the Australian Native Bushfood Industry', RIRDC Research Paper No. 97/22, Canberra.

Karingal Consultants, 1997, 'The Australian Wildflower Industry: A Review—Second Edition', RIRDC Research Paper No. 97/64, Canberra.

(b) The future

Potentially valuable new products continue to emerge. Some that are evident are essential oils from the native plants *Boronia*, *Tasmannia*, *Backhousia*, *Chamelaucium* and *Melaleuca* (see RIRDC 1996). Further, one can detect a growing trend towards more active commercialisation of native Australian wildlife and towards commercialisation of 'bushtucker' (see ACIL Economics Pty Ltd 1997, RIRDC 1997, Choquenot *et al.* 1998, and Commonwealth of Australia 1998). Finally I am aware that the Western Australian Department of Conservation and Land Management has an active program to survey native plants for potentially useful compounds. The commercial value of such products is still untested, and detailed investigation of each is imperative (Bond *et al.* 1997). It seems more than likely that economically successful uses of native vegetation and wildlife will emerge gradually and tentatively, rather than with a sudden flurry, and will repay patient investment.

Nevertheless, in my view it would be foolish to conclude that there are no more valuable industries to be discovered among Australia's native species. The difficulty lies in calculating the curve describing a relationship between current value of remnant vegetation and the potential for economic return should further useful native species be discovered. In the main, current landholders clearly believe that this curve leads to placement of a relatively low economic value on remnant vegetation.

Acknowledgment

This information has been obtained largely from the publications of the Rural Industries Research and Development Corporation, but any errors of interpretation remain mine.

References

ACIL Economics Pty Ltd, 1997, 'Sustainable Economic Use of Native Australian Birds and Reptiles: Can Controlled Trade Improve Conservation of Species?', RIRDC Research Paper No. 97/26, Canberra.

Bond, K.A., Chudleigh, P.D. and Wood, I.M.W., 1997, 'Assessment of Commercial Prospects and Research Priorities for New Industries: Methodological Review and Development', RIRDC Research Paper No. 97/52, Canberra.

Choquenot, D., Caughley, J. and McLeod, S., 1998, 'Scientific, Economic and Social Issues of Commercial Use of Wild Animals in Australia', Bureau of Resource Sciences, Canberra.

Commonwealth of Australia, 1998, 'Commercial Utilisation of Australian Native Wildlife', Report of the Senate Rural and Regional Affairs and Transport References Committee, Parliament of the Commonwealth of Australia, Canberra.

RIRDC, 1996, 'Essential Oils and Plant Extracts Program 1996–2001', RIRDC, Canberra.

RIRDC, 1997, 'Current Projects 1997–98', RIRDC, Canberra.

Appendix I
Questionnaire Used for the Final Evaluation

Exploring the Future R&D Requirements for Managing Australia's Natural Resources
Remnant Native Vegetation—Workshop 2: Evaluation Questionnaire

Name:

Now that the two workshops in this exercise have been completed, please fill in the following questionnaire to provide us with your current assessment of the impact and value of the foresighting process. Please hand your completed questionnaire to Peter Chudleigh or Ron Johnston.

A. Which of the following best describes your opinion of the foresighting process? (Nominate 1st and 2nd preferences in appropriate boxes)

☐ Waste of time
☐ Amusing
☐ Interesting approach
☐ A novel way of considering the future but little practical application
☐ Jolted me out of my existing way of thinking
☐ Introduced future possibilities in a realistic manner
☐ Has stimulated me to think of the future in a more free-thinking manner

B. Do you think that the resulting strategies and R&D priorities from the foresighting exercise will be useful in planning and managing R&D in the future? (tick one box)

☐ Little/no use
☐ Some use
☐ Very useful

C. Do you think the outcomes of this foresighting exercise will influence the future management of policy and R&D concerned with remnant vegetation?

Yes ☐ ☐ No

If yes, how?.....

.....

If no, why?.....

.....

D. Do you think you will perform your work activities in the future differently to the past as a result of participating in the foresighting exercise? (tick one box)

☐ Little/no change
☐ Some change
☐ Major change

E. What changes (if any) are you likely to make in your remnant vegetation-related activities as a result of participating in the foresighting exercise?

.....

.....

F. Do you think it would be useful for this same group to reconvene at a later date to review the impact of the foresighting exercise and re-examine strategies and priorities developed? Indicate below your strongest preference (tick one box):

☐ No
☐ Maybe
☐ Yes, in 6 months time
☐ Yes, in 1 years time
☐ Yes, in 2 years time
☐ Yes, in 5 years time
☐ Other (please specify) .....

.....

QUESTION G

At the beginning of the first workshop, you completed a questionnaire where you listed the strategies, constraints and priorities relevant to preserving and enhancing remnant vegetation. Now we are at the end of the process, we would like you to answer this question again.

Name:

G1. What do you think will be the three most important management strategies (in order of importance) that could be implemented to promote the re-establishment, re-habilitation and future health of remnant vegetation?

Strategy 1:

Strategy 2:

Strategy 3:

G2. What do you consider to be the most constraining factor affecting the implementation of each of these three strategies?

Factor constraining Strategy 1:

Factor constraining Strategy 2:

Factor constraining Strategy 3:

G3. What do you consider are the three most important R&D topics (in order of importance) to be supported in pursuing the objective of preserving and enhancing remnant vegetation?

Topic 1:

Topic 2:

Topic 3: