Economics of remnant native vegetation conservation on private property

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

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Foreword

This research report by Michael Lockwood, Sandra Walpole and Carla Miles provides some critical pieces in the jigsaw of information needed to develop effective approaches to conserving native vegetation in Australia.

The research was funded by the Land and Water Resources Research and Development Corporation (LWRRDC) and Environment Australia through the National R&D Program on Rehabilitation, Management and Conservation of Remnant Vegetation. This report is one of a series of landmark papers, which articulate a hitherto under-researched issue—the extent to which institutional factors are impeding conservation efforts on private lands. The outputs of these research reports go a long way towards the development of new institutional arrangements—incentives, planning, extension programs and regulation—that are likely to be much more effective in encouraging and assisting landholders to conserve native vegetation.

The conservation of native vegetation is, along with provision of environmental flows in rivers, probably the highest priority conservation challenge in Australia. Loss, fragmentation and degradation of native vegetation is the single biggest cause of biodiversity loss, the single biggest driver of dryland salinity, and among the largest components of our net greenhouse gas emissions. Further losses of the threadbare remnants of bush and woodlands in our more intensively farmed landscapes will have a profound impact on the aesthetics of rural life.

At first glance, it might seem reasonable, particularly from an urban perspective, to simply demand that rural landholders protect and conserve the native vegetation dotted across their farms and along creeks and road reserves. Don't farmers have a responsibility to look after their native bush? Is there not a duty of care, consistent with the stewardship role of private landholders, on behalf of future generations, not to knowingly degrade native vegetation communities?

If only it were that simple. This report shows clearly that, at a farm scale, conserving remnant native vegetation costs money. The on-farm cash benefits derived by landholders from fencing off and looking after bush are outweighed by the costs of fencing and other measures. So when we ask farmers to conserve bush, we are asking them to incur a net cost to do so. Given the contemporary economics of most broadacre farming, it is unrealistic to expect that the level of protection society would prefer for its native vegetation will be delivered through voluntary, altruistic efforts on the part of cash-strapped farmers.

The report shows, however, that at a catchment scale, using hedonic pricing methods to value the conservation of biodiversity, the net benefits of conserving remnant native vegetation are positive. This means that it is in the interests of society as a whole to fund the conservation of remnant vegetation on farms. But there are also benefits for farmers, and many would argue they have an obligation to share at least a proportion of the cost.

Lockwood, Walpole and Miles provide a comprehensive breakdown of the costs and benefits of conserving remnant vegetation on farms, and the distribution of these costs and benefits at farm and catchment scales. This task is far from straightforward. Many intangibles are difficult to quantify and to apportion across different players in space and time. Yet, if we are to develop institutional arrangements that reward landholders for implementing conservation measures in the wider public interest, then we need to develop ways of working out the distribution of costs and benefits, and who should pay for what and how.

This paper is a valuable contribution to that considerable challenge. It builds on a comprehensive mapping of costs and benefits, with very useful discussion of the sorts of incentive schemes and the nature of obligations on

landholders, which could be built into vegetation programs.

There is great value in this report for policy makers, catchment bodies, local government, extension workers and everyone interested in the future of Australia's unique and diverse native vegetation communities.

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Land and Water Resources Research and Development Corporation.

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We benefited considerably from the input made by members of the project Steering Committee: Noelene Wallace (North-east Catchment and Land Protection Board), Ian Davidson (Greening Australia), Leanne Wheaton (Murray Catchment Management Committee), Mark Sheahan (Department of Land & Water Conservation), Fleur Stelling (Murray Catchment Management Committee), Jack Sinden (University of New England), Judy Frankenberg (Hume Landcare Group), Roger Good (New South Wales National Parks & Wildlife Service), Kevin Ritchie, (Department of Natural Resources & Environment) and Terry De Lacy (Cooperative Research Centre for Sustainable Tourism). We have also drawn on previous work by project team members Evelyn Buckley, David Carberry, Helen Glazebrook, Emma Smith and Kylie Scanlon.

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Executive summary

This report outlines the results of the project *Economics of remnant native vegetation conservation on private property*. The project objectives were to:

1. identify and characterise the remnant native vegetation on private land in two study areas (North-east Victoria and the Murray catchment in New South Wales);
2. estimate the market economic value of these remnants;
3. estimate the non-market economic value associated with these remnants;
4. recommend mechanisms by which the values identified in objectives 2 and 3 can be translated into policies and incentives for remnant vegetation conservation; and
5. assess the likely success of the policy alternatives developed under objective 4.

As part of achieving objective 4, we used the various economic values to compile a benefit–cost analysis.

The study area in Victoria covered 1,880,056 ha, including 113,313 ha of remnant native vegetation (RNV); 1,205,498 ha of forested public land; 8,000 ha of private pine plantations; and 553,245 ha of predominantly cleared private land. Just over half the RNV was of medium quality, nearly half of high quality, and only a small proportion of low quality.

The study area in New South Wales covered 3,643,686 ha, including 203,429 ha of RNV; 381,076 ha of forested public land; 15,896 of private pine plantations; and 3,043,285 ha of predominantly cleared private land. About two-thirds of the RNV was of medium quality, about one quarter of high quality, and one tenth of low quality.

Market economic values

Three aspects of the market economic value of RNV were estimated:

- costs and benefits to landholders who own the RNV (which we term 'on-farm costs and benefits');
- community benefits arising from avoiding infrastructure damage owing to salinity and preventing emission of greenhouse gases (which together we term 'catchment benefits'); and
- effects on the resale value of the properties containing RNV.

On-farm costs and benefits. A sample of landholders who owned properties in North-east Victoria and the Murray catchment in New South Wales was surveyed to quantify: (i) management costs, including weed control, fencing, pest control, burning, maintaining access tracks and firebreaks, and removal of fallen timber; (ii) opportunity costs of preventing clearing; and (iii) benefits associated with increased stock production, increased agricultural production arising from mitigation of land degradation, increased crop production, and production of timber for firewood and fencing. Assessments were made of the current situation, and of the incremental affect of imposing five different scenarios, each of which increased the level of conservation management of the remnants.

Under current management, about 53% of Victorian participants and about 82% of New South Wales participants were gaining a net economic benefit from their RNV. However, under more conservation-orientated management regimes, the vast majority of landholders would experience a net loss. Extrapolation of the survey results across the two study areas showed that, depending on the assumptions made, this loss would range between $113.0 M and $36.5 M for North-east Victoria, and between $52.9 M and $42.1 M for the Murray catchment. RNV conservation thus imposes a significant net cost on most landholders. The study confirmed that one of the major barriers to protecting RNV is the economic cost associated with conservation management. Policies designed to achieve conservation objectives for RNV, if they are to be successful, are likely to require significant

financial incentives for landholders to undertake conservation activities.

Catchment benefits. Dryland salinity and soil erosion are the two main types of land degradation that might be exacerbated by continuing RNV decline and have an impact on downstream rural and urban populations. Based on information available from neighbouring projects, and studies undertaken for the whole Murray–Darling catchment. The following costs were calculated for the North-east Victoria and Murray catchments:

- costs of remnant vegetation clearance to local government;
- costs of remnant vegetation clearance to non-farm businesses;
- costs of remnant vegetation clearance to urban households; and
- cost of carbon dioxide release following clearing.

The net benefits from prevention of these costs over a 40-year period were estimated to be $7.4 M in North-east Victoria and $7.9 M in the Murray catchment.

Property values. In a decision to purchase a property, there is an implicit market value in how the presence or amount of RNV contributes to the observed price of land. We used an economic technique called hedonic pricing to determine the contribution RNV and other factors make to land prices. The preferred model estimated from the combined Victorian and New South Wales data contained four variables that had a significant positive correlation with property price:

- size of the property;
- presence of a house;
- purchase of property in addition to land already owned; and
- fences with good condition and placement.

The existence of RNV at a proportion greater than 50% had a negative influence. Below this threshold, however, the area of RNV appeared to have little influence on property price.

Non-market economic values

We used two stated preference methods, contingent valuation (CV) and choice modelling (CM), to assess the non-market economic values of RNV in the two study areas. Both of these methods involved the use of mail surveys to determine community willingness to pay (WTP) for RNV conservation. The economic estimates from the two methods were not significantly different, providing evidence for the convergent validity of the results. The CM data were used in subsequent analyses, because they allowed calculation of WTP for a range of different scenarios.

Average household WTP for RNV conservation in North-east Victoria was about $73, and about $75 for the Murray catchment. The aggregate benefit to voters of conserving RNV in North-east Victoria was $60.7 M. The corresponding figure for New South Wales voters (Murray catchment) was $75.6 M.

Benefit–cost analysis

Three value components — community WTP, net on-farm costs, and catchment benefits — were integrated into a benefit–cost analysis. The results of the analysis indicated that, under most conditions, there was a net economic benefit in conserving RNV. For example, given a 5-year time horizon and a discount rate of 7%, governments could spend up to $29.8 M in North-east Victoria and $40.5 M in the Murray catchment and still achieve a net economic benefit, provided the conservation outcomes were achieved.

Policy proposal

Agencies such as the Department of Land and Water Conservation (DLWC, New South Wales), Greening Australia and the Department of Natural Resources and Environment (DNRE, Victoria) already provide incentives to farmers. Our research indicates that further development and expansion of such programs is warranted. We suggest mechanisms by which the result of the benefit–cost analysis can be incorporated into an incentive policy for RNV conservation, and outline our attempts to

undertake a preliminary assessment of the likely success of the proposals. Amongst other things, we recommend a package that contains the following two elements.

1 Non-binding management agreements that include direct grants of up to $2,000/km to contribute towards fencing costs; and 100% rate rebates for the area of RNV under the management agreement, with a minimum payment of $250 per annum.

2 Binding management agreements that include direct grants for fencing materials and labour up to $5,000/km; 100% rate rebates for the area of RNV under the management agreement, with a minimum payment of $250 per annum; and annual payments for RNV management costs (such as control of weeds and feral animals).

We also cover issues such as the institutional arrangements needed to support RNV conservation and the delivery of enhanced economic incentives; the need for increased prohibitions on RNV clearing; priorities for allocating funds; RNV management plans; monitoring and enforcement; and education.

1 Introduction

This report summarises the results of the project *Economics of remnant native vegetation conservation on private property*. The project ran from June 1996 to November 1999, funded by LWRRDC and Environment Australia through the National Remnant Vegetation R&D Program. The New South Wales National Parks and Wildlife Service (NSW NPWS) and the Department of Natural Resources and Environment (DNRE, Victoria) were partners in the project. Other collaborating organisations included the Department of Land and Water Conservation (DLWC, New South Wales), Greening Australia, the Murray Catchment Management Committee (MCMC), the North-east Catchment Management Authority, and the West Hume Landcare Group. The research team, from the Johnstone Centre, Charles Sturt University, comprised Michael Lockwood, Sandra Walpole, Evelyn Buckley, Carla Miles, David Carberry, Helen Glazebrook and Allan Curtis.

The main project objectives were to:

1. identify and characterise the remnant native vegetation (RNV) on private land in the study areas (North-east Victoria and the Murray catchment in New South Wales);
2. estimate the market economic value of these remnants;
3. estimate the non-market economic value associated with these remnants; and
4. recommend mechanisms by which the values identified in objectives 2 and 3 could be translated into policies and incentives for remnant vegetation conservation.

As part of achieving objective 4, we used the various economic values to compile a benefit-cost analysis. This report first outlines the significance and scope of the work, then describes how each of the objectives were met.

2 Significance and scope

The clearing of native vegetation in rural Australia has been identified as a major environmental problem, and has been implicated as a cause of dryland salinity, weed invasion, soil erosion, soil structural decline and the loss of native plant and animal species (Nadolny *et al.* 1991; ABS 1992). Remnant native vegetation (RNV) is a term we use to describe those patches of bushland which remain on private property following widespread clearance of native vegetation[1]. In addition to continued clearing, RNV faces incremental degradation from threats such as inappropriate grazing, timber harvesting, fire, weed invasion, rising watertables and insect attack.

Conservation of RNV is an important aspect of combating dryland salinity, declining water quality, soil erosion, and loss of biodiversity. Until recently, nature conservation has been based largely on the reservation of public land. While these reserve areas are critical, bushland on private property is also important, particularly for those vegetation types that are not well represented on public land. At present, more than two-thirds of Australia is managed by private landholders (Commonwealth of Australia 1996). The area of conservation reserves, now comprising about 7.7% of Australia, does not provide an adequate representation of the continent's biological diversity (CSIRO 1996).

Impediments to RNV conservation include resistance from some social and political institutions, economic costs, inconvenience, incompatibility with the landholder's style of land management, and a lack of social acceptability among some rural subcultures (Chamala 1992; O'Brien 1992; Vanclay 1992; Campbell 1994; Goldney and Watson 1995).

The regulatory approach to prevent clearing has had some success, but is difficult to enforce, lacks local support, leads to inequitable distribution of benefits and costs, and does not halt the incremental decline of RNV quality. Economic incentives offer a complementary approach that can overcome these limitations. The justification and design of economic incentive policies has been hampered by a lack of data on:

- who would bear the economic costs of RNV conservation, and the magnitude of these costs;
- who would gain benefits from RNV conservation, and the magnitude of these benefits; and
- whether the net benefits outweigh the net costs.

We used landholder surveys, community surveys and secondary sources to gather such data, and incorporated them into a benefit–cost analysis (BCA) of RNV conservation policy for two study areas: North-east Victoria and the Murray catchment in New South Wales. To incorporate all components of economic value, a BCA must take into account both market and non-market costs and benefits. An analysis that includes consideration of both these value components is sometimes termed an extended BCA. An extended BCA is based on several requirements and assumptions. It is important to recognise these, as they impose limits on the interpretation and applicability of the results. Four of the more important requirements and assumptions are as follows.

1. A BCA of a proposed policy requires that there be identifiable stakeholders who have preferences concerning the issue at hand, and that these preferences meet a set of conditions determined by economic theory (completeness,

1. Only native forest and woodland are considered in this paper. Wetlands lacking a *Eucalyptus camaldulensis* overstorey and native grasslands are not included in the analysis.

reflexivity, transitivity, non-satiation and continuity)[2]. Certain personal, social and moral values may not be expressed in a way that is consistent with all these conditions. Such values cannot be meaningfully incorporated into a BCA. Hence, a BCA may only be a partial value assessment.

2. The economic preferences of stakeholders must either be:
   (i) accurately revealed, directly or indirectly, through market transactions; and/or
   (ii) measured in a survey that enables each stakeholder to state accurately their willingness to pay (or willingness to accept compensation) for the policy. Such surveys are termed 'stated preference' surveys.
3. A BCA usually assumes that it is acceptable to use preferences based on the existing distribution of wealth, which of course affects ability to pay, and therefore willingness to pay.
4. A decision must be made about the aggregate time preference for money. It is usual to discount future benefits and costs to present values using a discount rate. The higher the discount rate, the lower are future benefits and costs valued relative to the present. Since the discount rate can affect the result of a BCA, and the choice of a rate is to some extent a matter of judgment on the part of the analyst, it is common to compute the BCA using a number of different discount rates. This enables determination of the sensitivity of the BCA result to the choice of discount rate.

Because of these factors, it may be necessary to rely on other participatory and political processes to make a final judgment about the merits of a policy. A BCA may make an important contribution to these judgments.

2. See, for example, Gravelle and Rees (1981) for an explanation of these conditions.

3 Inventory of remnant native vegetation

The locations of the two study areas, North-east Victoria, and the Murray catchment in New South Wales, are shown in Figure 1. RNV in the two study areas was identified using remote sensing and field surveys.

A preliminary identification of RNV areas was done by classifying three-band satellite images of the relevant 1:100,000 scale map tiles. Areas of RNV were also provisionally classified into broad vegetation types (BVTs), based on prior knowledge of the distribution of each BVT (DNRE 1996). Only remnants greater than 1 ha were included. This threshold was adopted because it is unlikely that smaller areas would support nature conservation values in the medium to long term. The following data were compiled:

- study area boundaries;
- private/public land boundaries;
- RNV locations on private land;
- BVT classification of remnants; and
- proportions of RNV classified as being of high, medium or low nature conservation quality for each BVT[3].

Sixty-two sites across North-east Victoria were field checked for the accuracy of both the provisional RNV location and BVT classification. These sites were chosen to cover all BVTs from across the geographic range of the study area. This ground-truthing of the provisional identifications and classifications indicated 95% accuracy in both location and BVT ascription of the RNV blocks.

The North-east Victoria study area covered 1,880,056 ha, including 113,313 ha of RNV; 1,205,498 ha of forested public land; 8,000 ha of private pine plantations; and 553,245 ha of predominantly cleared private land. Just over half the RNV was of medium quality, nearly half of high quality, and only a small proportion of low quality.

In the Murray catchment, 203 sites were field checked for the accuracy of both the initial RNV location and BVT classification. Accuracy in identifying RNV blocks was an unacceptably low 74%, mostly because of difficulties in identifying the relatively sparse RNV in the western third of the study area. Reclassification of RNV in this portion of the study area corrected all the identified errors, though the final degree of accuracy is uncertain.

The New South Wales study area covered 3,643,686 ha, including 203,429 ha of RNV; 381,076 ha of forested public land; 15,896 of private pine plantations; and 3,043,285 ha of predominantly cleared private land. About two-thirds of the RNV is medium quality, about one quarter is high quality, and one tenth is low quality.

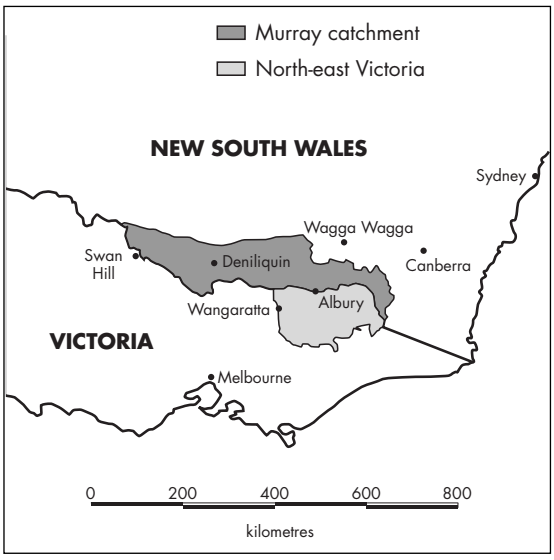

Figure 1. Study areas

3. Quality classes were allocated based on the following criteria: intactness, presence of tree hollows, presence of fallen timber, extent of overstorey regeneration and extent of overstorey dieback (see Lockwood *et al.* (1997) for details).

4 Estimation of economic values

RNV has a number of economic value components that can be incorporated into a BCA. RNV can contribute to on-farm productivity through provision of unimproved grazing, timber products and stock shelter. It can impose an opportunity cost if the forested land could otherwise be cleared and used as improved pasture, pine plantation, or for some other enterprise. There are also costs to landholders associated with weed control, pest control, fence maintenance, and fire management. RNV may provide benefits to downstream rural and urban populations though amelioration of land degradation associated with salinity, water quality decline and soil erosion. Salinity in particular imposes costs associated with decline in agricultural productivity and damage to infrastructure. Since RNV acts as carbon storage, preventing clearing is beneficial in terms of reducing carbon emissions to the atmosphere (with the consequent mitigation of global warming). The Australian community also places economic value on attributes of RNV such as scenic amenity and contribution to biodiversity conservation. In this section we describe our assessment of these values, and briefly consider the contribution of RNV to the resale value of properties.

4.1 On-farm values[4]

Data on the on-farm benefits and costs associated with RNV in the two study areas were collected using landholder surveys. Drafts of the survey instrument were refined with the assistance of a focus group of North-east Victoria landholders, members of the project steering committee, and a pre-test among other North-east Victoria landholders. Details of the process used to develop the surveys are given in Miles (1998a). In the Victorian sample, 100 participants were interviewed between November 1997 and February 1998. In the New South Wales sample, 122 participants were interviewed between February 1998 and June 1998.

The surveys enabled quantification of the following economic values:

- management costs, including weed control, fencing, pest control, burning, maintaining access tracks and firebreaks, and removal of fallen timber;
- opportunity costs of preventing landholders from clearing RNV to establish pasture, pines, hardwoods, cropping, rice, olives, grapes, or chestnuts; and
- benefits associated with increased stock production, increased agricultural production arising from mitigation of land degradation, increased crop production, and production of timber for firewood and fencing.

Participants were given the option of undertaking the interview either in person (face-to-face) or over the telephone. This provided participants with the choice most convenient for them, allowing a greater number of interviews to be made, while reducing the travel costs involved in carrying out all the interviews in person. A printed questionnaire and scripts for telephone conversations were developed to standardise the interviews.

The mixed strategy of face-to-face and telephone interviews had the potential to result in varying responses between the two different methods. The likelihood of such differences was investigated following the pre-test of the survey. There were no differences at that stage, so a mixed approach continued for the remainder of the interviews. In addition, Chi-square tests using the whole data-set were done on several key questions to test for any significant differences. Again, there were no significant differences between responses gathered by the two methods.

The study areas were stratified according to vegetation type, landform, climate and land use.

4. See Miles *et al.* (1998a) for further details.

Combining information on the area of RNV, the economic data, and the strata in which the surveyed properties were located, enabled extrapolation of costs and benefits from the individual property level up to the entire area of RNV present in the respective study areas. The values per hectare of RNV for properties in the same stratum were averaged, and multiplied by the total area of RNV in that stratum. Unsurveyed strata were given the average value of all the other strata.

For the North-east Victoria study area, the combination of all four land characteristics resulted in 55 strata that contained RNV. Strata-specific survey data were available for 103,647 ha (or 91.5%) of the total RNV area of 113,313 ha. For the New South Wales study area, the combination of all four land characteristics resulted in 79 strata that contained RNV. Strata-specific survey data were available for 183,964 ha (or 90.4%) of the total RNV area of 203,429 ha.

4.1.1 Property characteristics

In North-east Victoria, 26,058 ha of land was being managed by the participants, of which 6,659 ha (25%) was RNV. The average size of each property surveyed was 260 ha, with an average RNV area of 66 ha on individual properties (ranging from 1 to 810 ha). The average number of RNV patches greater than or equal to one hectare on individual properties was 2.4. The highest number of patches recorded for one property was 10. Participants were also asked to indicate the size of their largest patch of RNV. On average, this was 45.5 ha, almost three quarters (68%) of the total area of RNV on each property. When asked to rate the quality of RNV, the majority of participants indicated that their remnants were either modified (55%) or intact (40%).

In the Murray catchment, 195,571 ha of land was being managed by the participants, of which 18,542 ha (9%) was RNV. The average size of each property surveyed was 1,603 ha, with the average RNV area of 154 ha (ranging from 1 to 2,000 ha). There were, on average, 6.2 RNV patches greater than or equal to one hectare on each property. The size of the largest patch of RNV was on average 91.5 ha, or 60% of the total area of RNV on each property. When asked to rate the quality of RNV, the majority of participants indicated that their remnants were either modified (60%) or intact (19%), but a higher proportion of remnants was considered degraded (21%) compared with the North-east Victoria study area (5%).

The most common farming enterprise undertaken on North-east Victoria properties was the grazing of beef cattle, followed by the grazing of sheep for wool, and dairying. In the New South Wales study area, the most common enterprise was cropping, followed by cattle grazing, sheep for wool and sheep for mutton.

Table 1. Direct management costs associated with remnant native vegetation

		Average $/year per property			Total $/year for all properties	$/ha of RNV
		Materials	Labour	Total		
Weed control	NE Vic	831	988	1,818	181,790	27
	Murray	577	514	1,086	132,500	7
Fencing	NE Vic	222	360	582	58,180	9
	Murray	253	175	426	51,915	3
Pest control	NE Vic	172	354	526	52,619	8
	Murray	237	366	600	73,193	4
Other[a]	NE Vic	37	136	172	17,225	3
	Murray	124	166	289	35,215	2

[a] Burning, maintaining access tracks and firebreaks, removal of fallen timber, and erosion control

For the Victorian participants, the major use of RNV related to farm productivity was firewood extraction, followed by stock shelter and shade, domestic grazing and fence posts. A similar use pattern was evident in the Murray catchment, with fence posts being less important, while honey production and commercial firewood extraction were more significant. Other uses included protecting water quality, for education, and acting as a windbreak. Some 65% of Victorian participants and 47% of New South Wales participants used their RNV for various recreational purposes. A range of uses was identified, with walking being the most popular activity for Victorians, and camping and relaxing most popular with New South Wales participants.

4.1.2 Direct costs

Direct costs were the time and money specifically spent on RNV management. Table 1 shows the average annual amount spent on the ongoing management of RNV per property, taking into account landholders' labour costs that were valued at $15 per hour (based on advice from the project advisory committee). The total costs for all participants and the average costs per hectare of RNV are also provided. On average, participants were spending $3,098 per year in North-east Victoria and $2,400 in the Murray catchment on the direct management of their remnants. Weed control was the highest cost associated with the ongoing management of the RNV in both North-east Victoria and the Murray catchment. Some 30% of Victorian and 44% of New South Wales participants had some RNV fenced off, with an average of $582 per year spent on maintaining fencing in North-east Victoria and $426 in the Murray catchment. New South Wales participants spent more money on pest animal management than those in Victoria.

4.1.3 Past clearing and opportunity costs

Twenty-one per cent of participants in North-east Victoria and 19% in the Murray catchment indicated that they had cleared areas of RNV in the past 10 years. On average, 22 ha had been cleared by these Victorian participants, and 143 ha by the New South Wales participants. Pasture establishment was the most common reason in both study areas, but in the Murray catchment, cropping and rice production were also significant.

Thirty-four per cent of Victorian participants said they would consider clearing areas of RNV in the next 10 years, compared with 11% in the Murray catchment. The total potential area of RNV to be cleared in North-east Victoria was 568 ha, compared with 842 ha in the Murray catchment. The proposed clearing would reduce the total area of RNV on Victorian participants' properties by 9%, and on New South Wales properties by 5%. Participants were asked to indicate on a scale from one (very unlikely) to five (very likely), the likelihood of clearing for different land uses. Pasture development was the most popular reason for Victorians wanting to clear, although the likelihood of clearing for any of the listed reasons was not strong, with most means below two. Establishment of hardwood plantations was the most likely reason for New South Wales participants to want to clear RNV.

Participants who had cleared in the past were significantly more likely to clear in the future, both in the Murray catchment and North-east Victoria (in a ∂^2 test, $p < 0.02$). In both study areas there was a significant difference in the size of properties between participants who were considering clearing and those who were not (in a Wilcoxon rank sum test, $p < 0.05$), with those having larger properties more likely to clear. There was also a significant difference in the area of RNV on properties between participants who were considering clearing and those who were not (in a Wilcoxon rank sum test, $p < 0.02$), again with owners of properties containing larger areas of RNV more likely to clear.

While the likelihood of clearing was correlated with membership of Landcare, in North-east Victoria significantly more Landcare participants had already fenced areas of RNV (in a ∂^2 test, $p < 0.0005$). This difference was not evident for the New South Wales participants.

The opportunity costs for participants who suggested they might clear in the next 10 years were calculated by obtaining the net present values[5] (NPVs) for alternative land uses and multiplying these values by the area (ha) to be cleared, and the probability of clearing for the specified purpose.

The NPV estimates for the returns from alternative land uses were gathered from research publications and contacts, including Kellas (1993), Walpole (1994), Hobman (1995), Elton (1997), Trapnell (1998) and Uebergang and Lavis (1998). The assumptions underlying these estimates varied according to the life of the projects; the discount rates used; and the regions in which the studies were conducted. In some cases, the raw data were adjusted to obtain a standard measurement of NPV for all alternative land uses. For example, NPVs for projects with shorter time frames than others were recalculated based on the time frame of the longest project, which was 40 years for pines and native hardwood establishment. A seven per cent discount rate was used in the calculation of all NPVs. Results from the opportunity cost calculations are given in Section 4.1.5.

4.1.4 On-farm benefits

Benefits were assessed by first asking participants whether they considered that they receive a particular benefit type from their RNV. Major benefit types were presented to participants, and they also had the opportunity to indicate benefits not on the list. The 'other' category was divided into response categories after the surveys were completed. Some participants were unable to comment on whether there were particular benefits or not, simply because they did not know, or the benefit was not applicable to their property. Where possible, participants were also asked to quantify the benefits — for example, tonnes of firewood, number of stock grazing in the RNV for a certain time period, and so on. Table 2 gives the perceived benefits participants received from their RNV.

Table 2. Perceived on-farm benefits of remnant native vegetation

Benefit	Victoria (% of participants[a])	New South Wales (% of participants[a])
Aesthetics	89	95
Timber for firewood and fencing	86	68
Increased agricultural production	77	73
Recreation	73	54
Habitat for animals which help control pests	69	61
Increased stock production	62	84
Cleaner water	60	49
Nutrient cycling/soil formation	45	42
Other	37	38
Increased crop production	0	25
No benefits	0	0

[a] More than one alternative could be selected by each participant.

Of the benefits listed in the survey, aesthetics received the highest number of positive responses in both study areas. Victorian landholders next recognised timber for firewood and fencing, increased agricultural production, recreation, and habitat for invertebrate pest predators. Many commented on the balancing out effect of having both pest animals and those that help control pests. About 60% thought that RNV provided increased stock production and water quality. A dominant response by landholders who did not agree that RNV provided an increase in stock production was that the stock (cattle in particular) preferred to congregate

5. The NPV for a proposal is calculated by adding up the net benefits over the lifetime of the proposal, as given by:

$$NPV = \{^{t=n} B_t - C_t\} \div \{^{t=1}(1 + r)^{t}\}$$

where:

t is a particular year of the project, which ranges from 1 at the start of the project to the lifetime of the project at n years;

B_t are the benefits in year t;

C_t are the costs in year t; and

r is the discount rate throughout this report.

around single trees in open paddocks rather than dense areas of bushland. New South Wales landholders more strongly recognised the benefits of RNV for stock production. Less than half of the participants thought there were nutrient cycling and 'other' benefits.

Although only two per cent of Victorian participants had cropping as their main farming enterprise, seven per cent had some cropping areas. Of these participants, none believed there were any crop-production benefits associated with RNV. In contrast, about one third of the New South Wales participants with cropping as a major part of their enterprise recognised some crop-production benefits associated with RNV. None of the participants believed that there were no benefits associated with remnants.

The most common benefit reported under the 'other' category was wildlife habitat. Other perceived benefits included value as a windbreak, contribution to quality of life, the effect RNV has on climate, privacy, barrier to noise, maintaining ecological balance, educational value, nature conservation value, provision of sawlogs and as a seed source.

Because of the difficulty of quantifying many of the benefit types, the economic assessment undertaken in this work included only increased stock production, increased agricultural production arising from mitigation of land degradation, increased crop production, and timber for firewood and fencing. The estimates of total benefits are therefore conservative.

Increased stock production

Two aspects of stock production were assessed: (i) the actual grazing benefits that stock derive from spending time in the remnants; and (ii) the increased production arising from enhanced livestock health, including their ability to shelter in the RNV during extreme weather; and enhanced pasture production.

For Victorian participants, the grazing benefit attributable to the time spent in the remnants was computed using the product of the gross margins of stock, the number of stock using the RNV, and the length of time spent in the RNV. The potential marginal benefit from the total farm production took into account the gross margin, the number of stock using the RNV, and the increase in stock production. Several New South Wales landholders gave unrealistic answers that were not picked up at the time by interviewers. These landholders asserted that their stock grazed most of the year in the RNV. This was despite the presence of extensive areas of cleared pasture on their properties. Given this, the grazing benefit for New South Wales participants was computed on the basis that stock spent twice as much time in the cleared areas as they did in the RNV.

The gross margins used for sheep and cattle were based on commodity prices derived from the Australian Bureau of Agricultural and Resource Economics commodity price forecasts (Uebergang and Lavis 1998). The percentage increase in stock production owing to livestock health and pasture production from shelter and shade was set at 20%. This figure was derived from research, and estimates obtained from the survey. Even though participants specified different percentage increases in stock production, a 20% value was applied in all cases to be consistent. This value may over-estimate some of the values reported by participants, since 10% was the average increase reported. However, the benefits of shelter to stock have been widely researched (Lynch and Donnelly 1980; Dengate 1983; Bird *et al.* 1984; Richmond 1992; Fitzpatrick 1994), and represent figures closer to 20%, although this includes the benefit trees provide to both pasture growth and livestock health. Note that much of the research undertaken on the benefits of trees for shelter and shade has related to planted shelterbelts and windbreaks, rather than naturally occurring remnants of bushland. However, the figures indicate the possible benefit derived from RNV even though the shelter structure is different. Clearly, benefits and costs of RNV will vary from property to property. The type of benefit will depend on the species of trees providing the benefit, the immediate environment and the intended uses of the farm (Scanlan 1992).

Increased agricultural production

Increased agricultural production owing to land degradation control was calculated based on the assumption that the presence of certain proportions of RNV can aid in the mitigation of land degradation, and thus can be beneficial to overall farm output. Walpole (1999) calculated increases in pasture output attributable to combating land degradation given a particular level of RNV. Based on the average proportion of RNV of 25% for Walpole's (1999) study area at Gunnedah, north-western New South Wales, the total benefits of combating land degradation were $13.95/ha. This figure represents the benefits that RNV provides in terms of shelter and shade, as well as land degradation control benefits. An average marginal benefit of $4.41/ha was determined as a shelter and shade benefit for RNV. Subtracting this from $13.95/ha, gives a $9.54/ha benefit attributable to land degradation alone. This benefit occurs on cleared parts of the farm, which have less run-off and erosion owing to the presence of RNV further up the slope. We assumed that: all RNV is 'upstream' of the grazed area; all production benefits from RNV were related to improved grazing; and increasing RNV has a constant marginal effect on land degradation control benefits. Our estimates of the contribution of RNV to productivity via land degradation control for each property were based on these assumptions and Walpole's (1999) estimates.

Increased crop production

The estimation of by how much RNV augments crop production was based on the protection RNV provides from wind, thereby reducing moisture loss. It has been estimated that the protection benefits of RNV extend for at least 15 times the height of the tree canopy (Dengate 1983). However, for a distance equal to about twice the canopy height, the protection benefits are offset by shading and moisture competition. If we assume the average height of RNV canopy to be 20 m, crops within 40 m of the RNV do not benefit, but the productivity of crops between 40 m and 300 m from RNV is enhanced by about 20% (Dengate 1983; Richmond 1992; Bird *et al.* 1993; Fitzpatrick 1994). The survey information was not detailed enough to determine the exact area on each property that was so located. To calculate a benefit, we have assumed that: (i) benefits were limited to those participants who stated that their crop production was enhanced by the presence of their RNV; and (ii) their crop was assumed to be located adjacent to one side of their largest RNV block, which was assumed to be square (to enable calculation of the length of one side). The benefit was then given by 20% of the product of the sheltered area (less the 40 m zone adjacent to the RNV) and the gross margin for the crop.

Timber for firewood and fencing

The annual revenue of firewood was calculated by multiplying the number of tonnes extracted per year by $100/tonne. The benefit of posts extracted per year was calculated at $10/post, based on quotes given by fencing material suppliers.

The current net benefits associated with increased stock production, increased agricultural production arising from mitigation of land degradation, increased crop production, and timber for firewood and fencing, are given in the next section.

4.1.5 Benefit–cost analysis of on-farm RNV values

The issue being addressed in this study was whether the conservation of RNV is economically viable for landholders. Five alternative management scenarios were evaluated, and compared with the maintenance of the current situation (Table 3). For the five alternative scenarios for RNV management, clearing of RNV was not permitted. Although clearing is currently restricted in both New South Wales and Victoria, we have still included clearing controls as an opportunity cost for several of the scenarios because landholders have still cleared significant areas of RNV, and several landholders were considering clearing more RNV. Prohibiting clearing can be considered an opportunity cost of regulation.

The opportunity costs associated with activities such as establishment of orchards and vineyards were very high. It was of interest therefore to assess, in scenario

4, the effect of excluding these from the analysis. Since no New South Wales participants indicated that they would potentially clear RNV for such alternative uses, scenario 4 has been computed for only the Victorian study area. It was also of interest to exclude consideration of opportunity costs altogether, since in a policy context it may not be appropriate to offer incentives for what some people regard as a duty of care (scenario 5). It was still of economic interest, however, to compute the net costs of conserving RNV, including the costs of regulation (scenarios 1, 2 and 3).

Fencing RNV is important for achieving nature conservation objectives since this allows for either exclusion or effective management of stock. Hence, a requirement in all of the five scenarios was to fence either part or all of the RNV. Scenarios 1 and 2 involved fencing all RNV on each property. For participants who already had areas of RNV fenced, only the cost to fence the remaining RNV was estimated. For participants who did not have any RNV fenced, the cost was based on fencing all the RNV. However, it may not be practical to fence all RNV areas. It is likely to be most useful with respect to both land management and nature conservation objectives to fence at least the largest RNV block. Hence, scenarios 3, 4 and 5 required fencing of only the largest block of RNV on each property.

The results based on the five scenarios are summarised in Tables 4 and 5. The NPVs for the current situation and each scenario were calculated by subtracting the sum of the present values (PVs) of all the relevant cost components from the sum of the PVs of all the relevant benefit components. A period of 40 years and a discount rate of 7% were adopted in all cases. The long period was required because of the

Table 3. Scenarios for calculation of on-farm present value

Scenario	Management requirements
Current situation maintained	RNV may/may not be fenced, grazed or used for timber products Landholders may/may not have intentions to clear[a]
Scenario 1	Fence all RNV on property Strictly enforce prohibitions on all RNV clearing Cease domestic grazing Cease collection of firewood and posts
Scenario 2	Fence all RNV on property Strictly enforce prohibitions on all RNV clearing Allow grazing consistent with biodiversity conservation[b] Allow collection of firewood and posts consistent with biodiversity conservation[c]
Scenario 3	As for Scenario 2, but fence only largest RNV block
Scenario 4	As for Scenario 3, except exclude RNV that landholders desired to clear for high value uses such as grapes or horticulture[d]
Scenario 5	As for Scenario 3, except consider retention of RNV a 'duty of care'[e], so opportunity costs of clearing regulations are not included in the analysis

[a] Current regulations in Victoria would discourage, though not necessarily prevent, this extent of clearing. Under the New South Wales *Native Vegetation Conservation Act 1997*, most clearing applications assessed during 1998 and 1999 were approved, either in their original form, or in a modified form to reduce environmental impacts.

[b] Limit grazing to a maximum of 10 weeks per year. Details of grazing regimes consistent with achieving biodiversity outcomes need to be determined according for the particular requirements of each vegetation type. At present such detail is unavailable.

[c] Limit firewood and post extraction to 0.5 tonne/ha/year.

[d] This scenario allows us to address the question (in Section 5) of whether preventing clearing for low value uses, but allowing clearing for high value uses, is economically justified. Only North-east Victoria landholders expressed a desire to clear for high value uses.

[e] A duty of care places a responsibility on landholders to retain at least existing RNV, but not necessarily to manage it for conservation purposes. Under this scenario, landholders are assumed to forego some of the property rights that are normally associated with private land. They do not, therefore, have the opportunity to improve the capital value of land currently occupied by RNV, or substantially change its character.

need to include the opportunity costs of establishing pine or hardwood plantations. Income from these alternative land uses is typically assessed over 40 years — to adopt a shorter period would involve serious underestimation of the benefits associated with these enterprises. For consistency, this then requires that all values were assessed over the 40-year period. While the NPV for each scenario is of interest, the crucial figure is actually the difference between the NPV for the current situation and that for each scenario. This difference is labelled the incremental effect (IE) of each alternative scenario.

The results of the on-farm BCA indicate that the maintenance of the current management regime had an aggregated positive value of $241,983 for the 100 Victorian participants, and was worth $11,688,741 to the 122 New South Wales participants. This is an average positive return (over 40 years) of $2,420 per property for Victorian participants, and $95,809 per property for New South Wales participants. The North-east Victoria NPVs were negative for all scenarios, whereas they were all positive for the Murray catchment with the exception of scenario 1. All the IE values were negative for both study areas.

The values for individual properties varied considerably. If the current management practices undertaken by participants continued over the next 40 years, one participant in Victoria would be economically worse off by $331,279, whereas another would gain by $253,850. The corresponding minimum and maximum values for New South Wales participants were a loss of $220,407 and a gain of $1,491,552.

It was also of interest to examine the number of participants who gain and lose under each of the scenarios. If participants were to continue current management of their remnants over the next 40 years, just over half (53%) of the Victorian participants would gain economically from their RNV. More New South Wales participants were gaining more value from the RNV, with 82% having a net economic benefit under current management regimes. The alternative scenarios all result in an increase in the number of participants with negative

Table 4. Aggregate on-farm net present value results for Victorian participants

	PV costs ($)			PV benefits ($)	NPV ($)	IE ($)
	Direct	Opportunity	Total			
Current	4,130,350		4,130,350	4,372,333	241,983	n/a
Scenario 1	6,923,746	3,395,314	10,319,061	2,200,420	–8,118,641	–8,360,624
Scenario 2	6,053,603	3,395,314	9,448,917	3,881,606	–5,567,311	–5,809,294
Scenario 3	5,610,142	3,395,314	9,005,457	3,881,606	–5,123,850	–5,365,834
Scenario 4	5,610,142	543,465	6,153,607	3,757,719	–2.395,888	–2,637,871
Scenario 5	5,610,142	0	5,610,142	3,757,719	–1,852,423	–2.094,407

Table 5. Aggregate on-farm net present value results for New South Wales participants

	PV costs ($)			PV benefits ($)	NPV ($)	IE ($)
	Direct	Opportunity	Total			
Current	3,903,831	n/a	3,903,831	15,592,572	11,688,741	n/a
Scenario 1	7,428,989	2,969,354	10,398,343	6,196,499	–4,201,844	–15,890,585
Scenario 2	6,576,305	2,969,354	9,545,659	11,470,639	1,924,981	–9,763,761
Scenario 3	5,462,108	2,969,354	8,431,462	11,470,639	3,039,177	–8,649,564
Scenario 5	5,462,108	0	5,462,108	11,278,993	5,816,885	–5,871,857

NPVs, especially scenario 1, under which no Victorians would have a net gain from their RNV, and only 30% of New South Wales participants would at least break even.

As noted above, combining information on the area of RNV in each stratum, the NPV results from each sample of participants, and the strata in which the surveyed properties were located, enabled extrapolation of economic values from the individual property level up to the entire areas of RNV present in the study areas. Two time periods were assessed — 5 and 40 years. The five-year analysis was included because of the need to match the scenario to a reasonable policy horizon. One of the major value components, the opportunity costs of not clearing any RNV, is significantly underestimated over this period. This is primarily because landholders wanting to clear to establish pasture, hardwood or softwood plantations, or for horticultural activities such as orchards, would not obtain a return on their investment within five years. No opportunity costs have been included in the five-year scenario. The results are given in Tables 6 and 7.

Under each of the time periods, the NPVs for the change from the current situation to the proposed conservation scenario are negative. The North-east Victoria NPVs ranged from –$113 M for the 40-year scenario with inclusion of all opportunity costs, to –$30.9 M for the five-year scenario. The Murray catchment NPVs ranged from –$52.9 M for the 40-year scenario with inclusion of all opportunity costs, to –$35.1 M for the five-year scenario. RNV conservation imposes a significant net cost on most landholders.

Table 6. On-farm net present values over 40 years for the study areas

	North-east Victoria ($ M)[a]			Murray catchment ($ M)[a]		
	Current situation	Proposed scenario	Net change	Current situation	Proposed scenario	Net change
Benefit						
On-farm productivity	80.1	71.5	–8.6	182.2	165.4	–16.8
Cost						
RNV management	–80.1	–108.0	–27.9	–49.0	–74.3	–25.3
Opportunity cost (OC)	0.0	–76.5	–76.5	–0.0	–10.8	–10.8
Limited OC	0.0	–9.1	–9.1			
NPV scenario 3 (all OCs)			–113.0			–52.9
NPV scenario 4[b] (limited OCs)			–45.4			–52.9
NPV scenario 5 (no OCs)			–36.5			–42.1

[a]Rounded to nearest $100,000

[b]As noted in Table 3, RNV that landholders wish to clear for high value uses such as grapes and orchards was excluded from the analysis for scenario 4. This exclusion involved 504 ha in North-east Victoria. This meant that the on-farm productivity benefits and RNV management costs were also slightly lower for this scenario than for the other four scenarios.

Table 7. On-farm net present values over five years for the study areas

	North-east Victoria ($ M)[a]			Murray catchment ($ M)[a]		
	Current situation	Proposed scenario	Net change	Current situation	Proposed scenario	Net change
Benefit						
On-farm productivity	25.1	21.2	–3.9	49.0	38.6	–10.4
Cost						
RNV management	–26.1	–53.1	–27.0	–15.9	–40.6	–24.7
NPV scenario 5 (no OCs)			–30.9			–35.1

[a] Rounded to nearest $100,000

4.1.6 Implications of the on-farm survey results

The most important economic benefits from RNV under current management regimes were productivity effects associated with prevention of land degradation, firewood production and, for the New South Wales study area, stock and crop shelter. The most significant cost was for weed management.

At first glance, the benefits New South Wales participants currently receive from their RNV might seem unrealistically large. However, a large proportion of the benefit was not a direct contribution to landholders' incomes. The largest benefit, land degradation mitigation, was a measure of how much productivity would be lost without the RNV. The firewood benefit was money saved, rather than a direct contribution to farm income. Note also that the benefit was a discounted value calculated over 40 years. As such, it constitutes only a small proportion of the average New South Wales participant's annual income.

The major actions in the proposed management scenarios were the prevention of clearing, fencing of the RNV, and limitations on grazing and on firewood and post removal. These changes would negatively affect most of the participants. In North-east Victoria, for example, with the average RNV area of 66 ha, a large amount of fencing would need to be erected, especially as 70% of the participants would be fencing their remnants for the first time. A large percentage of participants used their RNV for grazing (71% in North-east Victoria, 75% in the Murray catchment), so the economic impacts of restricting grazing were significant. In the Murray catchment, the proposed restrictions on firewood production also have a major effect on RNV benefits.

About one-third of Victorian participants and about one-tenth of New South Wales participants indicated they were considering clearing parts of their RNV in the next 10 years. For these landholders in particular, it is evident that RNV management was largely driven by economic concerns, rather than environmental and nature conservation considerations. The dominant reason participants had for clearing in the past was for pasture development. This was also the main reason for clearing in the future, although among the New South Wales participants there was also a significant interest in establishing hardwood plantations.

Landholders with large properties, large areas of RNV and a history of clearing in the past are more likely to clear in the future. Factors such as level of education, whether participants had bought the land in the last 10 years, and age had no effect on participants' intentions. Other studies have found similar results relating to property size, with owners of smaller properties being more likely to conserve RNV and wildlife (Breckwoldt 1983; Griffin 1990; Wilson 1992). Results from a landholder survey on the value of box–ironbark remnants (Hamilton *et al.* 2000) suggested that landholders with larger properties were more concerned about factors that returned a profit, whereas smaller landholders were more concerned about recreation and preservation of habitat. Primary producers are less likely to undertake conservation activities than those with a larger proportion of outside income (Breckwoldt 1983; Reeve and Black 1993). Factors relating to profitability are paramount for larger landholders as they are usually reliant on their property as their main source of income. This is particularly true for the majority of New South Wales participants.

One of the aims of the National Landcare Program is to develop a stewardship or land ethic, presumably with the view that this will affect the behaviour of landholders, in particular their adoption of practices that would improve farm viability and enhance biodiversity conservation. About half of the participants were members of Landcare, but these Landcare members were no less inclined to clear in the future than were participants who were not in Landcare. These findings are consistent with a landholder survey conducted in 1993 examining the relationship between Landcare and stewardship in North-east Victoria (Curtis and

De Lacy 1994; Curtis 1997). That work showed that there were no links between Landcare participation, stewardship and adoption of sustainable agricultural practices. There was no significant difference in the level of stewardship ethic between participants in Landcare and non-Landcare areas. Even more strikingly, Walpole (1999) found a negative correlation between the proportion of trees on a property and membership of Landcare in a survey of landholders near Gunnedah.

Voluntary programs such as Landcare which promote a change in attitudes and awareness are clearly not sufficient to ensure a change in behaviour of land managers. Landcare, as a form of communication and extension, is unlikely to achieve a change in landholder behaviour on a scale likely to have an effect at a landscape level (Curtis 1997). Voluntary programs may create behavioural change incrementally over the long-term, but legislation, incentives and strong political commitment will be required to engender significant changes in the short term (Binning and Young 1997).

It is questioned whether landholders should be expected to conserve biodiversity without significant financial, technical, institutional and moral support (Campbell 1994). The most common goals of farmers are for the business to survive and grow, to set and overcome challenges, and to make a profit while they are on the land (Makeham and Malcolm 1993). Even though some landholders appreciate that conservation may have wider economic rewards, and that land degradation may affect future yields, conservation practices may not be economically rational in the short term (Vanclay 1992), or even in the medium to long term, as found for the majority of participants in this study. If environmental safeguards such as RNV protection reduce the profitability by adding to landholder costs, as is the case for most landholders in North-east Victoria and the Murray catchment, then adoption will be difficult, and environmental damage will continue to occur.

Landholders often lack the funds to carry out rehabilitative works on their properties (Bryant 1992). Many are trying to pursue conservation activities, but it is becoming financially harder to do so. The scale of the costs associated with any of the management regimes examined in this study illustrates the financial strain placed on landholders when conservation activities are considered. Most of the landholders who are interested in nature conservation, and are doing something about it, are economically secure (Breckwoldt 1983). Most participants indicated that they would undertake activities to conserve their RNV if economic incentives were available.

This study confirms that one of the major barriers to protecting RNV is the economic cost associated with conservation management. A large proportion of participants cannot expect a positive return from investing in any of the five suggested RNV management scenarios. The direct and opportunity costs clearly outweigh the benefits. Policies designed to achieve conservation objectives for RNV, if they are to be successful, are likely to require significant financial incentives for landholders to undertake conservation activities.

4.2 Catchment benefits

Dryland salinity and soil erosion are the two main forms of degradation that might be exacerbated by continuing RNV decline, and might have an impact on downstream rural and urban populations. The catchment-level costs incurred by individuals, non-agricultural businesses and public utilities as a result of rising watertables and decreased water quality are relatively easy to identify and therefore tangible costs associated with this damage are readily determined (Eberbach 1998). Based on information available from neighbouring projects, and studies undertaken for the whole Murray–Darling catchment, the following costs were calculated for the North-east Victoria and Murray catchments:

- costs of remnant vegetation clearance to local government;

- costs of remnant vegetation clearance to non-farm businesses;
- costs of remnant vegetation clearance to urban households; and
- cost of carbon dioxide release following clearing.

Costs of remnant vegetation clearance to local government

Oliver *et al.* (1996) conducted surveys of local government authorities in the Murray Basin. Eight of the 15 councils in the Murray catchment indicated that they had incurred repairs and maintenance expenditure totalling $862,200 as a result of salinity/rising watertables. All North-east Victoria councils indicated that they had no repairs and maintenance expenditure related to salinity and rising watertables. However, based on the information on salinity levels, it is reasonable to assume that some costs are currently being incurred, but have not been attributed by councils to salinity. According to Oliver *et al.* (1996) annual average expenditure because of salinity and rising watertables was $149,000 for councils in Victoria and $114,000 for New South Wales councils across the Murray–Darling basin. For the purposes of this analysis, it was assumed that an annual expenditure of $50,000 is being incurred by councils in the Victorian study area.

Costs of remnant vegetation clearance to non-farm businesses

Businesses located in areas affected by salinity and raised watertables will incur costs related to damaged capital infrastructure and amenities. A study in the Loddon and Campaspe catchments (Whish-Wilson and Shafron 1997) found that the average annual cost for non-farm businesses affected by salinity and raised watertables was $26. There are 3,994 non-farm businesses in the New South Wales study area, and 3,069 in the Victorian study area. These businesses include accommodation, construction, manufacturing/mining, services, and retail/wholesale. Our calculations of the costs arising from salinity assume that the non-farm businesses in the upper parts of the catchment (east of Albury–Wodonga and south of Wangaratta) were not affected by salinity. This reduces the total number of non-farm businesses affected by salinity to 3,859 in the New South Wales study area, and 2,478 in the Victorian study area. Therefore, the total annual costs are $100,334 and $64,428, respectively.

Costs of remnant vegetation clearance to urban households

The Australian Mineral Development Laboratories (AMDEL) assessed the cost to urban households of either repairing, maintaining or replacing items damaged by saline town water (Lubulwa 1997). The AMDEL study included the impact of salinity on pipework and water fittings, hot water heaters, domestic appliances, water softeners, detergents and soaps, clothing, motor vehicles, garden produce, pot plants and evaporative air conditioners. The 1995 salinity cost estimate was 0.67 ($/household/year/EC unit[6]). These results can be used to estimate the costs to households from increases in EC units.

Our calculations of the cost to urban households as a result of salinity assume that the households in the upper parts of the catchments were not affected by salinity. Based on survey results for the Loddon and Campaspe catchments (Lubulwa 1997), it was also reasonable to assume that 10% of all households have a rainwater tank, thus avoiding any damage from salinity. This reduced the total number of households affected by salinity in North-east Victoria to 15,675, and in the Murray catchment to 23,357. The households in Swan Hill, Echuca, Moama and Barham were not included in the analysis, as it was not possible to separate the effects from the Goulburn/Broken and Loddon/Campaspe catchments. If it is assumed that at the current rate of clearing in the catchments, the annual increase in EC units is 1 EC unit, then the annual costs to all North-east Victoria and Murray catchment households are $10,502 and $15,649, respectively.

6. EC = electrical conductivity, in units of which salinity is measured. 1 EC unit = 1 microsiemen (μS)/cm/year.

The assumption of 1 μS/cm per year is likely to be very conservative, but there is no historical information available to give estimates of rates of change over time. To test the influence of this assumption, we also calculated the benefit estimates assuming rates of 5 and 20 μS/cm per year. The annual costs to all North-east Victoria and Murray catchment households are $52,511 and $78,246, respectively, for an increase of 5 μS/cm per year and $210,045 and $312,984, respectively, for an increase of 20 μS/cm per year.

Carbon sequestration

Human activities such as the burning of fossil fuels and land clearing are increasing the levels of greenhouse gases such as carbon dioxide in the earth's atmosphere. Elevated levels of these gases are likely to cause global climate change. Forests act as 'sinks' that absorb carbon dioxide, thereby building up a store of carbon in trees, other plants and soil. When land is cleared, a large proportion of the stored carbon is rapidly converted back into carbon dioxide. Land clearing contributed about 13% of Australia's greenhouse gas emissions in 1996 (AGO 1998).

Preserving and increasing the area of forest can enable Australia to reduce emissions and meet international commitments under the Kyoto Protocol. As a signatory to the Protocol, Australia intends, in conjunction with other industrialised nations, to adopt binding national emission targets. Australia's annual emission allocation for the five-year Kyoto commitment period, scheduled to begin in 2008, is equivalent to 108% of 1990 emission levels, subject to adjustment for sinks and international transfers (AGO 1999).

The mechanisms necessary to implement the protocol are still being developed. One possibility being considered is to incorporate carbon sinks, such as forest plantations, into an emissions trading system by allocating credits for the amount of carbon sequestered (stored in plants). Plantation operators could sell these credits in an emissions trading system. Preventing the clearing of RNV could also be considered as a carbon credit. The value of such carbon credits cannot be determined with certainty, but estimates place it at between $10 and $50 per tonne of carbon dioxide, with a mid-range of $30 per tonne, meaning that the value of Australia's emissions allocation under the Kyoto Protocol is about $12 billion per year (AGO 1999).

Preventing clearing of RNV in the two study areas can make a small contribution to reducing greenhouse gas emissions. Carbon sequestration has been highlighted by the Centre for International Economics (CIE 1998) as the most important off-site use value of remnant vegetation. For the purposes of this study, it is useful to include an estimate of these benefits, although these values are clearly not restricted to the study areas.

An indicative value can be put on the carbon sequestration benefits of preventing RNV clearing by equating them with the estimated value of the equivalent carbon credits. For the purposes of this report, we have adopted the most conservative of the estimates reported in AGO (1999) — $10 per tonne of carbon dioxide. After clearing, carbon is released from a site for a 20-year period, which results in around 180 tonnes of carbon dioxide being released from each cleared hectare of land (CIE 1998). Given a value of $10/tonne carbon dioxide, the benefit of not clearing is $1,800 per hectare. Based on results from the survey, landholders intend to clear 7,174 ha in North-east Victoria, and 3,425 ha in the Murray catchment over the next 10 years. Assuming that landholders will clear the entire area they indicated in the first year, the annual carbon sequestration benefit of not clearing would be $645,660 per year and $308,250 per year for the next 20 years for the Victorian and New South Wales study areas, respectively.

Calculation of present values

The catchment benefits of conserving RNV were calculated as the difference between the costs incurred from the current management scenario and those likely to be incurred under the proposed conservation scenario (Table 3, scenario 3). These

benefit estimates take into account the relative contribution of RNV to watertable levels and water quality compared with vegetation on public land, perennial pasture and tree planting on private land. The calculations drew on the work of the Murray–Darling Basin Commission (1996), which attributed the benefits of vegetation impact on the watertable and water quality in proportion to the area of remnant vegetation occurring in the catchment. Of the tree cover in North-east Victoria and the Murray catchment, 8.5% and 33.9%, respectively, is RNV, with the balance being forested public land, hardwood and softwood plantations. For the purposes of this study, these values were used to indicate the proportional contribution RNV makes to the watertable and water quality levels in the two study areas.

The present values of the catchment benefits (PVBs) incurred by retaining remnant vegetation are indicated in Table 8. The calculations have been undertaken for a 40-year period. Given the relatively large contribution made by carbon sequestration, Table 8 also gives PVB estimates that exclude this value component. On this basis, RNV conservation yields a net benefit of about $4.5 M in the Murray catchment and almost $1 M in North-east Victoria. Under the same conditions, the carbon sequestration benefits were estimated to be about $3.3 M for the Murray catchment and $6.8 M for North-east Victoria.

The potential savings to local government, households and non-farm businesses from ceasing RNV clearing are larger for the New South Wales study area, where the RNV makes up a larger proportion of total tree cover than it does in North-east Victoria. The costs currently being incurred by local government in the Murray catchment are high in comparison with non-farm businesses and households. It is not possible to draw a comparison between the Victorian and New South Wales local government costs until some reliable values can be obtained from the councils in North-east Victoria. Further details are given in Walpole and Lockwood (1999).

Assumptions for calculations

It must be recognised that our benefit estimates involve numerous assumptions and considerable uncertainty. The following points indicate some aspects of particular concern.

1. The approach used by Whish-Wilson and Shafron (1997) in the Loddon and Campaspe catchments provides a good model for how to estimate the total costs of salinity and high watertables on agricultural productivity. Their approach requires detailed data on the areas affected by salinity. At the time of writing, these data were unavailable for either North-east Victoria or the Murray catchment. Furthermore, there are no models that enable predictions to be made of the impact that clearing particular areas of RNV might have on salinity levels. We have therefore been unable to include the marginal benefits that preventing clearing make to the agricultural productivity of downstream properties. To produce more reliable and inclusive results, detailed biophysical catchment

Table 8. Catchment benefits for the 40-year scenario

	North-east Victoria ($ M)[a]			Murray catchment ($ M)[a]		
	Current situation	Proposed scenario	Net change	Current situation	Proposed scenario	Net change
Local government costs	–0.83	–0.62	0.21	–15.82	–11.51	4.31
Non-farm business costs	–1.18	–0.86	0.32	–1.49	–1.34	0.15
Household costs	–0.19	–0.14	0.05	–0.24	–0.16	0.08
Carbon emission costs	–6.84	0	6.84	-3.27	0	3.27
Present value of benefits			7.43			7.80

[a] Rounded to nearest $10,000

models are required that enable estimates to be made of the effect each hectare of RNV has on watertables. However, such an analysis is beyond the scope of the work reported here.

2. We have assumed that salinity will rise by 1 μS/cm per year over the next 40 years. The actual rate of change may be much greater than this. However, it was found that the PVB estimates were not highly sensitive to the rate of salinity rise.
3. The clearing rates that are the basis of our estimates come from a landholder survey done in 1997. Since that time, approval has been given for a large softwood processing mill to be established at Tumut, just to the north of the Murray catchment. This new mill has been guaranteed that at least 30,000 ha of new pine plantations will be established. It is likely that some of these will be located in the Murray catchment, leading to additional pressures to clear RNV.
4. We have assumed a direct proportional link between area of forest cover, including RNV, and the salinity related costs faced by households, businesses and local government. The important aspect of this simplistic assumption is whether there is a simple linear relationship, as we assume, or a more complex and perhaps non-linear one, as is more likely. But since we know of no information to help us here, it is a matter of making the best estimate that we can on current information. Again, a detailed catchment model is required to enable more reliable estimates to be made.
5. We have assumed that the claim by councils in Victoria that they currently incur no salinity related costs reflects a lack of recognition on their part of the impact salinity has on infrastructure maintenance and replacement costs. Accordingly, our analysis included consideration of the role RNV conservation plays in avoiding such costs. However, the validity of including this (small) benefit component is unknown.
6. A market in carbon permits is unlikely to reflect the full economic value of reducing greenhouse gases. Estimates based on market price of these permits may therefore under-state the full economic benefit of avoiding greenhouse gas emissions. And of course the benefits calculated here for carbon sequestration are purely speculative, as a system of carbon credits does not currently exist in Australia.

Most of the assumptions we have made will tend to result in underestimation of RNV catchment benefits.

4.3 Property values

It may be possible to determine the market value of RNV through market transactions of properties containing RNV. From an economic perspective, the ability to value goods and services and obtain measures of welfare change where price or output levels change is often difficult for environmental 'goods'. In the transaction of land, it is often possible for individuals to choose their level of consumption of environmental goods through their choice of location, or selection of market goods. Remnant native vegetation can be regarded as an environmental good, and thus it may be possible to determine its market value through transactions of properties that contain it. This suggests that, in a decision to purchase a property, there may be an implicit market for the presence or amount that RNV contributes to the observed prices and consumption of market goods.

Hedonic pricing provides a means of determining the contribution of RNV to observed changes in land prices. The theoretical basis for this approach can be found in Rosen (1974), Freeman (1979) and Palmquist (1991). Hedonic pricing explores the relationships that may exist between the price of a good, and the bundle of characteristics (or attributes) which the good possesses, to explain variations in the prices of the differentiated goods under consideration.

The study areas chosen for this project are very large. The Murray catchment is 40,000 square kilometres, and the North-east Catchment 19,750 square kilometres. In developing a hedonic model that attempts to capture the influence that RNV may

be having on rural land values, it is important to consider a range of political, climatic, geographical, biophysical and land-use factors. The main categories that may be involved in the determination of rural land prices for the North-east Victoria and New South Wales Murray catchment study areas are:

- external forces — government influences that are likely to affect the use and profitability of the farm;
- land characteristics — those factors that influence productivity, consumption and location; and
- vegetation characteristics — the type of RNV that exists on the property and the surrounding area.

4.3.1 Data sources

Data for the hedonic study comes from three main sources: land sales records, direct responses from surveyed landholders, and biophysical information from the geographic information system (GIS) database for the study areas.

Land sales records

All real estate transactions are registered with the Valuer General's Offices in New South Wales and Victoria. A value of 2 ha was chosen for the minimum size of a holding to be included in the analysis. It was assumed that properties included are not part of an urban residential development.

Sales information for 2,480 properties in the North-east Victoria study area was obtained. This covered all private transactions of land greater than 2 ha from 1987 to 1997. The variables provided with these sales records were: seller name, owner name, owner address, property location, total area, parish, municipality, lodged plan number, title number, sale date, municipality name, sale price, sale terms, improvements, construction classifications, and land-use classifications.

The equivalent information for the Murray catchment in New South Wales proved to be more difficult and costly to obtain. This finally led to a decision to approach each local government authority within the catchment for land sales data once it was established which survey participants had made a land purchase within the last 10 years.

With the provision of sale contract dates, it was possible to determine whether the land purchases had been made before or after land clearance regulations were introduced. In Victoria, the *Planning and Environment Act 1987* was amended in November 1989, introducing State-wide controls over the clearing of native vegetation, and requiring landholders to obtain a permit before clearing. In August 1995, the 'New South Wales State Environment Planning Policy No. 46 – Protection and Management of Native Vegetation' was introduced to prevent inappropriate clearance of native vegetation in the State. With this information, it will be possible to determine whether there were any significant differences in land purchase values before and after these clearance controls were introduced.

Survey data

Landholders who had purchased land containing RNV were surveyed to obtain detailed information about the property, the purchase, and the factors that influenced their decision. Selection of an appropriate survey technique, development of the survey instrument, selection of interviewees, and conduct of the interviews are described in Section 4.1.

The last section of the survey instrument contained questions relating to the purchase of property containing RNV. The questions elicited information about the sale, the seller, the perceived condition and productivity of the land at the time of purchase, the presence of a house and/or other buildings on the property, its proximity to other currently owned properties, and the gross income from the purchased property. Also included was a list of 27 factors that might have added, detracted, or had no influence on the purchase price. Respondents were

asked to rate the influence of each factor on a scale from minus five (detracted most from the value), zero (didn't affect the value) to plus five (added most to the value).

GIS data

Resource inventory data collected as part of the broader study and stored in GIS form provided information on broad, vegetation-type classifications, landform and climate for the two study areas. GIS coverage of all land parcels within the Victorian study area made it possible to link the property sales records with land parcels that contained RNV. Unfortunately, land parcel data in GIS form for the New South Wales study area proved to be too difficult and costly to obtain, so this information was obtained from each shire in the study area in printed form.

Additional information

As part of the broader study, the cost of alternative management regimes was determined for RNV. Current costs associated with the management of RNV included fencing, weed and pest control, and various other activities specific to individual properties. An informed purchaser is likely to be aware of these costs at the time of purchase, and thus may use this information as a guide to their purchase decision. The costs of implementing alternative management scenarios that included fencing out all remnants, excluding or limiting grazing, and firewood and timber extraction were also calculated for each property.

4.3.2 Results

North-east Victoria

Of the 2,480 land sales transactions provided by the Office of the Valuer General, Victoria, 364 were for purchases of properties identified as containing RNV. Despite the provision of purchaser details, many were not listed in the Telstra White Pages, several numbers had been disconnected or were never answered despite attempts to call at various times during the day and evening, and some people initially contacted indicated that they either had no RNV or only scattered or planted trees. Of the 130 landholders contacted who had RNV, 30 declined to participate in the survey, giving a final response rate of 77%. Of the 100 respondents who participated in the survey, 80 indicated that they had made a purchase of land containing RNV in the past 10 years. This sample therefore represents 22% of all properties purchased in the past 10 years containing RNV.

The general observations made from the Victorian and New South Wales surveys are summarised in Table 9. The average area purchased was 115 ha, and the average price paid was $178,499, or $2,732/ha. The average area of RNV on the purchased properties was 35 ha, or 33% of the total property. Some 46% of respondents were making an additional purchase of land, and 45% of the properties contained a house at the time of purchase. The average age of the purchasers was 46, and their average length of education was 12 years. The average household gross income was $68,417, with 40% of this being derived from on-farm income. Seventeen per cent of the respondents had no on-farm income, while 20% derived their total income from on-farm production. Some 53% of the respondents were members of Landcare.

Of the factors listed in the survey (in order of importance), water availability, appearance of the landscape, good view, potential income, a place to bring up a family and the presence of RNV added most to the value of the land at the time of purchase, while weeds and pests, fire risk and adjacent pine forest detracted most from the value of the property. It is interesting to note that aesthetic factors such as the appearance of the landscape and a good view were rated more highly than the perceived productive capacity of the property.

The influence of the clearance regulations on property values deserves examination. Thirty-four percent of the properties in Victoria were purchased before November 1989, the rest after the introduction of the legislation. There was no significant difference between the sale price per hectare before and after the introduction of the

legislation. The introduction of the clearance legislation had no significant influence on the purchaser's future intentions to clear. This suggests that the legislation might have had no influence on prices because it is perceived to be a regulation that is not strictly upheld. Thus, future 'improvements' to the purchased property might still include the option to clear. Alternatively, the legislation might have no influence on the purchase price because the purchaser has no intention to clear in the future.

Murray catchment

Because of the dearth of information on sales records within the New South Wales study area, survey participants could not be selected in a purposive manner as they had been in Victoria. Of the 255 landholders contacted, 129 respondents declined to participate in the survey. The reasons given were similar to those of the respondents in Victoria, but it was felt that anxiety and suspicion regarding the more recent land clearance legislation in New South Wales was in large part to blame for the disappointing response rate (49%). Of the 122 participants randomly surveyed in the Murray catchment, 44 indicated that they had made a purchase of land containing RNV in the previous 10 years. It is not possible to estimate what proportion of total sales of properties containing RNV this figure represents.

The general observations made from the surveys are summarised in Table 9. The average area purchased was 656 ha, and the average price paid was $498,275 or $980/ha. The average area of RNV on purchased properties was 142 ha, which is 21% of the total area purchased. Eighty percent of respondents were making an additional purchase of land, and 58% of properties purchased contained a house at the time of purchase. The average age of the purchasers was 45, and their average length of education was 13 years. Average household gross income was $112,359, with 74% of this being derived from on-farm income. Five percent of the respondents had no on-farm income, while 30% indicated that their sole source of income was from on-farm production. Some 56% of the respondents were members of a Landcare group.

Of the factors listed the survey (in order of importance), potential agricultural income, water availability, access to property already owned, appearance of the landscape and potential capital gain were the most important factors affecting the value of the land, while weeds and pests, fire risk and shire rates detracted most from the value. In comparison to the Victorian results, factors affecting production appear to have a higher priority than the aesthetic values in influencing property values.

Table 9. Summary of general observations for the study areas

Measurement	North-east Victoria	Murray catchment
Number of respondents	80	44
Average area purchased (ha)	115	656
Average price paid ($)	178,499	498,275
Average price per hectare ($/ha)	2,732	980
Average area of remnant native vegetation (ha)	35	142
Proportion of remnant native vegetation (%)	33	21
Additional purchase (%)	46	80
House on purchased property (%)	45	58
Average age of purchaser (years)	46	45
Average length of education (years)	12	13
Average household gross income ($)	$68,417	$112,359
On-farm income (%)	40	74
Landcare member (%)	53	56

Hedonic models

The decision to purchase land is a very complex one that needs to consider a range of factors. Attempts were made to measure and include as many of these factors as possible in preliminary hedonic models. However, it became evident that only a small proportion of them was having a significant influence on the sale value of the property. These factors included consumption, production and vegetation characteristics of the property. It also became evident that the sample size in New South Wales was too small to permit development of a reasonable model to reflect the market in the Murray catchment.

The preferred model estimated from the combined Victorian and New South Wales data contained four variables that had a significant positive relationship with property price:

- size of the property;
- presence of a house;
- purchase of property in addition to land already owned; and
- fences with good condition and placement.

The existence of RNV at a proportion greater than 50% had a negative influence. Below this threshold, however, the area of RNV appeared to have little influence on property price. Further details of the models used can be found in Walpole *et al.* (1998).

In a perfect market with full information, property prices should reflect, among other things, all costs and benefits associated with RNV. Economic benefits of RNV include increased stock production, increased agricultural production arising from mitigation of land degradation, increased crop production from shelter and shade effects, and timber for firewood and fencing. Any economic value arising from scenery and nature conservation benefits of RNV would also be reflected in property price. Costs of RNV include pest plant and animal control, fire management and fencing. In the on-farm assessment, 53% of participants in North-east Victoria and 82% in the Murray catchment enjoyed a net benefit from their RNV. A perfect property market would reflect this net benefit. It would therefore be double-counting to include in a benefit–cost analysis both a property price component and a direct assessment of RNV costs and benefits. With perfect information, a property market and direct surveys should produce the same estimate of net economic value. However, based on the results of this hedonic analysis, the property market is not at present a good measure of the economic value of RNV. Presumably this is primarily due to the lack of information and awareness on the part of both buyers and sellers.

4.4 Non-market value assessment

Economic values held by the community for RNV conservation are non-market values— that is, they are not expressed through any formal or organised market system. Since they are not revealed directly in the market place, and cannot be indirectly recovered though surrogate market techniques, they can be assessed only by using stated preference methods. The most widely stated preference method used in research is contingent valuation (CV). Details of the theory, application and limitations of CV are given in Mitchell and Carson (1989). Concerns about the validity of CV data have limited their use in environmental policy development, especially in Australia (Bennett and Carter 1993; Bennett 1996). The degree to which hypothetical values obtained in CV adequately reflect real economic constraints, such as the availability and potential expenditure on substitutes for the good being valued, is uncertain. There has been considerable controversy in the literature concerning the ability of CV to produce valid estimates of economic welfare changes. For a CV survey to produce valid data, participants must (Lockwood 1998):

1. have the opportunity, if the good is unfamiliar to them, to construct their preferences in the course of answering the survey;
2. have the cognitive ability to express their preferences for environmental goods as a willingness to pay;

3. clearly apprehend the good they are to value in a manner that is congruent with the intentions of the surveyor;
4. consider their budget constraint;
5. consider the availability and their potential expenditure on substitutes for the good being valued;
6. find plausible the justification given in the CV scenario for why payment is required;
7. accept the legitimacy of the payment vehicle used in the survey — that is, have no 'in principle' objections to making a payment using this vehicle;
8. believe that if they do not pay for the good, it will not be provided; and
9. trust that any payment they might make would actually be used in the manner specified.

Many of the attributes required to satisfy these validity conditions have been detailed elsewhere (Mitchell and Carson 1989; Arrow *et al.* 1993), and are now standard practice in most CV work. However, concerns remain, particularly with respect to points two, four and five above. If some participants fail to adequately take account of substitute goods and alternative expenditure opportunities, or offer positive responses without full recognition of the actual expenditure involved ('yea-saying'), welfare estimates will be inflated. These lingering concerns have encouraged the exploration of alternative stated preference methods. One of these, the relatively new technique of choice modelling (CM), may offer a means of addressing such concerns (Bennett 1996; Morrison *et al.* 1996; Hanley *et al.* 1998). In addition, CM can enable extrapolation of participants' preferences across different quantities and qualities of the good being valued.

In CM, participants are presented with several sets of choices, each involving two or more options. The participant is asked to select their preferred option in each choice set. Each option is typically defined in terms of salient attributes, including a dollar 'willingness-to-pay' (WTP), and the levels of each attribute are varied across the choice set. A given set of attributes and attribute levels can generate a large number of potential choice options. A CM design usually requires that a fraction of these potential options be selected for inclusion in the survey instrument. The selected options then need to be incorporated into choice sets (Louviere 1988).

Choice models produce estimates of the values of changes in individual attributes within an option as well as the value of aggregate changes in environmental quality. The analysis of the results of the CM provides a reflection of the trade-offs that each individual makes between the attributes of the options. CM has been used in analyses of transport choices (Hensher 1995), consumer goods (Louviere and Woodworth 1983), tourism (Morley 1994) and shopping centre choice (Barnard and Hensher 1992). Applications to environmental valuation are relatively new — examples include Adamowicz *et al.* (1994), Boxall *et al.* (1996), Rolfe and Bennett (1996), and Morrison *et al.* (1998).

We used both CV and CM to assess the non-market economic values of RNV in two study areas. Four survey instruments were developed:

- a CV instrument addressing RNV conservation in the Murray catchment;
- a CV instrument addressing RNV conservation in North-east Victoria;
- a CM instrument addressing RNV conservation in the Murray catchment; and
- a CM instrument addressing RNV conservation in North-east Victoria.

4.4.1 Survey development

Focus groups and pre-tests were used to help develop the surveys. Four focus groups were initially conducted with 28 participants. Each focus group built on the information from the previous focus group, and successive drafts of the survey instruments were developed using information and feedback from each session. Obtaining representative subsamples is generally not possible in focus group work. However, it is important that some attempt be made to cover a range of ages, incomes, and social backgrounds. To ensure that the

focus groups covered a number of different people, three group sessions were conducted in Sydney and one in the regional town of Orange. Since there was no reason to suggest that the basic perceptions of Victorians would be significantly different from those of New South Wales residents, the information obtained from the New South Wales focus groups was assumed to be applicable to the Victorian component of the study.

Each participant was sent a formal letter inviting them to attend the activity and giving an outline of the topic, location and time**.** Participants were paid $20 as reimbursement for expenses associated with attending the focus group. The sessions were recorded on audio tape and notes taken.

Issues explored in the focus groups included:

- perceived importance of various conservation issues;
- relative value of different vegetation types;
- attributes contributing to the conservation quality of native vegetation;
- relative importance of native vegetation on public and private land;
- effect of presence or absence of rare species in forests;
- perceptions of agricultural management;
- WTP for RNV conservation; and
- preferred mechanisms for collecting and managing any funds generated through participants' WTP.

The focus groups also dealt with issues such as question order, language (use of jargon and technical terms) and visual aids (removal of a graph and photos from the drafts). The amount that participants would be prepared to donate as a one-off payment to improve management of RNV on private property provided a range of potential bid values for the CV and CM choices. Draft surveys were also circulated to the project advisory committee and several economists familiar with the CV and CM methods. These outcomes were also incorporated with the above results to assist survey design.

Draft survey instruments developed using insights gained from the focus groups were then pre-tested. The pre-test was undertaken to replicate, as far as possible, the final survey construction, delivery and sample population. Fifteen CV and 15 CM surveys were mailed to 30 acquaintances not associated with this field of research. The surveys were accompanied by a reply paid envelope and a letter outlining the project and asking the receiver to complete the enclosed survey, and to make additional comment on the instrument. It was suggested that such feedback could relate, but not be restricted to, areas such as language, clarity, difficulty, question order and length of time to complete. The 30 participants were distributed throughout the Sydney area and regional New South Wales.

The CV pre-test survey instrument was easier for participants to understand than the CM instrument and generated fewer comments. The average time to complete the survey was approximately 12 minutes for the CV survey and 20 minutes for the CM survey. The CM survey instrument used in the pre-test included 16 choice sets. Many participants commented that this was too many questions. To reduce the burden on participants, the final CM instrument used two blocks of eight choice sets. Other modifications made as a result of the pre-test included:

- clarification of the purpose of the study;
- provision of additional information on the geographic location of the study area;
- removal of a graph used to detail the condition of the various types of vegetation in the study area, which was considered by participants to be of little use;
- improvements to the structure and appearance of the surveys; and
- inclusion of a Native Vegetation Trust to manage the money.

Following the focus groups and the pre-testing, a hybrid of these two techniques was conducted to get further comment on revised draft survey instruments. This 'intensive pre-testing' involved 12 people from

the Sydney region, who were each mailed copies of both survey instruments to complete. These participants then came together in two separate groups to discuss the surveys. Questions asked of the participants related to:

- realism of the scenarios outlined;
- additional information required to answer the survey;
- use of visual aids;
- realism of the payment vehicle; and
- use of quantitative versus qualitative attribute levels in the CM instrument.

As a result of this meeting, the payment vehicle was further refined, commodities were described quantitatively, visual aids were omitted as they were seen to cause bias, and further modifications were made to the layout and design of the instruments. On advice from participants, the final CM instruments also placed more emphasis on the importance of reading the insert before answering the questions. While there were still comments on the difficulty of the CM questions, the participants were generally happier than previous groups, primarily because fewer choices had to be made.

4.4.2 Common elements in the CV and CM instruments

In order to facilitate comparison between the two methods, it was important to ensure that as far as possible participants were presented with identical information and questions, apart from the willingness-to-pay or choice questions.

Each version had the same cover, included a map of the study area, and explained the purpose of the survey. There were five sets of questions common to both survey instruments. Question 1 assessed participants' views on the relative importance of various RNV values. Question 2 asked whether participants had ever been to the study area, and if so if they recalled the general appearance of the landscape. Both these questions potentially provide information to assist the interpretation and validation of participants' responses to the economic valuation questions. Questions 3 and 4 were framing questions aimed at helping participants make their valuation in an appropriate context. Question 3 prompted participants to consider their views on the importance of environmental issues other than native vegetation conservation. Question 4 prompted participants to consider the importance of RNV in the study area relative to native forest elsewhere in Australia and around the world. The valuation decisions were also framed by an explicit reminder to participants that:

- there are many other calls on their household budget;
- there may be other environmental issues they care about; and
- there are other areas of native vegetation in New South Wales [Victoria].

The final questions in the survey instruments gathered socioeconomic data from the participants.

4.4.3 CV scenario

The CV scenario was as follows:

> Farmers face many economic pressures in producing food, wool etc. Sometimes they decide to clear areas of native vegetation to increase their incomes from grazing, crops or pine plantations. They may also use native vegetation for bush grazing and extraction of timber products. These activities reduce or eliminate some of the nature conservation values associated with native vegetation.
>
> If the current situation continues, native vegetation will be cleared and degraded in the Southern Riverina [North-east Victoria]. To ensure that this does not occur, farmers need to be helped to protect these areas. Money is needed to cover the costs of fencing areas to keep stock out, managing the native vegetation, and compensating the farmers for lost income.
>
> The government does not have enough money to cover these costs. This means extra money is required. To ensure sufficient money is available, New South Wales [Victorian] households would have to make a one-off payment.
>
> The money would be collected by the Australian Taxation Office as part of your 1998 tax return, and the

> total sum given to a special Native Vegetation Trust Fund. This trust will be responsible for transferring the money to the farmers and ensuring that is spent appropriately.
>
> We would like to know how much you are willing to pay to go from the current situation to a future situation where conservation of the native vegetation is improved. The table on the following page describes the current situation and the possible future situation.

Participants were then asked to read some additional information concerning the current situation, and the proposed future situation. As far as possible, this information was presented in a fashion similar to the material provided in the CM instrument. The attributes used to describe these situations were the area of native vegetation remaining in five years time; the one-off payment required to secure the change; future use by the farmers; and the average number of native plants and animals present in the RNV. Levels of the attributes for the two versions reflected differences in the New South Wales and Victorian study areas.

A valuation question was then asked:

> Would you be willing to make a one-off payment of $x to conserve native vegetation on private property in the Southern Riverina [North-east Victoria]?

Based on the responses in the focus groups and pre-tests, the dollar values used in the CV survey were $5, $10, $20, $30, $50, $100, $150, and $300.

We followed the Arrow *et al.* (1993) recommendation that respondents be offered a 'no answer' option as well as the usual 'yes' and 'no' options. Offering a 'no answer' option is one way of diminishing the incidence of 'yea saying', since participants are not forced to make a definitive choice. The issue then arises as to how to deal with the 'no answer' responses. Two obvious possibilities are either to simply drop these participants from the sample, or to equate a 'no answer' with a 'no'. The former option effectively assumes that the preferences of those responding with 'no answer' are no different from the rest of the sample. This seems unlikely. The latter option assumes that doubts about their willingness to pay would probably translate into the amount not being paid. We believe this is a reasonable assumption. The desirability of taking this conservative option is reinforced by the tendency of CV results to overestimate actual WTP. A third option taken by Wang (1997) is to model 'no answer' choices as occupying a region of uncertainty around each individual's maximum WTP. According to this view, an offered bid amount close to the expected value of WTP will give rise to choice uncertainty and hence selection of the 'no answer' option. While this is plausible, we still, following Carson *et al.* (1994), prefer to take the conservative option and assume that 'no answer' responses are best regarded as 'nos'.

If the answer to the WTP question was 'no' or 'no answer', a separate question was then asked to determine the reason for these responses. Options given to participants were:

- I would be willing to pay something, but not as much as the amount given in question 5;
- my household does not benefit from conservation of native vegetation on private property in Southern Riverina;
- I believe farmers have the right to do what they like on their properties;
- my household cannot afford to pay;
- native vegetation in Southern Riverina should be conserved, but the costs should be paid for in some other way;
- there is not enough information for me to make a decision; and
- other — please give reason.

The first four options are legitimate economic reasons why a participant may have a zero willingness to pay. These zero responses were included in the calculation of welfare estimates. Participants selecting the fifth or sixth options may have a WTP if the question were presented in some other fashion, or if more information were available. Since we cannot be sure that the WTP of these participants was in fact zero, they were omitted from the welfare calculation. The answers of each participant who offered another

reason under the last option were individually assessed to determine whether or not they should be considered a zero WTP response.

4.4.4 CM questions

Based on responses from the focus groups and pre-tests, RNV area, payment amount, future management by farmers and biodiversity were the attributes selected to define the choices presented to participants. Selection of attribute levels was constrained by the biophysical attributes of the two study areas and management possibilities for RNV, and informed by feedback from focus group and pre-test participants. The attributes and levels used in the CM surveys are shown in Table 10. Each choice set comprised three options. The base levels for each alternative (for the New South Wales survey these were 80,000 ha, $0, extensive use, and 60 species) were used to describe the current situation. This option was included in all choice sets. The remaining levels for each attribute were constructed into two alternative choice options, each of which involved an environmental improvement and a WTP component.

Table 10. Attributes and levels used in the choice modelling surveys

Attribute	Level (New South Wales)	Level (Victoria)
Area of native vegetation remaining in five years time	80,000 ha 110,000 ha 140,000 ha	75,000 ha 95,000 ha 115,000 ha
Your one-off payment	$0 $10 $50 $150	$0 $10 $50 $150
Future use by the farmers[a]	No use Some use Extensive use	No use Some use Extensive use
Average number of native plants and animals	60 species 85 species 110 species	60 species 85 species 110 species

[a] Computation of CM models showed that some use > current use > no use, so the *use* variable was coded such that some use = 1, current use = 0, and no use = –1.

The final design thus involved two survey sub-versions, each of which contained a block of eight choices, with each choice offering three options.

The CM scenario was as follows:

> Questions 5 to 12 all concern the native vegetation on private property in the region shown on the map on the inside front cover.
>
> Farmers face many economic pressures in producing food, wool etc. Sometimes they decide to clear areas of native vegetation to increase their incomes from grazing, crops or pine plantations. They may also use native vegetation for bush grazing and extraction of timber products. These activities reduce or eliminate some of the nature conservation values associated with native vegetation.
>
> In each question we want you to choose between three options concerning the future of the native vegetation on private property (see the example on the next page). Each option is slightly different in terms of the area of the vegetation, your payment amount, use by the farmer, and numbers of plants and animals. These features are described in more detail on the colour page inserted in this booklet.
>
> Option 3 is the situation in five years time if changes are not made now. Options 1 and 2 are two other possible situations in five years time, where some action has been taken to conserve the native vegetation on private property in the Southern Riverina. Of course there may be other options, but we want you to only consider the ones presented in options 1 and 2.
>
> Questions 5 to 12 are specially designed to help us measure which features influence your choices about native vegetation. We need you to answer every question without worrying about the options given in the other questions.
>
> Some of the options may seem a little odd — for example an option that involves less area and more native species. However, such a possibility could occur if the smaller area is all high quality habitat, and some of the larger area is of lower quality.
>
> Some of the options include you making a **one-off payment** to cover the costs of fencing the areas, managing the native vegetation, and compensating the farmers for lost income. See the blue page inserted into this survey for more details.

An example choice set and answer was then provided to visually show participants the required method for answering each question. An insert was provided

with each CM survey instrument that gave participants background details and explanations of the attributes. This information was included as a separate sheet to enable participants to easily refer to it when completing the choice sets. The attributes used in the choice sets were the same as those used to describe the current and future situations in the CV survey.

4.4.5 Participant sample

Participants were recruited from random samples of 2000 Victorian and 2000 New South Wales voters obtained from the State electoral rolls. Each of the four survey instruments (CV and CM for each State) was mailed to 1000 potential participants. The mail out procedure followed Dillman's (1978) 'total design method'. The first mail out was conducted on Thursday 28 August 1997, followed by a reminder postcard on Friday 12 September 1997. A second mail package was sent to those who had not replied by Wednesday 1 October 1997.

4.4.6 Results

Return rates

Return rates from the mailouts are shown in Table 11. The minimum return rate was for the New South Wales CM survey (46.8% completed, 54.4% total), and the maximum return rate was for the Victorian CV survey (56.4% completed, 63.1% total). Incomplete returns included participants who either:

- mailed back a survey with a note or letter, or rang up indicating that they did not want to fill out the survey because they had no interest in the issue;
- mailed back a survey with a note or letter, or rang up indicating that they did not want to pay anything:
  - "I donate to other causes, I cannot donate to this one";
  - "I am an 80-year-old pensioner. I can't afford to pay anything";
  - "We are both on low incomes — although we support protection and conservation of nature we could not afford to support it financially";
- mailed back a survey with a note or letter, or rang up indicating that they did not know anything about, or were too far away from, the study area:
  - "I don't have any connection to the area — native vegetation does mean a lot to me, but I would prefer to support a more local area";
  - "Haven't been to the Riverina for 20 plus years and can't imagine my answers will be of any use";
  - "I am an 85-year-old pensioner and have no knowledge of the Riverina and hence have nothing to say about this topic"; or
- mailed back a blank survey.

Demographics

A comparison between the demographic characteristics of the samples and that of the relevant population is given in Table 12. These data indicate that the samples are a good demographic representation of the New South Wales and Victorian populations. The most notable differences are for the Victorian CV sample, which has a higher proportion of females and a lower mean income than for the Victorian population.

Table 11. Return rates

Survey version	New South Wales		Victoria	
	CV	CM	CV	CM
Initial mail out	1000	1000	1000	1000
Undeliverable	86	92	101	86
Total completed returns	478	425	507	484
Incomplete returns	66	69	60	65
Total returns	544	494	567	549
Completed return rate (%)	52.3	46.8	56.4	53.0
Total return rate (%)	59.5	54.4	63.1	60.1

Visitation and attitudes

Considerably more Victorians had visited North-east Victoria and remembered what it looked like, compared with New South Wales participants' visitation and remembrance of the southern Riverina. This difference probably reflects the relative distances of the study areas from the major

population centres of the two States — Melbourne is much closer to North-east Victoria than Sydney is to the southern Riverina.

Participants were asked a series of attitudinal and framing questions in both survey instruments in order to gain some insight into their responses to the economic questions, and to provide a context in which the valuation questions could be answered. There were no notable differences in the responses to these questions between the four survey instruments. The most important reasons for valuing native vegetation on private property were to prevent land degradation, to protect native vegetation, and to conserve for future generations. Comments provided in relation to the 'other reason' option included scientific research, ecosystem protection, clean water and air quality.

Question 3 addressed the importance of other environmental issues to the participant and provided situations from the global level through to local considerations. Participants generally rated all of the situations described as very important. The next framing question asked participants to rate the importance of conservation of native vegetation in various parts of the world. Participants generally rated the areas described as important, but forests on public land in the participant's State were clearly seen as the most important.

WTP results

CV responses were analysed using logistic regression. Taste and demographic variables were assessed for their significance (as indicated by *t*-statistics) and those found to have a significance of 0.05 or better were included in the models. CM models were computed using the multinomial logit model. WTP estimates were calculated based on a change from the current situation to the same proposed RNV conservation scenario as assessed in the corresponding CV survey. Since these are somewhat different from scenario 5, as indicated below, we also computed the CM models using values for the *area*, *use* and *species* attributes that matched scenario 5.

From the CV surveys, household mean WTP for this degree of RNV conservation in the Murray catchment was about $95. Mean WTP for RNV conservation in North-east Victoria was about $98. From the CM surveys, household mean WTP for RNV conservation was about $138 for the Murray catchment and about $133 in North-east Victoria.

The confidence intervals of these WTP estimates from CV and CM overlap. This is not surprising, given that the confidence intervals for the CV result were large. Note that the approach of using overlapping confidence intervals to test hypotheses that the means of two simulated distributions are not significantly different may be subject to Type II error (Poe *et al.* 1994). As recommended by Poe *et al.* (1994), we therefore used a convolutions approach that confirmed that the WTP estimates from the two methods were not significantly different.

In general, a comparison of CV and CM results will not give unequivocal evidence of the validity of either technique. There is no reliable measure of the non-market economic value of RNV against which the results of the CV and CM can be compared. A check of the ability of the instruments used in this work to

Table 12. Sample and population demographics

Variable	New South Wales mean[a]	New South Wales CV mean	New South Wales CM mean	Victoria mean[a]	Victoria CV mean	Victoria CM mean
Sex (percentage female)	51	49	52	51	54	49
Age (years)	45.1	46.1	45.8	44.3	46.5	44.9
Education (years)	13.3	13.0	12.9	13.6	12.8	13.0
Annual household income ($)	41,847	39,274	42,085	40,400	38,635	40,140

[a] Based on CLIB96 (1997)

predict actual WTP is not available. Nonetheless, the fact that the very different elicitation techniques of CV and CM produced WTP estimates that were not significantly different, provides evidence of convergent validity — that is, evidence that the two independent methods lead to the same ends. It is still possible that this 'end' is not the required construct — WTP. The fact that income is positively related to WTP in all models provides some support for the theoretical validity of the methods, as do the significant coefficients on all attributes.

The surveys provide evidence that CM can give results that are at least as credible as those generated by CV, while having the significant advantage that WTP for a range of changes in key attributes (*area*, *use* and *species*) can be determined. This enables WTP to be estimated for a number of different policy options. For this reason, we used the CM results to compute the BCA in section 5. The CM household mean WTP estimates based on scenario 5 were about $75 for the Murray catchment and about $72 for North-east Victoria. Aggregating these data from the level of individual households up to all households in the respective States gives a benefit to Victorian voters of conserving RNV in North-east Victoria of $60.7 million, and a benefit for New South Wales voters with respect to the Murray catchment of $75.6 million.

5 Extended benefit–cost analysis[7]

The economic value estimates given in sections 4.1, 4.2 and 4.4[8] were compiled into an extended benefit–cost analysis (BCA) that assessed a change from the current situation:

- RNV on some properties is extensively grazed and/or used for timber products;
- RNV on some properties is not fenced;
- some landholders have intentions to clear over the next 10 years (7,174 ha in Victoria and 3,425 ha in New South Wales);
- biodiversity decline will continue on some properties;

to an improved RNV conservation scenario:

- fence largest RNV block on each property where this is currently unfenced;
- prohibit all RNV clearing;
- allow grazing consistent with biodiversity conservation;
- allow collection of firewood and posts consistent with biodiversity conservation; and
- rate of biodiversity decline will be reduced.

Three BCAs were computed, based on the different treatments of opportunity costs (OCs) as described in Table 3, scenarios 3, 4 and 5. Scenario 5 involved a 5-year time frame, and scenarios 3 and 4 were computed over 40 years (Table 13).[9] To test the sensitivity of the BCA results to choice of discount rate, the NPVs were computed using rates of 4%, 7% and 10%.

7. Further details are given in Lockwood and Walpole (1999).

8. There may be some double counting here, in that the community WTP for RNV conservation (Section 4.4) could be in part motivated by concerns about salinity damage and climate change that were measured in section 4.2. We tried to avoid this by only mentioning nature conservation benefits when outlining the scenario to respondents. In response to an introductory question concerning possible ways in which people might value native vegetation, about 2% of respondents mentioned climate-related reasons, and about 2% mentioned salinity. Given this, we believe the extent of double counting is likely to be small.

9. The scenario used in the CM survey had a time horizon of 5 years. This assumption may therefore underestimate WTP for the 40 year time frame scenarios. Respondents may have been willing to pay more for longer term conservation.

Table 13. Summary of benefit–cost analysis results

	Net present value ($ M)	
	North-east Victoria	Murray catchment
4% discount rate		
Scenario 3 (40-year conservation program, all OCs)	–128.6	20.8
Scenario 4 (40-year conservation program, limited OCs)	3.0	20.8
Scenario 5 (5-year conservation program)	29.0	36.6
7% discount rate		
Scenario 3 (40-year conservation program, all OCs)	–44.9	30.6
Scenario 4 (40-year conservation program, limited OCs)	22.8	30.6
Scenario 5 (5-year conservation program)	29.8	40.5
10% discount rate		
Scenario 3 (40-year conservation program, all OCs)	–2.1	35.7
Scenario 4 (40-year conservation program, limited OCs)	33.5	35.7
Scenario 5 (5-year conservation program)	30.5	39.3

The BCAs shows that there is a net economic benefit in conserving RNV, except in North-east Victoria when orchard and vineyard related OCs are included in the analysis (scenario 3).

Two benefit components underlie the BCA results — a private benefit to the condition and productivity of landholders' properties, and a public benefit associated with biodiversity conservation and aesthetic values. Note that the benefits to properties are entirely due to the prohibition on clearing, whereas the improvements in RNV management and preventing clearing both contribute to protection and enhancement of biodiversity. The costs all accrue to landholders in the two study areas.

For scenarios 4 and 5, a publicly funded incentive scheme that achieved the conservation outcomes would yield net economic benefits, provided the payments did not exceed the values given in Table 13. In terms of RNV policy, we prefer the 5-year time horizon, to enable review and, where necessary, revision.

We also consider that it is neither practical nor appropriate to compensate landholders for the opportunity costs of being prohibited from clearing RNV. It would be very difficult to identify those landholders genuinely desiring to clear without attracting strategic behaviour on the part of some landholders who would have had no intentions to clear before compensation being available. In addition, it would be unfair to reward those who wish to clear by making available compensation that was not available to those wishing to retain their RNV. The principle of granting compensation to landholders for not being able to clear RNV can also be challenged. Binning and Young (1997) distinguished between a duty of care (where costs of RNV conservation are regarded as part of the normal costs of production) and provision of non-marketable public conservation service (in which case, economic incentives are appropriate). They suggested that a duty of care should apply to those management practices that are required to achieve land-use objectives at a regional or landscape scale. We consider that the duty of care applies to a requirement that landholders retain existing RNV, whereas improving the RNV management involves provision of public conservation service. This justifies provision of incentives based on costs to landholders associated with: (i) loss of productivity arising from a reduction in grazing and timber products extracted from the RNV; and (ii) the costs of improved RNV management associated with fencing, weed control and feral animal management.

On this basis, governments could spend up to $29.8 M in North-east Victoria and $40.5 M in the Murray catchment and still achieve a net economic benefit, provided the conservation outcomes were achieved. However, we need to further qualify these BCA conclusions.

First, no policy has guaranteed outcomes. Since the BCA assumed that the desired conservation objectives would definitely be achieved, the net benefits are overestimated to the extent that this does not occur.

Second, the various cost and benefit estimates rely on numerous assumptions and simplifications. Some benefit and cost components may have been overestimated. For example, concern has been raised that some landholders in the on-farm survey may have over-stated the costs of RNV management. On the other hand, there is some evidence that stated preference methods may overestimate benefits. Some benefits and costs have not been included in the analysis. Though local productivity benefits associated with RNV were estimated from the on-farm surveys, the BCA did not include agricultural productivity benefits accruing to downstream properties. This is potentially a highly significant benefit component associated with RNV. To estimate these values, detailed biophysical catchment models are required that measure the effect each hectare of RNV has on watertables. These effects could then be translated into impacts on agricultural productivity. The required models are not available for the two

catchments studied. On the other hand, the BCA did not incorporate transaction costs associated with establishing and implementing the policy. These costs arise from activities such as acquiring information about policies, analysing their implications, negotiating and administering contracts, and collecting and administering payments. Thus, some benefit and cost components may have been overestimated, and others have been left out of the analysis. Although these effects will tend to balance each other out, their overall impact on the accuracy of the BCA result is unknown. Such data inadequacies and uncertainty are inevitable, given the breadth of the work and the resource constraints of the project.

Third, the actual budget for the incentive policy should be such that the desired conservation outcomes are delivered at minimum possible cost. This will ensure that the net economic benefits of the conservation achievements are maximised. That is, the lower the costs, the larger the surplus of economic value that accrues to the community. A cost effectiveness analysis was beyond the scope of our work.

Fourth, given that the policy, or something like it, should not just be restricted to the two study areas, and a diminishing community willingness to pay would be expected for additional catchments, further work is required to establish a suitable funding cap for State-wide programs.

Finally, budgets for such programs are, of course, a matter for political consideration. For these reasons, we refrain from suggesting a budget for the incentives outlined in section 6, but offer the preceding discussion and benefit estimates as inputs for decision-making.

Despite these qualifications, and other assumptions and limitations that we have noted elsewhere in the paper, we are confident that a publicly funded incentive policy that encouraged or enabled landholders to manage their RNV according to the conservation scenario would, under most circumstances, yield net economic benefits.

6 Augmented incentives for remnant native vegetation conservation

Agencies such as DLWC, New South Wales, Greening Australia and DNRE, Victoria already provide incentives to farmers. Our research indicates that further development and expansion of such programs is warranted. In this section we suggest mechanisms by which the BCA result can be incorporated into an incentive policy for RNV conservation, and outline our attempts to undertake a preliminary assessment of landholders' responses to such a policy.

In September 1998 we published a report that reviewed a range of policy options, and suggested a proposed incentive policy for delivering improved RNV conservation (Miles *et al.* 1998b). We conducted a survey of landholders to determine their response to some key elements of the proposal, as well as seeking comments on the document.

6.1 Landholder survey

The on-farm surveys (section 4.1) asked whether the landholders were willing to make further comment on RNV policy. Of the 222 initial respondents, 148 indicated that they might be willing to participate in a follow-up survey. These landholders were sent a mail survey that was designed to assess their views concerning the main features of the policy proposal detailed in Miles *et al.* (1998b). Four main aspects of the proposal were assessed:

- non-binding management agreements;
- binding management agreements;
- employment of a RNV Officer; and
- priority areas for RNV conservation.

The 148 landholders were sent a letter reminding them that when they originally undertook the first survey, they had indicated a willingness to participate in further research about incentives for remnant vegetation conservation. They were then informed that one of the major findings from the first survey was that remnant vegetation is costly to manage, and that financial incentives may be required by landholders to undertake conservation activities. The policy proposal about incentives for remnant vegetation conservation was introduced, and the purpose of the survey was described as being the research team seeking landholders' views on how useful these policy proposals might be.

The surveys were mailed out in November 1998, followed by a reminder notice for those that had not returned the survey within two weeks. Seventy-four completed surveys were returned (38 from Victoria and 36 from New South Wales) — a 50% response rate. The results from the survey are summarised in Table 14.

There was support for both non-binding and binding management agreements, though this was tempered by a significant degree of uncertainty. There was no significant difference between the responses of Victoria and New South Wales landholders.

Many respondents made additional written comments on the proposals. Eleven respondents commented on the need for larger economic incentives than those provided under the non-binding agreements. Three landholders specifically referred to the need to increase the funding available to support fencing, and four argued that there was a need to compensate landholders for not being able to graze, log or clear the RNV. Suggestions on a funding formula were offered, such as a compensation package based on 70% of the production value of cleared land on a per hectare basis; or developing a formula based on dry sheep

equivalent (DSE) capacity and wool price, plus fencing. Seven landholders provided additional comments supporting the non-binding agreements, while eight said they needed more detailed information before they could make a commitment. Six commented on problems associated with funding fencing works. Several already had areas fenced, and so would not get any benefit from such an incentive, while others pointed out the impracticality of fencing when the native vegetation was fragmented or in flood prone areas.

With respect to binding management agreements, several landholders again expressed a need for more detailed information. Thirteen offered additional comments in support of binding agreements. Three were concerned about how a binding agreement would carry forward in the event the property was

Table 14. Landholder survey results

Question	Response	Victoria (N = 38)	New South Wales (N = 36)
Would enter into a non-binding agreement	Yes (%)	37	56
	No (%)	5	8
	Maybe (%)	55	36
	Don't know (%)	3	0
Would enter into a binding agreement	Yes (%)	45	53
	No (%)	11	6
	Maybe (%)	45	39
	Don't know (%)	0	0
Value of an RNV Officer	Useful (%)	55	75[a]
	Not useful (%)	11	3
	Maybe (%)	29	19
	Don't know (%)	3	6
Priority areas of RNV (average: 0 low, 1 medium, 2 high)	High quality RNV	1.5	1.3
	Vegetation type all on private land	1.4	1.7
	Links between areas	1.2	1.2
	Rare species	1.9	1.8
Benefits of RNV (% yes, excluding N/A)	Stock production	85	94
	Crop production	32	73[b]
	Land degradation control	89	88
	Timber	79[a]	57
	Clean water	89	87
	Habitat	76	83
	Nutrients and soil	89	96
	Recreation	68	64
	Aesthetics	86	100[b]
Intending to clear	% yes	37[b]	14
	Average area (ha)	14	81
Likelihood of clearing (of those intending to clear, % of responses 3 or above on a scale 1 very unlikely to 5 very likely)	Pines	7	40[a]
	Hardwood	57	60
	Pasture	71	40
	Grapes	14	0
	Crop	21	0
	Rice	0	0
	Other[c]	14	20

[a] Significantly higher than the value for the other study area ($0.1 < p < 0.05$)

[b] Significantly higher than the value for the other study area ($0.05 < p < 0.01$)

[c] Chestnuts, olives, mill logs

sold. One landholder was concerned that the incentives offered under the binding agreements were too high, and that this would encourage "the wrong people" to enter into agreements. Seven respondents preferred non-binding agreements to binding agreements because they were concerned about losing rights or management control over their land.

There was strong, although not unanimous, support for the funding of a RNV Officer. The support was stronger in New South Wales than in Victoria. Seventeen respondents offered additional comments supportive of the proposal, while six felt it would be a waste of money. Several of the latter preferred funds to be spent on on-ground works, rather than in employing advisers.

In terms of categories of RNV that should be priority targets for management agreements, the average rating for all categories was medium to high. The highest average priority was for areas containing rare, threatened or vulnerable species, and the lowest was for areas that provide links between blocks of native vegetation. Six respondents added comments to the effect that conservation of all RNV should be a high priority. Two commented that lower priority should be given to areas adjacent to public land because they considered that those areas were not well managed. One person felt that the most important priority should be to improve the quality of RNV.

There were no significant differences in the responses between the 1997–98 and late 1998 surveys with respect to intention to clear RNV, area to be cleared, and the reasons for clearing.

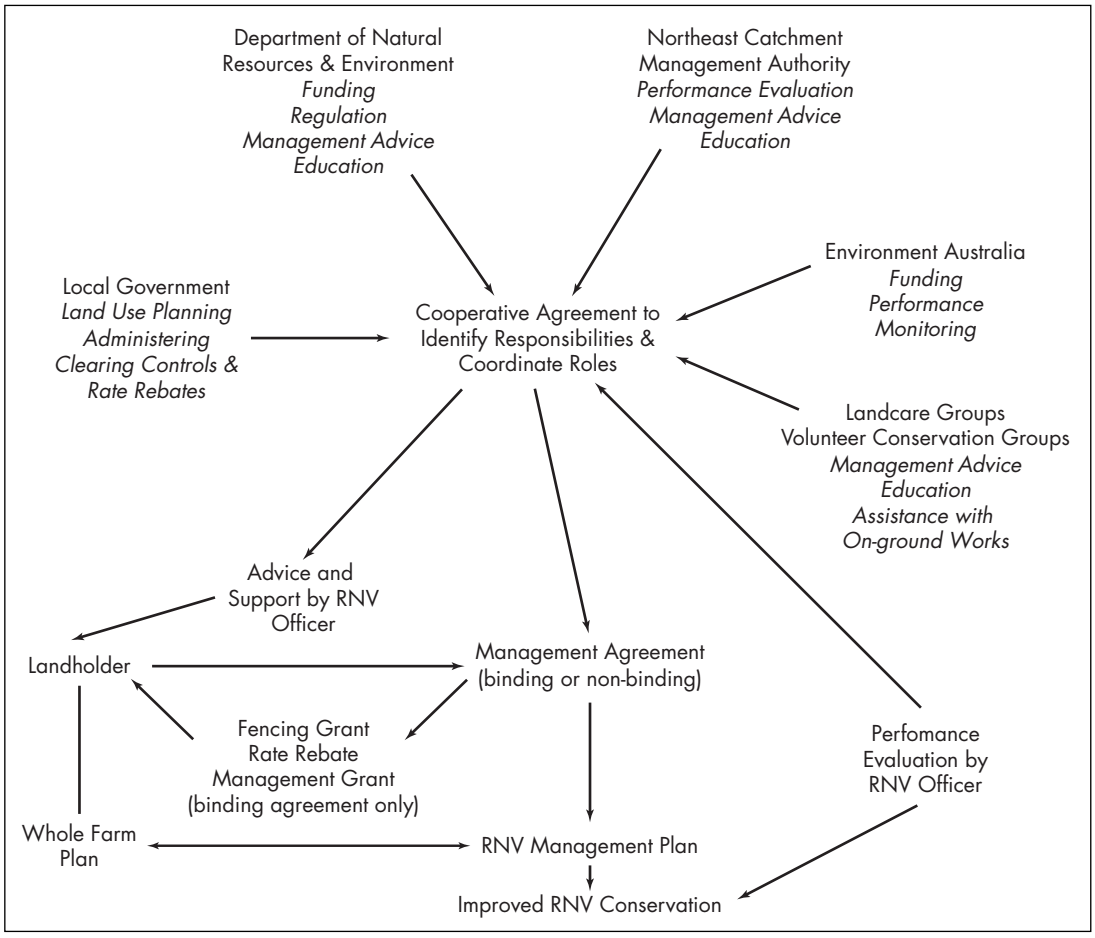

Figure 2. Structure of the proposed policy package (North-east Victoria)

6.2 Elements of an incentive policy

This section presents our views on some key elements of an incentive policy proposal for RNV conservation in the two study areas of North-east Victoria and the Murray catchment of New South Wales. The policy is based on the initial proposal outlined in Miles *et al.* (1998b), comments received on this document, results of the landholder survey, and outcomes from the BCA. The components of the policy are indicated in Figures 2 and 3.

6.2.1 Management agreements

The popularity of management agreements as an effective tool to protect and enhance RNV was discussed in Miles *et al.* (1998b). Individual management agreements allow an agency to design a menu of contracts that is more likely to achieve agency objectives in a cost-effective manner (Weaver 1998). The landholder survey reinforced the potential of such agreements, as well as the need to offer landholders the opportunity to select either a binding or non-binding management agreement. The weakest aspect of non-binding agreements is a lack of certainty that the anticipated benefits of RNV conservation will be realised. Binding agreements, on the other hand, will maximise the probability that benefits will be achieved and maintained.

Binning and Young (1997) emphasised the need for financial incentives to be tied to entry into binding management agreements in order to secure permanent protection of RNV. As indicated by the landholder survey, if substantial economic incentives are offered, the majority of landholders are likely to at least consider entering into binding agreements.

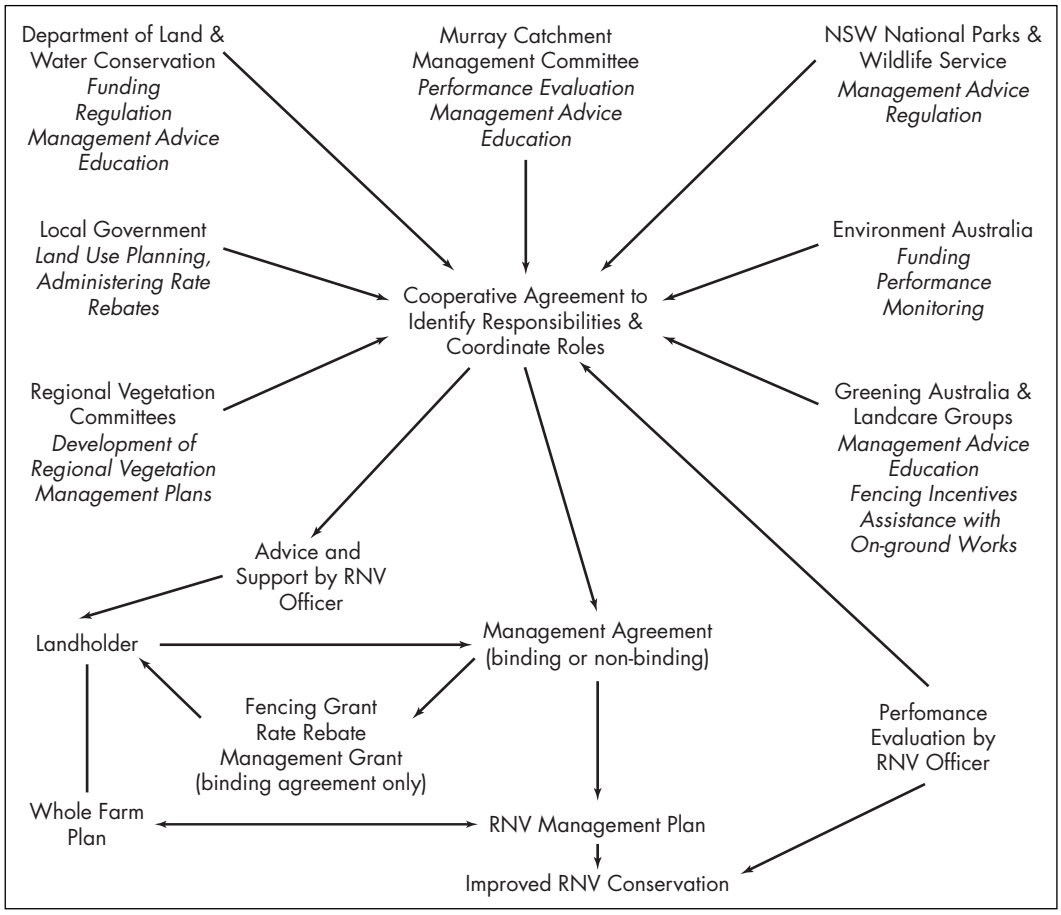

Figure 3. Structure of the proposed policy package (Murray catchment)

However, binding agreements, because of their restrictive nature, tend to be less accepted by landholders. Concerns have been raised by landholders about losing rights or management control over their land, for example. In the longer term, this may change as such agreements become more commonplace, and if greater trust develops between landholders and the institutions involved in RNV conservation. There is therefore an urgent need to further develop constructive relationships between agencies and landholders. Agencies such as Greening Australia, the Department of Natural Resources and Environment (DNRE, Victoria), the Department of Land and Water Conservation (DLWC, New South Wales) and the National Parks and Wildlife Service (NSW NPWS) have already been making efforts to do this. This effort must be maintained and strengthened through ongoing communication, partnership development and education. Organisations such as the Murray Catchment Management Committee and Landcare groups can assist in this process by providing crucial bridges between government agencies and landholders.

In the short term, it is likely that non-binding agreements will continue to be more popular with landholders. In the longer term, an attempt should be made to tip the balance more towards binding agreements. Of course the balance between binding and non-binding agreements will, in the end, be decided by landholder choices. Those responsible for managing the agreements (see below) need to have appropriate marketing and education programs in place to ensure that landholders make these choices in an informed way, and in a climate conducive to acceptance of an agreement. To be successful, management agreements must engage strong landholder support and commitment. Such agreements need to be seen as partnerships between the landholder and the contracting organisation. Terms of agreements need to be binding on both the landholder and the contracting organisation (NPWS 1996).

We suggest that the following two types of agreement be offered to landholders.

1. Non-binding management agreements that include:
   – RNV management plans;
   – direct grants of up to $2,000/km to contribute towards fencing costs; and
   – 100% rate rebates for the area of RNV under the management agreement, with a minimum payment of $250 per annum.
2. Binding management agreements that include:
   – RNV management plans;
   – direct grants for fencing materials and labour up to $5,000/km;
   – 100% rate rebates for the area of RNV under the management agreement, with a minimum payment of $250 per annum; and
   – annual payments for RNV management costs (such as control of weeds and feral animals), based on the mean cost per study area as determined by Miles *et al.* (1998a), calculated as an annuity over 5 years.

We suggest that both types of agreement should be for five years. This period should be sufficient to achieve short-term management objectives, while providing a limit on the duration of government support. Renewal of agreements should be based on satisfactory performance as measured against the objectives of a management plan (see below).

6.2.2 Institutional arrangements

As indicated in Figures 2 and 3, there are many agencies, organisations and individuals with a stake in RNV management and conservation. For the study area in Victoria, the agencies and organisations involved include the North-east Catchment Management Authority; DNRE; Environment Australia (Commonwealth Government); the local governments of the Alpine Shire, Indigo Shire, Rural City of Wangaratta, Towong Shire and Rural City of Wodonga; and community organisations such as Landcare groups. For the New South Wales study area, stakeholder agencies and organisations include the Murray Catchment Management Committee; DLWC, Victoria; Regional Vegetation Committees

(RVCs); NPWS; Environment Australia; Greening Australia; the shires of Wakool, Murray, Berrigan, Corowa, Hume, Albury, Holbrook, Tumbarumba, Windouran, Conargo, Jerilderie, Urana, Lockhart and Culcairn; and Landcare groups. At present, attempts to establish an effective approach to RNV conservation are being hampered by the difficulty of coordinating effort across so many institutions.

We suggest that the way forward is for all institutional stakeholders to jointly develop and enter into a cooperative agreement for RNV conservation. Such a partnership arrangement should be established in accordance with the following guidelines.

1. The process for arriving at an agreement should be initiated and hosted, in the first instance, by the CMA and CMC, with organisational support from DNRE, Victoria and DLWC, New South Wales.
2. RNV management should occur within a nested institutional structure that takes advantage of existing institutions and allows each level of government to take action at a scale that is appropriate to its jurisdiction (Binning and Young 1997). The agreement should be consistent with the Intergovernmental Agreement on the Environment 1992, which sets down the broad roles and responsibilities of the three levels of government with respect to environmental matters. Some of the main points of the agreement are that:
   – the development and administration of the policy and legislative framework will remain the responsibility of the States and local government;
   – local government has a responsibility for the development and implementation of locally relevant and applicable environmental policies within its jurisdiction in cooperation with other levels of government and the local community;
   – the Commonwealth will continue to cooperate with the States in agreed programs;
   – the States have primary responsibility in the general area of nature conservation;
   – the Commonwealth has a particular interest in facilitating the effective and efficient coordination of nature conservation across all jurisdictions; and
   – there is a need for national cooperation to ensure that native vegetation remnants that are ecologically significant on a national scale are identified, that management and protection arrangements are consistent across borders, that research initiatives are coordinated and not duplicated, and that off-reserve protection activities complement the reserve system.
3. In recognition of the problem that the economically and geographically smaller councils in New South Wales will have more difficulty engaging with the policy and in establishing an effective partnership, special attention should be paid by the Murray CMC and DLWC to encourage participation by New South Wales councils.
4. The agreement should designate one of the institutions as having responsibility for managing the implementation of the policy, including authorising management agreements, delivering incentives, and employing, where necessary, additional RNV Officers. Landholders would then have a 'one-stop shop' from which they could enter into agreements, receive incentive payments, develop a RNV management plan, and receive support and advice from a RNV Officer. The designated management institution (DMI) should have the legal powers needed to enter into both binding and non-binding agreements with landholders.
5. Identification of the DMI should be a matter for negotiation between those institutions interested in participating in the development of the cooperative agreement. The recent trend for State governments to establish regional institutions such as CMCs and vegetation management committees in New South Wales, and CMAs in Victoria, has led to tensions between the roles and functions of these

organisations relative to local government. There is concern amongst local governments and others about potential confusion and conflicts with respect to statutory functions, the uncertain longevity of these new regional bodies and, since they are generally not elected, their potential to diminish local governance (Binning *et al.* 1999).

The roles of local governments and State government agencies, and their relationship with the CMA/CMC, can be specified in the corporative agreement. Where organisations such as Greening Australia are already providing incentives, they should also be party to the agreement. This would help avoid unnecessary duplication of effort and overlapping of responsibilities.

6. Design of the institutional arrangements under the cooperative agreement should, where possible, build on existing strengths of the partner organisations. For example, the Nature Conservation Working Group of the Murray CMC and Greening Australia provide useful models for effective engagement with landholders and successful delivery of fencing incentives.

7. Applications for management agreements should involve the DMI, and the State agencies responsible, if these are not the DMIs.

8. As part of developing the agreement, it should be determined if any of the existing instruments for establishing non-binding or binding agreements between landholders and a public institution can be used or adapted to fulfil the purposes of this proposed policy. The relationship between existing RNV incentives should also be established.

   Incentives are currently offered by the Commonwealth Government, State agencies and non-government institutions. Bushcare, a program under the Commonwealth's Natural Heritage Trust that is administered by Environment Australia, can assist landholders from both study areas to better manage their RNV.

   In New South Wales, landholders can currently enter into various agreements and access a range of incentives for RNV conservation. 'Management contracts' are non-binding voluntary agreements that can be negotiated between a landholder and DLWC. They enable landholders to access grants of up to $10,000 for activities which conserve native vegetation on their properties, including fencing, site preparation, feral animal control, weed control, and tree and shrub planting. For amounts over $10,000, 'property agreements' can be negotiated. A property agreement is a voluntary binding agreement between a landholder and the DLWC outlining the management of native vegetation on an individual property. The NPWS administers 'voluntary conservation agreements' and 'wildlife refuge agreements' that are non-binding voluntary agreements under the *National Parks and Wildlife Act 1974*. Greening Australia has a fencing incentive program that operates in the Murray catchment.

   Incentive programs that could contribute to RNV management in Victoria include the 'Land Protection Incentive Scheme' (a State-wide program designed to assist landholders to carry out landcare works such as protective fencing, soil erosion control, tree planting and salinity control); and the 'Tree Victoria' program which makes grants available to rural groups to assist with revegetation and remnant vegetation protection projects. Landholders in Victoria can enter into 'Trust for Nature' voluntary covenants, while DNRE offers 'Land Management Corporative Agreements' and 'Land For Wildlife' agreements.

9. The agreement should recognise the interaction between RNV management by private landholders, and public land management by government agencies, especially with respect to issues such as weeds and feral animals. This recognition may simply require reference to the

neighbour relations programs that State agencies already have in place to deal with such matters, but some additional assurance that management efforts in private RNV will not be compromised by the standard of adjacent public land management may be necessary.

6.2.3 Increased prohibitions on RNV clearing

The agreement should establish that no RNV may be cleared for uses such as grazing, cropping, hardwood or softwood production. As noted above, we regard retention of RNV as a duty of care. Permits for clearing RNV in areas suitable for high value uses such as viticulture might be considered. This increase in restrictions on RNV clearing is in line with the results of the BCA. These prohibitions should be recognised in local government and regional planning instruments such as Local Environment Plans and Regional Vegetation Management Plans (New South Wales) and Planning Schemes (Victoria).

We recognise that this suggestion is counter to current land use planning practices in both study areas. In New South Wales, areas available for clearing without permits are to be identified in Regional Vegetation Management Plans developed by RVCs. Plans (still in preparation) will: (i) identify areas where native vegetation may be cleared without application; (ii) identify areas where an application to clear will be necessary; (iii) identify areas of RNV that must be retained; (iv) allow clearing exemptions to be developed according to regional requirements; (v) highlight areas where the condition of native vegetation should be improved; and (vi) recommend areas that should be revegetated. Note that because RVCs have not been established on the basis of regional catchments, the Murray catchment will encompass more than one RVC. We recommend that the RVCs adopt a 'no clearing' policy for all RNV, contingent on the availability of suitable incentives to enable landholders to manage their RNV effectively.

In Victoria, RNV clearing controls operate through planning permits under the State section of the Planning Scheme under the *Planning and Environment Act 1987*. Local government administers all clearing permits. If the application concerns an area of less than 10 ha, this is the only level of administration that is involved. If the area is greater than 10 ha, or involves timber harvesting, the application is referred to DNRE also. The *Planning and Environment Act 1987* specifically rules out the possibility of compensation for those refused permits to clear. We recommend that the local sections of the relevant Planning Schemes include a RNV conservation zone that prohibits clearing, except for the high value uses mentioned above.

6.2.4 Funding

An essential part of the management agreements proposed is the provision of financial incentives. There is a range of direct management costs associated with RNV protection. These include the cost of erecting fences, maintenance of fences and tracks, weed and feral animal control, and fire management. Most landholders in the two study areas will experience a net loss if management regimes are introduced to enhance conservation values. It is therefore an aim of the management agreements to offer financial assistance to landholders to undertake best management practices. Funding is also required to cover additional staff costs (see 'Implementation') and to compensate local government for costs imposed on them by the policy.

Direct funding to landholders under non-binding agreements would be limited to a contribution that will cover part of the costs of fencing RNV (up to $2,000 per km), plus a rate rebate. The lower level of financial support attached to non-binding agreements reflects the relative uncertainty that the benefits sought would be delivered. In the initial proposal, the contribution was set at $1,200 to be consistent with the level of funding provided under Greening Australia and Natural Heritage Trust programs for non-binding agreements. However, comments from departmental staff and landholders suggested that an increase was essential to improve the attractiveness of non-binding agreements, particularly in North-east Victoria. It also needs to

be recognised that fencing costs vary considerably with factors such as topography and accessibility. It is likely to cost more to fence RNV in North-east Victoria and the eastern part of the Murray catchment, than in the central and western parts of the Murray catchment. The administering agency may wish to consider building some flexibility into the level of incentives offered to account for these factors.

As an added incentive to secure the long-term protection of RNV, the level of financial assistance would increase for binding agreements. Funding would be available to cover the full costs of fencing, including labour, for a cattle-proof fence. Since these costs depend on property-specific factors such as topography, the grant should be based on actual fencing costs for each property. Quotes from fencing contractors we contacted, as well as Victoria Department of Agriculture estimates (Boord and Trapnell 1993), suggested that these costs are generally between about $3,000 and $5,000 per km. We have therefore placed a $5,000 per km cap on the grant. Landholders committing to binding agreements would also be covered for any increase in costs arising from implementation of the management plan. The average magnitude of these costs for the two study areas is given in Table 15.

Table 15. Productivity and management costs of remnant native vegetation conservation

	Net cost (present value) of a five-year conservation scenario ($/ha RNV)	
	North-east Victoria	Murray catchment
On-farm productivity	34	51
RNV management	238	121

Given that the general community and downstream landholders have been identified as beneficiaries of improved RNV management, there is a potential justification for these two groups to fund the incentive scheme. The general community could 'purchase' the biodiversity, aesthetic and Landcare benefits via government funding of the incentive scheme. Extracting a contribution from downstream landholders would be more complex. Unlike biodiversity values, the external benefits would also be largely maintained regardless of the RNV management regime, as long as the vegetation is not cleared and is not suffering incremental decline. The major costs to landholders in this regard are the opportunity costs associated with not being permitted to clear RNV for some alternative land use. As noted above, it is not practical to compensate landholders for the opportunity costs of being prohibited from clearing RNV. In addition, according to the stated preference surveys that were used to determine community willingness to pay for conserving RNV, protecting the condition of the rural landscape with respect to factors such as soil and water is also regarded as a public benefit by many people. For these reasons, we recommend that the incentive policy be entirely government funded.

Although the details of funding arrangements need to be clarified as part of the cooperative agreement process, we suggest that the funding would probably be best done through a joint State–Commonwealth arrangement. State and Commonwealth funding of the program is consistent with the fact that the policy is primarily directed at improving RNV management, thus providing public good benefits associated with biodiversity conservation, water quality and aesthetic amenity.

Although rate rebates may not be a large financial incentive for landholders, they are a symbolic way of recognising landholders' efforts to manage RNV. Since rates are levied by local government, this proposal would require coordination under the cooperative agreement between local government and the DMI. The legislative basis for local councils offering rate rebates for conservation activities is described in Cripps *et al.* (1999). We propose that the local governments provide a 100% rebate on rates levied on RNV for those properties covered by either type of management agreement, with a minimum payment of $250 per annum being made to all landholders entering into an agreement. This minimum payment is required because small rebates

give no incentive to landholders, and may be seen by them as a waste of time, or even an insult. Since local government needs to be supported in their RNV conservation effort, State–Commonwealth funds should be used to reimburse councils the foregone rate revenue, as well as covering increased administration costs.

6.2.5 Implementation

On-ground implementation of the policy will require a joint effort on the part of landholders, agency staff and possibly the assistance of volunteer organisations such as Landcare groups and the Victorian Trust for Conservation Volunteers. Organisations such as DNRE, DLWC, NPWS, Greening Australia, Murray CMC and a network of the Upper Murray Landcare Groups already employ officers who have, at least in part, some role with respect to RNV conservation. In the New South Wales study area, there are currently fencing incentive officers (Greening Australia), native vegetation officers (DLWC), and a native vegetation project officer (CMC) who could potentially take on the role of RNV Officer. Similarly, in the study area in Victoria there is a Bushcare Officer, a revegetation officer, and a farm tree extension officer (all DNRE). It might be possible for these officers to undertake the proposed RNV management duties. However, it might not be viable to appoint extra duties to these existing officers, hence the appointment of new RNV Officers will probably be required. The roles and responsibilities of professional personnel involved in RNV management, and the complementary relationships between them, should be specified in the cooperative agreement. Part of the cooperative agreement process should be to identify if either one or more of these existing staff members could be given responsibility to implement the policy, or if additional staff would be required for effective implementation of the policy.

In any case, we suggest that RNV Officers for the two study areas be identified and given responsibility for:

- encouraging and administering applications for management agreements;
- assessing the quality of RNV sites;
- developing management plans with landholders;
- providing information and technical advice on best practice RNV management; and
- assessing performance against criteria set down in the management agreements.

Delivery of the actual RNV conservation activities (fencing, weed control and so on) would be the responsibility of the landholder, with support from a RNV Officer, whose role would be to provide management support, advice, and information on best management practices for RNV. An important priority for the proposed management agreements is to motivate landholders and to maintain their long-term interest in conservation. As well as the RNV officer and CMA/CMC, Landcare and other community education organisations will continue to have an important role in this regard.

6.2.6 Recipients

For reasons of equity, as well as community and political acceptability, any landholder with RNV should be eligible to enter into either a binding or non-binding management agreement. The regional catchment management plan and biodiversity action plans (New South Wales), together with the following priorities, should be used by the RNV officer to rank landholder applications for entry into agreements:

- RNV containing any rare, threatened or vulnerable plant or animal species, and in particular those listed under the *Threatened Species Conservation Act 1995* (NSW) or the *Flora and Fauna Guarantee Act 1988* (Vic.);
- high quality RNV;
- RNV containing a vegetation type that has a relatively high private land/public land ratio;
- RNV in groundwater recharge areas and along watercourses; and
- RNV that links with other areas of native vegetation such as those on adjacent public land.

The objective should be to get as much area of the RNV in the above five categories under

management agreements. Managing the RNV to maintain or enhance its quality will be addressed in the RNV management plan that is required under a management agreement.

The rankings should be used to assist decisions concerning the merits of each potential agreement, and to allocate resources where they are likely to have the most benefit for RNV conservation. Regardless of their entry into an agreement, all landholders would be able to seek advice from the RNV Officer.

6.2.7 Management plans

Development of management plans as part of binding or non-binding agreements will be a joint responsibility of RNV Officers and landholders, in consultation with the State agencies responsible. Plans should include measurable objectives, and indicate the actions required to achieve these objectives. Ideally, the RNV management plan should be a sub-plan of a whole-farm plan. RNV management needs to become a standard part of farm planning. Some indication of the willingness of landholders to be involved in property planning is given by the fact that, in 1995, 24% of Victorian Landcare group members were participating in property planning activities (Curtis 1996). These participation rates were in the absence of the economic incentives to be provided as part of this proposed policy package. The plan should also be consistent with higher level plans such as the regional vegetation management plans and regional biodiversity strategy in New South Wales, and the regional catchment management strategy and vegetation management plan in Victoria. While State government agencies have the capacity to develop plans and strategies, they do not have the capacity, or in some cases the local expertise, to effectively implement them. As noted above, this should be the responsibility of landholders in conjunction with RNV Officers.

Given the lack of definitive best practice guidelines for RNV management, an adaptive approach should be used. Adaptive planning treats management as an iterative process of review and revision.

Management interventions are regarded as a series of successive and continuous adaptations rather than a set of rigid prescriptions. The approach emphasises flexibility, requires willingness to learn through experience, and may require sacrificing present or short term gains for longer term objectives (Briassoulis 1989). The emphasis is on learning how the system works through management interventions that are both issue orientated and experimental (Dovers and Mobbs 1997). Adaptive planning recognises that there is often considerable uncertainty about the outcomes of any particular action. This uncertainty is built into plans so that information about the actual results of actions is used to inform and, where necessary, modify management practices. It is a process of learning by experience.

As described in section 3, the two study areas were stratified according to broad vegetation type, landform, climate and land use. Each property will have specific management needs depending on these local environmental characteristics and other factors such as past uses of the RNV. While the general structure and format of plans can be standardised, specific objectives and actions will probably need to be developed for each property. The planning effort will be considerable and will require the commitment of, and effective working relationships between, the landholders, RNV officers and agency staff.

Specific matters that would need to be addressed in most RNV management plans include:

- weed control, and where possible eradication;
- feral animal control;
- grazing regimes, if any, including stocking rates and times;
- extraction of forest products such as poles, posts and firewood, if any, including quantities to be taken; and
- fire management.

6.2.8 Monitoring and enforcement

Effective RNV management requires that landholders feel they are being rewarded for sympathetic management (encouragement) and not have rigid management regimes imposed on them (hindrance) (Binning and Young 1997). Although the emphasis in the proposed policy is on providing incentives rather than controls, some mechanisms are required to:

- ensure appropriate expenditure of the funds provided;
- evaluate whether the objectives of the management plans are being achieved; and
- review the effectiveness of the program.

Funds allocated according to management agreements should be provided to landholders on a contractual basis, with the RNV Officers responsible for determining that the terms of the contract are honoured. Monitoring of performance against the management plan objectives would also be the responsibility of the RNV Officer. The approach in dealing with any deficiencies in plan implementation should be the provision of information, technical advice and encouragement, rather than sanctions.

The program should be subject to an initial evaluation after three years. This evaluation should avoid targeting individual properties, though assessments will need to be made of a sample of properties, but rather aim to form an overall view on the success of the program for achieving both property specific and catchment wide objectives for RNV management. Note that spending more money does not necessarily equate to better biodiversity conservation outcomes. The program evaluation should attempt to measure the program's value for money. The continuation of the program should be dependent on a positive evaluation report. The evaluation should be conducted by an independent consultant to the managing agency as determined under the cooperative agreement.

6.2.9 Communication and education

We have already alluded to several aspects of the policy that must be supported by ongoing communication between stakeholders, and by enhancement of stakeholder knowledge. A change in culture is also required, such that providing a supply of high quality nature conservation, aesthetic and land protection benefits to the community is widely recognised and accepted as a legitimate component of rural productivity. Private landholders need to be recognised for, and themselves come to accept, their significance as suppliers of nature conservation values. Such a cultural change can be fostered through, among other things, the ongoing communication and education efforts by all those rural institutions involved in RNV conservation —government agencies, CMCs, CMAs, Landcare groups, Greening Australia, and others. Some landholders may also act as important role models in this regard.

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