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Informing conservation policy design through an examination of landholder preferences: A case study of scattered tree conservation in Australia

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ABSTRACT

Choosing effective policy instruments to achieve conservation goals has many challenges. We explore the challenge of instrument choice in the context of landscape-scale conservation on private land, where the challenge is to select instruments that are able to influence the management practices of large numbers of landholders with diverse values, beliefs and management priorities. We report on a landholder survey and workshop undertaken as part of a study focused on reversing scattered tree decline on private grazing land in Australia. We examined eight policy instruments against stated selection criteria in the context of four land management practices with potential to reverse tree decline: rotational grazing, tree planting, direct seeding of tree species, and reduced chemical fertilisers. Two of the four management practices (rotational grazing and tree planting) received much stronger support. Respondents considered all eight policy instruments more effective for supporting their uptake of these two practices compared to less preferred practices. Landholders preferred policy instruments providing short-term financial or material support, compared to longer-term instruments such as legal regulations or stewardship programs. The nature of the management practice on the production-conservation continuum significantly influenced landholder preferences for policy instruments: different instruments were preferred for conservation-oriented practices versus production-oriented practices. Our results support the conclusion that reversing scattered tree decline at the landscape-scale is best achieved by providing landholders with flexibility through offering multiple options in terms of both policy instruments and management practices.

1. Introduction

Reservation and management of public land is only a partial solution for many conservation problems. Policy instruments are required that encourage private landholders to maintain and enhance biodiversity assets on their land, but identifying effective instruments is challenging. In any region, conservation outcomes are determined by thousands of diverse landholders, whose decisions are shaped by personal goals and the varied biophysical, social and economic conditions they face (Siebert et al., 2006). Not only must policy instruments achieve conservation outcomes across this diverse audience, these instruments must be efficient, easily communicated to landholders, readily monitored and evaluated, and not cause unwanted impacts. Voluntary instruments must also be attractive to landholders to achieve widespread uptake.

The theory and practice of policy instrument choice is evolving and contested (Linder and Peters, 1989; Howlett, 2004). Very often, instrument choice is oversimplified and not made context-specific (Pannell, 2008), with singular instruments such as regulation or education championed as a 'cure all', supported by appealing metaphors (e.g. 'leave it to the market') and polar arguments – for example, that a choice must be made between market mechanisms versus regulation, or education versus financial disincentives (Howlett, 2004; Gunningham and Sinclair, 2005; Goulder and Parry, 2008). The last decade has seen a shift to promotion of the use of mixed instrument packages, in both conservation policy and other policy fields (Gunningham and Sinclair, 1999; Persson, 2006; Flanagan et al., 2011).

In conservation as in any sector, policy instruments are used to encourage, discourage, or enforce behaviour change by individuals, firms, or communities (Dovers, 2005; Howlett and Ramesh, 2003). While not always easily categorised, instruments often involve some combination of the following: command-and-control (e.g. legal regulations, conservation offsets), economic instruments (e.g. subsidies, taxes, etc.), self-regulation (e.g. certification, which also involves market incentives), voluntarism (e.g. community groups such as Landcare), and information strategies (e.g. extension programs) (Gunningham and Sinclair, 1999).

An understanding of the behaviour, perceptions and preferences of the targets of policy instruments – in our case, private landholders – is a crucial but often missing input to instrument

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choice (Pannell and Wilkinson, 2009). Available work often relies on the preferences of scientists or policy makers on ecological and administrative grounds, or established criteria such as estimates of net private and public benefits of the management practice or project in question (sometimes informed by studies of landholder views about these benefits) (e.g. Bowers, 1999; Pannell, 2008). These existing frameworks for instrument choice can be complemented by incorporating understanding of the landholder perceptions that determine the uptake of instruments, and hence their success in achieving conservation outcomes. In many cases, instruments thought to be efficient and appealing have failed due to a lack of landholder capacity or interest (e.g. Pannell et al., 2006; Valbuena et al., 2010), with examples of this type of instrument failure reported in conservation initiatives ranging from European agri-environmental schemes (Siebert et al., 2006; Espinosa-Goded et al., 2010) to stewardship programs in Australia (Valbuena et al., 2010).

Multiple studies have examined landholder perceptions of conservation problems, and willingness to adopt management practices intended to address them (Pannell et al., 2006; Knight et al., 2011). However, few of these studies have also examined landholder perceptions about the policy instruments intended to encourage adoption of management practices. Those that have typically examine perceptions of a single policy instrument, for example stewardship schemes implemented using market auction approaches (e.g. Adams et al., 2012). The few studies that have compared multiple instruments have typically confirmed that landholders prefer some instruments over others (Cocklin et al., 2007), and that instrument design and targeting can be improved through understanding landholder perceptions (e.g. Espinosa-Goded et al., 2010). However, these studies typically examined the uptake of a single management practice (e.g. Kabii and Horwitz, 2006; Pasquini et al., 2009; Greiner and Gregg, 2010; Valbuena et al., 2010), and therefore cannot identify whether instrument preference varies by conservation practice.

As part of a broader study of scattered tree decline in the Australian wheat-sheep belt, we used a landholder survey and workshop to explore perceptions of (i) four management practices identified by Fischer et al. (2009b) as having potential to reverse scattered tree decline, and (ii) eight policy instruments that could encourage uptake of these management practices. Our study was unique in that it examined landholder perceptions of multiple management practices and multiple policy instruments. We use the insights gained from this approach to identify lessons for the design of conservation policy for private land.

2. Case study: scattered tree conservation on private land

The decline of scattered remnant trees on agricultural land is a typical private land conservation challenge. The modification of natural ecosystems for agriculture exerts pressure on biodiversity in many landscapes (Hoekstra et al., 2005). In many regions, widespread clearing of forest and woodlands has resulted in a 'biological legacy' of isolated or small clumps of trees scattered across agricultural properties (Harvey and Haber, 1999; Manning and Lindenmayer, 2009). These trees 'are recognised worldwide as keystone structures because they have a disproportionate positive effect on ecosystems relative to the small number and area they occupy' (Manning and Lindenmayer, 2009, p. 126). These effects include enhancing landscape connectivity and wildlife habitat, increasing soil fertility, and improving water infiltration. Additionally, scattered trees and the vegetation structures they support are often the primary remaining representatives of endangered or threatened plant species (Lumsden and Bennett, 2005; Fischer et al., 2009a, 2010). Decline of scattered trees in agricultural landscapes is documented worldwide (Manning et al., 2006; Gibbons et al., 2008). The contemporary causes of decline are often attributable to agricultural practices that reduce natural regeneration, such as continuous grazing, cropping, or removal of fallen timber, rather than to deliberate clearing (Yates et al., 2000; Lumsden and Bennett, 2005; Manning and Lindenmayer, 2009).

In Australia and elsewhere, policies encouraging conservation of trees in agricultural landscapes often focus on protecting existing remnant patches and strips of native vegetation, and establishing new trees in these spatial configurations. Less attention is given to protecting or revegetating scattered trees. More active attention to scattered trees is essential given their ecological importance and the reality that, even with active planting, large swathes of agricultural landscapes will be devoid of trees within decades due to a lack of recruitment (Fischer et al., 2010). Addressing scattered tree decline requires understanding the ecological processes and land management practices contributing to decline. It equally requires identification of policy instruments that can achieve behaviour change by thousands of landholders.

From 2007 to 2011, the 'Sustainable Farms' study examined scattered tree decline in the Upper Lachlan catchment of New South Wales (NSW), Australia (Fig. 1). This largely grazed agricultural landscape forms part of the Box Gum Grassy Woodland region, recognised nationally and internationally as a significantly threatened eco-region (Hoekstra et al., 2005; Department of the Environment and Heritage, 2006). The project integrated ecological, economic and social research (Sherren et al., 2010a). The ecological component quantified the nature and extent of scattered tree decline (Fischer et al., 2009a), and identified four management practices likely to reverse decline:

(i) use of high-intensity short-duration grazing (e.g. 'cell' or 'time controlled' grazing) instead of continuous/long-duration grazing,
(ii) use of little/no chemical fertiliser in pasture management,
(iii) resting paddocks from agricultural activity for some years and direct seeding to achieve revegetation, and
(iv) planting and protection of new seedlings (Fischer et al., 2009b).

Social science components of the research revealed that landholders value scattered trees highly, but few actively manage these trees (Sherren et al., 2010b, 2011). This suggests landholders want

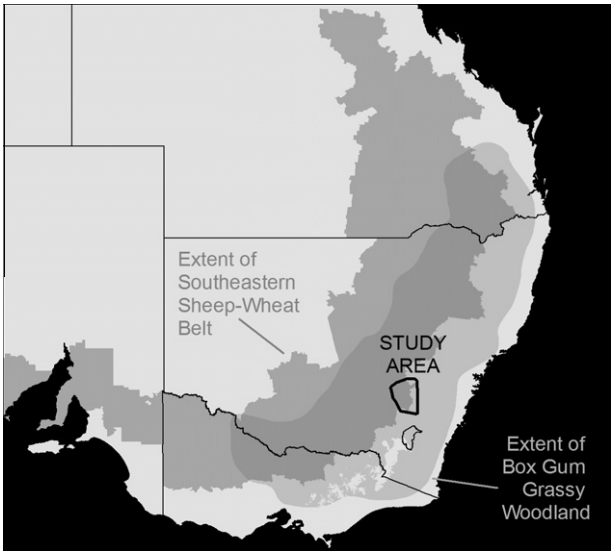

Fig. 1. Location of study region.

to conserve and regenerate scattered trees, but lack incentives, capacity or motivation to produce concerted action. Policy instruments that enable landholders to utilise the management practices listed above are critical to reversing scattered tree decline.

3. Methods

Multiple policy instruments have potential to assist adoption of the four management practices identified by Fischer et al. (2010) and thus reduce scattered tree decline. To identify the combination of instruments and practices likely to achieve the greatest on-ground impact, we needed to (i) quantitatively identify the distribution of views amongst landholders to identify the instrument-management practice combinations most likely to achieve widespread change, and (ii) qualitatively explain landholder preferences, to ensure policy instruments address the underlying drivers of behaviour. To achieve this, we used a mixed-methods approach, involving a postal survey and workshop. This overcame the inability of previous qualitative studies (Siebert et al., 2006) to identify the distribution of landholder preferences, while enabling iterative interpretation of the patterns observed in data to explain landholder preferences (Johnson and Onwuegbuzie, 2004). Rather than seeking to confirm particular hypotheses, the study was exploratory in nature.

A postal survey was distributed in early 2010–2552 landholders living in the region of Australia where the wheat-sheep farming belt intersects with the distribution of box gum grassy woodlands (Fig. 1). A stratified random sample was used, stratified by farm enterprise type (beef grazing, sheep grazing, mixed sheep-beef grazing, and mixed grazing-cropping), and by state (New South Wales, Victoria and Queensland). This stratification was based on expectations that policy preferences may vary by state and enterprise type. Farmer contact details were obtained from a large commercial database, *Farmbase*, which includes approx. 60% of Australian landholders.

We used multiple mail reminders to increase survey response, following Dillman et al. (2009). This involved sending the following at 9-day intervals: the initial survey and a letter encouraging participation, two reminder cards, re-sending the survey, and two further reminder cards. The 9-day interval was longer than Dillman et al.'s (2009) recommendation, to allow for mail delivery delay in rural areas. Survey recipients could choose not to participate by calling a free phone number, or returning their survey uncompleted in the provided pre-stamped envelope, consistent with ethical use of multiple reminder approaches (Schirmer, 2009). A dedicated free-call phone number ensured survey recipients to request survey assistance or otherwise contact the researchers. The survey was approved by the Australian National University's Human Research Ethics Committee.

Three hundred twenty-three surveys were removed as invalid due to death, retirement of the landholder from active land management, or incorrect address. There were 693 valid responses from the remaining sample (2229), giving a response rate of 31.1%. The responses were representative of the landholder population in terms of gender, age and farm enterprise type, although beef graziers were least likely to respond (26.8% response rate from specialized beef graziers and 28.6% from mixed sheep-beef graziers) and mixed graziers-croppers and sheep graziers most likely (34.9% and 34.2% respectively). Response rates varied by state, with a 33.8% response rate in Victoria, 31.4% in NSW, and 27.1% in Queensland. While not unduly low, the response rate would likely have increased with a shorter survey (the instrument was 22 pages), and more targeted survey distribution; some parts of the study region had little experience of scattered tree management issues (Sherren et al., 2012).

Landholders were asked their perceptions of right policy instruments intended to encourage uptake of Fischer et al.'s (2009b) four management practices. The instruments were selected based on review of the private land conservation literature (e.g. Sterner, 2003; Pannell, 2008; Hajkowicz, 2009), and instruments currently used in Australia and internationally (Clayton et al., 2009; NRMMC, 2010). They included instruments falling into Gunningham and Sinclair's (1999) categories of command and control regulation, economic instruments, self-regulation, voluntarism and information strategies. Some incorporated elements of more than one of these categories. The eight instruments were described in simple terms to ensure they were easily understood by respondents who sometimes had limited familiarity with particular instruments:

- *Provision of information and training* to landholders.
- *Voluntary community-based programs* to support coordinated efforts (e.g. via the Australian local-scale Landcare program).
- *Short-term financial support* for on-farm activities, such as grants for up to 5 years to undertake conservation work.
- *Stewardship payments* for on-farm activities, defined as long term (e.g. 15 years) payments in return for ongoing conservation activities.
- *Rewards for on-farm outcomes*, where payments are received upon achievement of conservation outcomes.
- *Supply of free materials* for activities, such as fencing or tree guards.
- *Legal regulations* that restrict activities affecting scattered trees.
- *Certification systems* that support landholders to obtain rewards in the marketplace for environmentally sustainable products.

We asked landholders to rate the effectiveness of each instrument for achieving uptake of the four management practices (short-duration rotational grazing; reduced fertiliser use; resting and reseeding paddocks; and planting and protecting seedlings four management practices), on a Likert-style scale of 1 (very poor) to 5 (very good), allowing for 'don't know' responses. Landholders were then asked to evaluate how effectively each instrument might support regeneration of scattered trees on grazing land through:

- achieving on-ground outcomes (dependability),
- providing a cost-effective use of public money (efficiency),
- being flexible and adaptive to different circumstances and needs of landholder (flexibility), and
- being easily understood by potential participants (communicability).

This provided insight into why certain instruments are favored, not simply what instruments are favored. More comprehensive evaluation criteria were considered, such as those described in Howlett and Ramesh (2003) and Dovers (2005). We used these four simple criteria as they (i) reflected core instrument choice considerations, (ii) had direct relevance to landholders (unlike criteria such as equity impacts or legal feasibility) and (iii) reduced the complexity of the survey, critical to increasing survey responses (Porter, 2004).

To help explain instrument preferences, the survey asked about the landholder's uptake of, and views about, the acceptability of the four practices; their management of scattered trees; their agricultural enterprise (property size, land uses); and demographic characteristics (age, gender, income, education, succession plans, occupation).

Survey data were explored descriptively to identify overall landholder preferences, followed by bivariate tests of correlation and significance. We used Kruskal–Wallis chi-square tests to iden-

tify significant differences between continuous variables for two or more independent groups, Friedman's test for two or more related groups, Spearman's rho to identify correlations between variables where one or both were ordinal, Pearsons r where both variables were continuous, and two-tailed t-tests where there was a categorical independent variable and continuous dependent variable. Correction for multiple comparisons was undertaken where appropriate using the Bonferroni correction.

Multivariate analysis was not undertaken due to the exploratory nature of the study: as eight different policy instruments and four management practices were examined, sample sizes were too small to quantitatively explain instrument preferences via multivariate modelling. Instead, we explored the likely relationships identified in bivariate analyses via a workshop with 15 landholders (engaged in a mix of sheep grazing, beef grazing and cropping) and two extension professionals engaged in private land conservation in the study region. The participants had participated in previous project activities (see Clayton et al., 2009), enabling them to draw on both their own knowledge and results of the Sustainable Farms project to inform their discussion.

Participants were presented with descriptive results from the survey, and asked (i) their views on the reasons for differing instrument preferences, and (ii) why they believed landholders ranked each instruments in different ways using the four criteria. This was used to generate hypothesized explanations for patterns seen.

The results are presented in two parts: the survey results, followed by using workshop discussions to inform interpretation of results and comparison to results of other studies.

4. Survey results

4.1. Landholder uptake and perceptions of the four management practices

Given our goal of identifying instruments that increase uptake of practices known to reverse scattered tree decline, we first analysed landholders' survey responses regarding their past use and acceptance of these four practices (Table 1). Over 55% of respondents had used or were considering using short-duration rotational grazing, planting and protection of seedlings, and reducing chemical fertiliser use. Only 18.9% had rested or were considering resting and reseeding paddocks. While these results are subject to some response bias, with current/potential users more likely to answer the question than non-users, they indicate a large difference in familiarity between the management practices. Similarly, the perceived acceptability of the practices varied: resting and reseeding paddocks and reducing fertiliser use were less commonly considered acceptable land uses by landholders than short-duration rotational grazing and planting and protecting seedlings. Reasons for these differences are not explored in this paper; they are instead used to inform understanding of preferences for policy instruments.

There were significant correlations in all cases between (i) adoption of a practice and its perceived acceptability, and (ii) the acceptability of a practice, and its perceived impact on farm enterprise profitability ($p < 0.01$ in all cases except one, Table 1). In all cases correlations were positive: for example, landholders were more likely to adopt short-duration rotational grazing if they found it an acceptable practice, and more likely to consider it acceptable if they did not believe it reduced profitability.

Table 1
Experience with and perceived acceptability of four management practices that encourage scattered tree regeneration, based on survey of landholders.

Management practice	Respondents who currently use, or would consider using, this practice[a]		Respondents who consider this land management practice acceptable or very acceptable[b]		Respondents who consider using this land management practice would reduce profitability of their farm enterprise over the long term[c]		Correlation between use of practice and perception that practice is acceptable[d]	Correlation between perceived acceptability and perception that practice reduces profitability[d]
	%	n	%	n	%	n	p, r_s (n)	p, r_s (n)
Short-duration rotational grazing	61.5	530	58.1	628	17.5	607	<0.000*, .451 (484)	<0.000*, −.323 (461)
Reducing fertiliser use	56.5	449	37.7	604	52.5	571	<0.000*, .239 (395)	0.036*, −.137 (363)
Resting and reseeding paddocks	18.9	469	9.4	612	68.1	609	<0.000*, .341 (433)	<0.000*, −.305 (416)
Planting and protecting seedlings	62.5	467	55.9	619	28.0	599	<0.000*, .523 (463)	<0.000*,−.230 (442)

[a] Landholders were asked to indicate if they (i) had not used the practice and had no intention of using it, (ii) if they had not used the practice but might considering doing so in future, (iii) currently used the practice, (iv) used the practice but were phasing it out, or (v) had used it in the past and no longer did so. There is likely to be some overestimation of willingness to use practices in these responses; a larger number of respondents reported their views on the acceptability of each land management practice than reported their history of uptake. A smaller proportion of respondents reported each management practice as being acceptable than reported having used or considered using the practice. With management practices significantly more likely to be considered acceptable by landholders who had either used, or were considering using, the practice in question ($p < 0.001$ in all cases), it is likely uptake rates were slightly lower in reality than is indicated by the subsample of respondents who responded to this question, a result of some landholders who were not actively using each practice leaving the question blank instead of responding that they had not used it.

[b] Landholders were asked to rate acceptability of each management practice on a five point scale from 'highly unacceptable' to 'highly acceptable', and provided a 'don't know' option. 'Don't know' responses were removed when performing subsequent correlations.

[c] Landholders were asked the extent to which they agreed or disagreed with the following statement for each management practice, using a 5-point scale: '[management practice] will reduce the profitability of my farm enterprise over the long-term'. A 'don't know' option was provided; 'don't know' responses were removed when performing subsequent correlations.

[d] Spearman's rho was used to identify correlations between (i) use of a practice and its perceived acceptability; and (ii) perceived acceptability and the perception a practice reduces profitability. 'Don't know' responses were removed. A post-hoc Bonferroni correction was applied to correct for multiple comparisons, and the corrected p-values are shown.

* Indicates significant relationships.

4.2. Landholder perceptions of policy instruments by management practice

We next examined the perceived effectiveness of each of the eight instruments for encouraging uptake of the four practices (Table 2). Supply of free materials was ranked more effective than other instruments, and legal regulation least effective, for all four practices, with the latter consider good/very good for achieving uptake by less than 15% of respondents.

Landholders rated some instruments as similarly effective irrespective of management practice, while others were rated differently depending on the practice being considered. In particular, the effectiveness of legal regulations was not rated significantly differently across the four management practices ($p = 0.188$, $\chi^2 = 7.942$); and while there was a significant difference between rating of management practices for all other policy instruments, the effect size was small for stewardship payments, rewarding outcomes, and certification. The remaining instruments (information and training, voluntary programs, short-term financial support, and free materials) were ranked significantly differently in terms of the different management practices, with larger effect sizes. In general, these instruments were rated more effective for achieving uptake of short-duration rotational grazing and planting and protection of seedlings than reduced fertiliser use or resting and reseeding paddocks.

4.3. Landholder evaluation of policy instruments

There was consistency between landholder's preferred instruments and their evaluation of instruments against the criteria of dependability, efficiency, flexibility and communicability (Table 3). Legal regulations and certification were least commonly rated as good/very good against all four criteria, and provision of free materials evaluated most positively, followed by short-term financial support. There was greater variability in the evaluation of other instruments (Table 3). Importantly, for each of the eight instruments, landholder's rankings of the different criteria varied significantly, indicating that respondents did consider each criterion separately, rather than using them as a proxy indicator of overall policy instrument preference.

4.4. Landholder familiarity with management practices and policy instrument preference

We explored whether a respondent's previous experience of the four management practices, history of protecting scattered trees, or socio-demographic characteristics were correlated with particular policy instrument preferences. The full analysis is provided in Appendix A; only significant relationships are described here. We did not apply a Bonferroni correction in this analysis, as the high risk of Type II error reduces the Bonferroni's usefulness in exploratory analysis such as this (Perneger, 1998).

Landholders who had used or were considering using the conservation-oriented practices of planting and protection of seedlings, or resting and reseeding paddocks, were more likely than non-users to rate five policy instruments as effective: information and training ($p = 0.019$, <0.000 respectively; see Appendix A for effect sizes), voluntary community-based programs ($p < 0.000$, 0.003), short-term financial support ($p = 0.004$, 0.021), certification systems ($p = 0.015$, 0.031) and supply of free materials ($p = 0.008$, 0.001).

This pattern was less evident for the two production-based management practices. Information and training and voluntary community-based programs were more likely to be considered effective by intended and actual users of short-duration rotational grazing compared to non-users ($p < 0.000$, 0.008 for information and training and voluntary programs respectively). Intended or actual reduction of fertiliser use was not typically associated with particular instrument preferences.

Landholders who reported actively protecting scattered trees on their property were more likely than other respondents to consider three instruments effective for achieving uptake of planting and protection of seedlings, and resting and reseeding paddocks: voluntary community-based programs ($p = 0.003$, 0.003), short-term financial support ($p = 0.004$, 0.021), and certification systems ($p = 0.015$, 0.031). Members of landcare groups reported a stronger preference for use of voluntary community-based programs for all practices except reduced fertiliser use, and for short-term financial support to achieve an increase in planting and protecting seedlings, and resting and reseeding paddocks. These results again suggest that existing experience with adopting the two conservation-oriented management practices is associated with greater interest in some policy instruments.

4.5. Landholder characteristics and policy instrument preferences

More mixed results were evident when socio-demographic and land management practices were examined (Appendix A). There were some significant relationships – for example, women were more likely than men to rank certification systems as effective for all four management practices, and non-farmers more likely than farmers to prefer information and training, voluntary community-based programs and certification systems, as effective for achieving planting and protection. However, these were not consistent across management practices or instruments. Previous studies have identified that non-farmers prefer longer term instruments such as certification while farmers prefer short-term instruments (Moon and Cocklin, 2011a); our results provide some limited support for this hypothesis.

5. Interpreting survey results

5.1. Understanding landholder's views about policy instruments

No single instrument is favoured by a large majority of landholders for any management practice. The most favoured instruments – free materials and short-term financial support – were rated 'good' or 'very good' by at most half of respondents, and the least popular instrument (legal regulation) by 10–14% of respondents depending on the practice considered. That said, some instruments are typically preferred by landholders irrespective of management practice type, particularly those that provide short-term support (supply of free materials and short-term financial support). Workshop participants believed this preference is attributable to the simplicity of short-term instruments, a wariness of long-term obligations and a belief that long-term government support is undesirable. It may also reflect the predominance of production-oriented landholders in our sample; Moon and Cocklin (2011a) found that production farmers prefer short-term financial incentives whereas non-production oriented landholders prefer other instruments. Instruments perceived as inflexible, arduous or complex such as legal regulations were least preferred, consistent with results of other studies (Cocklin et al., 2007; Ruto and Garrod, 2009; Aguilar and Saunders, 2011). Workshop participants believed landholders rank regulations poorly because of their perceived inflexibility, experience of past regulatory failures, and concerns about the administrative burden they impose; this is consistent with findings of other studies (Martin et al., 2007; Earl et al., 2010). Perhaps surprisingly, certification systems were the second least preferred instrument, viewed as relatively inflexible, difficult to understand, and unlikely to achieve outcomes. Work-

Table 2
Preferred policy instruments, ranked based on proportion of respondents who rated instrument 'good' or 'very good' in terms of its effectiveness for supporting uptake of management practices.

Policy instrument ranking	Management practice				Difference in perceived effectiveness of instrument between management practices[b]
	High-intensity short-duration rotational grazing	Substantial reduction in use of chemical fertilizers	Rest paddock for 5 years and direct seed	Plant seedlings throughout paddock and protect with tree guards/fences	p, χ^2 (n)
1 (Most preferred)	Free materials (45.9%, n = 432)[a]	Free materials (31.7%, n = 408)	Free materials (34.5%, n = 412)	Free materials (50.5%, n = 432)	Info & training* <0.000, 137.423 (357)
2	Info & training (39.3%, n = 453)	Short-term finance (28.4%, n = 418)	Stewardship (30.3%, n = 412)	Short-term finance (41.4%, n = 432)	Voluntary programs* <0.000, 50.617 (341)
3	Short-term finance (35.6%, n = 436)	Reward outcomes (27.7%, n = 412)	Short-term finance (30.0%, n = 420)	Stewardship (36.9%, n = 422)	Short-term finance* <0.000, 41.893 (348)
4	Reward outcomes (32.7%, n = 427)	Stewardship (27.6%, n = 411)	Reward outcomes (29.4%, n = 416)	Voluntary programs (36.2%, n = 428)	Stewardship* 0.004, 17.384 (337)
5	Voluntary programs (30.6%, n = 432)	Info & training (25.8%, n = 437)	Voluntary programs (24.0%, n = 418)	Info & training (36.1%, n = 441)	Reward outcomes* 0.004, 17.599 (331)
6	Stewardship (30.4%, n = 430)	Certification (25.4%, n = 410)	Certification (20.2%, n = 408)	Reward outcomes (34.3%, n = 426)	Free materials* <0.000, 67.107 (336)
7	Certification (27.2%, n = 425)	Voluntary programs (24.4%, n = 418)	Info & training (19.7%, n = 430)	Certification (27.5%, n = 421)	Legal regulations 0.188, 7.942 (323)
8 (Least preferred)	Legal regulations (14.2%, n = 421)	Legal regulations (10.1%, n = 408)	Legal regulations (12.3%, n = 410)	Legal regulations (14.3%, n = 418)	Certification* <0.000, 23.153 (326)

[a] The percentage in brackets indicates the proportion of respondents who responded that the policy instrument was 'good' or 'very good' in terms of its effectiveness in encouraging uptake of the management practice being considered. 'Don't know' responses were removed. The variance in number of respondents reflects removal of 'don't know' responses as well as variance in response, with some landholders choosing to leave some questions blank rather than responding to them.

[b] Friedman's test was used to identify differences in preference for policy instruments by management practice. A post-hoc Bonferroni correction was applied to correct for multiple comparisons, and the corrected p-values are shown.

* Indicates significant relationships.

Table 3
Proportion of respondents who rated each policy instrument as 'good' or 'very good' against four evaluation criteria.

Ranking	Evaluation criteria				Difference in ranking of policy instrument between evaluation criteria[b]
	Likely to achieve outcomes	Cost-effective	Flexible and adaptive	Easy for participants to understand	p, χ^2 (n)
1	Free materials (66.6%, n = 442)[a]	Free materials (54.6%, n = 425)	Free materials (51.9%, n = 419)	Free materials (63.4%, n = 423)	Info & training* <0.000, 30.462 (362)
2	Short-term finance (62.5%, n = 443)	Short-term finance (49.3%, n = 429)	Short-term finance (41.8%, n = 417)	Short-term finance (49.5%, n = 423)	Voluntary programs* <0.000, 17.815 (375)
3	Stewardship (55.4%, n = 432)	Voluntary programs (44.3%, n = 425)	Voluntary programs (41.3%, n = 412)	Voluntary programs (49.0%, n = 417)	Short-term finance* <0.000, 87.085 (374)
4	Reward outcomes (52.4%, n = 433)	Reward outcomes (43.1%, n = 423)	Stewardship (34.9%, n = 412)	Info & training (44.2%, n = 420)	Stewardship* <0.000, 78.482 (345)
5	Voluntary programs (43.2%, n = 428)	Stewardship (43.0%, n = 428)	Reward outcomes (34.0%, n = 413)	Stewardship (39.7%, n = 414)	Reward outcomes* <0.000, 64.996 (344)
6	Info & training (41.7%, n = 431)	Info & training (34.8%, n = 422)	Info & training (33.8%, n = 410)	Reward outcomes (39.4%, n = 413)	Free materials* <0.000, 30.360 (377)
7	Certification (29.7%, n = 427)	Certification (24.4%, n = 417)	Certification (20.1%, n = 411)	Certification (21.6%, n = 415)	Legal regulations* <0.000, 38.538 (351)
8	Legal regulations (18.0%, n = 425)	Legal regulations (16.0%, n = 415)	Legal regulations (9.6%, n = 407)	Legal regulations (12.6%, n = 414)	Certification* <0.000, 35.961 (335)

[a] The percentage in brackets indicates the proportion of respondents who responded that the policy instrument was 'good' or 'very good' in terms of its performance against each evaluation criterion. 'Don't know' responses were removed. The variance in number of respondents reflects removal of 'don't know' responses as well as variance in response, with some landholders choosing to leave some questions blank rather than responding to them.

[b] Friedman's test was used to identify differences in ranking of policy instruments between the four evaluation criteria. A post-hoc Bonferroni correction was applied to correct for multiple comparisons, and the corrected p-values are shown.

* Indicates significant relationships.

shop participants believed this is because certification involves complex paperwork and verification procedures, and because landholders lack familiarity with certification. This contrasts with a large body of literature arguing that market-driven certification provides a powerful incentive to change behaviour (e.g. Higgins et al., 2008).

The variation in landholder preferences for particular instruments can be partly understood through examining the perceived effectiveness of each instrument in terms of its dependability, efficiency, etc. Free materials were ranked higher than all other instruments on all four criteria, and certification and legal regulations lowest, consistent with overall preferences. Voluntary programs were rated higher than most other instruments in terms of their efficiency, flexibility and ease of comprehension, but ranked fifth in terms of their dependability, suggesting that their low overall ranking reflects concerns about whether they achieve on-ground outcomes. Information and training, meanwhile, was ranked low in terms of outcomes achieved, cost effectiveness and flexibility, but considered easy to understand. This differs to other studies that have found strong landholder preferences for education and training-related instruments (van Gossum and Maeyer, 2006; Aguilar and Saunders, 2011).

These results suggest that implementation of any instrument should be accompanied by strategies that address its perceived limitations. This may be achieved by combining multiple policy instruments to complement each other, although care is needed to ensure this does not result in perverse or unintended outcomes (Moon and Cocklin, 2011b). For example, achieving widespread landholder uptake of certification would require implementation of information and training instruments that build landholder familiarity with and capacity to achieve certification.

5.2. Matching policy instruments to management practices

Our study differed from previous work in that we examined how policy instrument preference varied between different management practices. Although this limited in-depth examination of each practice and instrument, it enabled exploration of interactions between landholder views about practices and instruments.

Our findings demonstrate a need to target policy instruments to specific practices. With the exception of legal regulations and free materials, instrument preferences are not global: they are context-specific. For example, stewardship payments were ranked second and third most preferred for achieving uptake of the two conservation-focused management practices – resting of paddocks and planting and protecting seedlings – but were considered less effective for achieving uptake of the more production-oriented activities of reducing fertiliser use or short-duration rotational grazing. This was consistent with the perceptions of workshop participants that farmers are wary of the constraint on long-term decision-making of contractual commitments associated with stewardship programs, and hence less likely to consider them effective when applied to production-oriented activities.

Views about information and training also varied by management practice; this instrument was ranked second most effective for achieving uptake of short-duration rotational grazing, suggesting landholders view this practice as amenable to uptake with additional information, but less effective for other management practices. The preferences expressed are consistent with the improved farm profitability associated with short-duration rotational grazing on many properties (Crosthwaite et al., 2008). Pannell (2008) has suggested that provision of information is effective only when the land use change being promoted financially benefits the landholder. In contrast, landholders felt information and training was unlikely to change their views about the relative unacceptability of reducing fertiliser use or resting and reseeding paddocks.

5.3. The importance of understanding familiarity of the management practice

Our results show that understanding landholder perceptions of management practices is critical to effective choice and design of policy instruments. The familiarity and acceptability of a management practice, and its perceived impacts on the farm enterprise are key considerations. In our study, policy instruments of all types were considered more effective for achieving uptake of practices landholders found more acceptable – planting and protecting seedlings and short-duration rotational grazing – than for the less acceptable practices of reducing use of chemical fertiliser and resting and reseeding paddocks.

Workshop participants felt these results reflected the familiarity of respondents with each practice: short-duration rotational grazing and planting and protection of seedlings are more common practices in the region and the other two practices less so. In our survey results, familiarity did seem to matter: landholders who had personally utilised a management practice, or were actively considering doing so, preferred different policy instruments than those with less familiarity, particularly information and training and voluntary community-based programs. Supply of free materials and short-term financial support, for example, were ranked higher by landholders who were considering resting and reseeding paddocks, or planting and protecting seedlings, than those who were not.

5.4. Targeting policy instruments to stage of uptake of management practices

The variation in policy instrument preference observed in landholders with differing levels of familiarity with each management practice points to a need to target instruments to landholder's stage of uptake of practices.

For example, workshop participants suggested that information and training is a more effective instrument when used to encourage practices that already have a high level of acceptance by landholders but which are not yet widely adopted. They argued that short-duration rotational grazing falls within this category, while tree planting (the other of the four management practices with wide landholder acceptance) is such a familiar and commonly adopted activity that landholders do not feel they require additional information.

Where practices are less familiar or accepted, instruments aimed at increasing acceptability should be prioritised; where the barrier to uptake relates more to the costs or time involved, different instruments will be needed to achieve increased in uptake.

5.5. Other factors influencing instrument choice

Instrument preferences are sometimes suggested to vary depending on the socio-demographic characteristics of landholders, or the nature of their enterprise (Kabii and Horwitz, 2006; Siebert et al., 2006), as are preferences for adoption of different conservation practices (Pannell et al., 2006). We do not attempt to review the extensive and often conflicting results of these studies. While our results provided limited support for a link, the strength and extent of relationships was considerably lower than that between management practice type and instruments. This suggests that identifying the instruments that best support uptake of particular management practices may be more worthwhile than attempting to predict which types of landholders prefer particular instruments. It also suggests that explaining the variance in views of different landholders is more complex than assigning a specific point of view to a particular type of landholder; multiple factors such as a landholder's previous experience with using a management practice,

Table A1
Relationships between perceived effectiveness of different policy instruments for achieving uptake and (i) management practice adoption, (ii) farm management and (ii) socio-demographic characteristics.

Policy option		Gender	Age	Job[a]	Off-farm income[b]	Succession plans[c]	Adoption history[d]	Scattered tree protection[e]	Landcare member[f]	Farm profit[g]	Farm type[h]	State[i]
		H, *p*, *n*	r_s, *p*, *n*	*Z*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	*Z*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	*H*, *p*, *n*
Provision of information	Rot. grazing	0.031, 0.86, 405	−0.073, 0.146, 401	−0.612, 0.54, 393	−0.074, 0.154, 373	4.279, 0.233, 393	**.236, 0.000, 345****	0.001, 0.981, 384	−0.151, 0.880, 375	0.002, 0.971, 352	3.692, 0.449, 385	4.755, 0.093, 408
	↓ Fertiliser	0.236, 0.627, 380	−0.068, 0.185, 378	−1.423, .155, 371	−0.048, 0.370, 350	3.698, 0.296, 371	**.137, 0.021, 286***	0.842, 0.359, 362	−0.623, .533, 360	0.002, 0.965, 332	3.507, 0.477, 372	0.105, 0.949, 381
	Rest paddock	2.454, 0.117, 373	−0.068, 0.192, 371	−0.231, 0.817, 364	0.024, 0.661, 347	2.478, 0.479, 365	**.239, 0.000, 284****	**6.095, 0.014, 356***	−1.49, 0.136, 354	0.082, 0.143, 324	2.615, 0.624, 370	2.945, 0.229, 375
	Plant + protect	1.086, 0.297, 394	−0.028, 0.581, 393	−**3.643, .000, 384****	0.06, 0.256, 365	5.821, 0.121, 383	**.132, 0.019, 314***	2.391, 0.122, 377	−1.902, .057, 370	0.001, 0.980, 342	3.265, 0.514, 381	**10.498, 0.005, 396****
Voluntary community based programs	Rot. grazing	0.005, 0.943, 375	−0.07, 0.182, 371	−0.472, 0.637, 363	−**.112**$^{'}$ **0.038**, **348***	3.585, 0.310, 363	**.147, 0.008, 321****	0.81, 0.368, 354	−**2.184, 0.029, 360***	0.044, 0.431, 328	5.253, 0.262, 375	**12.273, 0.002, 376****
	↓ Fertiliser	0.089, 0.765, 350	−0.05, 0.354, 347	−0.126, 0.899, 340	−0.077, 0.167, 326	2.61, 0.456, 340	0.117, 0.057, 264	0.115, 0.735, 335	−0.126, 0.899, 345	0.100, 0.078, 309	7.257, 0.123, 349	1.210, 0.546, 351
	Rest paddock	2.739, .098, 355	−**.138, 0.010**, **353****	−0.447, 0.655, 345	−0.001, 0.985, 331	2.965, 0.397, 346	**.211, 0.000, 270****	**9.123, 0.003, 338****	−**2.611, 0.009, 338****	0.064, 0.259, 311	2.88, 0.578, 365	3.514, 0.173, 356
	Plant + protect	1.848, 0.174, 377	−0.086, 0.096, 375	−**3.286, 0.001, 368****	0.002, 0.97, 351	5.408, 0.144, 365	**.240, 0.000, 297****	**8.824, 0.003, 358****	−**2.405, 0.016, 357***	−0.01, 0.855, 329	3.984, 0.408, 378	4.014, 0.134, 378
Short-term financial support	Rot. grazing	0.245, 0.621, 381	−0.041, 0.432, 377	−0.218, 0.827, 369	−**.127**$^{'}$ **0.017**, **353***	1.532, 0.675, 368	0.063, 0.260, 322	0.050, 0.822, 361	−1.933, 0.053, 360	−0.055, 0.313, 333	**13.583, 0.009**, **383****	2.455, 0.293, 382
	↓ Fertiliser	0.196, 0.658, 360	−0.048, 0.369, 357	−0.763, 0.446, 349	−0.099, 0.07, 334	0.62, 0.892, 350	0.115, 0.061, 268	0.943, 0.331, 343	−0.776, 0.438, 350	0.021, 0.709, 315	**11.532, 0.021**, **363***	1.907, 0.385, 360
	Rest paddock	3.146, 0.076, 366	−0.076, 0.149, 364	−0.635, 0.526, 356	0.029, 0.589, 342	0.723, 0.868, 357	**.192, 0.001, 280****	**5.325, 0.021, 348***	−**2.593, 0.010, 350****	−0.016, 0.776, 322	**10.925, 0.027**, **367***	**6.629, 0.036, 367***
	Plant + protect	3.771, 0.052, 381	−0.066, 0.201, 379	−**2.327, 0.020, 370***	−0.011, 0.832, 356	0.595, 0.898, 371	**.196, 0.001, 300****	**8.349, 0.004, 363****	−**2.589, 0.010, 361****	−0.068, 0.212, 335	6.303, 0.178, 356	**13.309, 0.001, 383****
Stewardship payments	Rot. grazing	0.334, 0.563, 361	−0.003, 0.958, 357	−0.409, 0.683, 351	−**.128, 0.019**, **339***	5.509, 0.138, 350	0.007, 0.896, 306	0.351, 0.553, 342	−0.706, 0.480, 347	−0.058, 0.304, 317	7.863, 0.097, 354	1.673, 0.433, 362
	↓ Fertiliser	2.452, 0.117, 346	−0.04, 0.458, 343	−0.337, 0.736, 337	−0.092, 0.097, 326	5.242, 0.155, 338	0.034, 0.589, 260	0.244, 0.621, 330	−0.111, 0.911, 350	−0.011, 0.846, 305	4.717, 0.318, 350	0.404, 0.817, 346
	Rest paddock	**3.826, 0.050, 350***	−0.026, 0.624, 348	−0.823, 0.411, 342	−0.073, 0.186, 331	3.173, 0.366, 343	0.057, 0.350, 271	1.525, 0.217, 332	−1.487, 0.137, 360	−0.051, 0.376, 308	4.059, 0.398, 363	0.367, 0.833, 351
	Plant + protect	2.664, 0.103, 364	−0.023, 0.667, 362	−1.004, 0.315, 355	−0.102, 0.059, 344	2.899, 0.407, 357	0.014, 0.811, 289	1.695, 0.193, 345	−0.218, 0.827, 350	−0.075, 0.178, 322	3.777, 0.437, 369	3.442, 0.179, 359
Rewards for on-farm outcomes	Rot. grazing	0.588, 0.443, 357	0.062, 0.248, 353	−0.299, 0.765, 348	−**.132, 0.016**, **335***	1.254, 0.740, 347	0.010, 0.869, 303	0.00 0.999, 340	−0.513, 0.608, 343	−0.057, 0.317, 315	9.427, 0.051, 359	1.534, 0.464, 359
	↓ Fertiliser	0.925, 0.336, 341	0.028, 0.608, 338	−0.147, 0.883, 333	−**.138, 0.013**, **320***	0.70, 0.873, 332	0.08, 0.204, 254	0.21, 0.647, 327	−0.032, 0.975, 326	−0.028, 0.624, 300	4.392, 0.356, 346	0.363, 0.834, 342
	Rest paddock	1.901, 0.168, 347	0.001, 0.979, 345	−0.888, 0.374, 340	−0.075, 0.178, 328	2.164, 0.539, 339	0.061, 0.321, 268	2.913, 0.088, 334	−1.614, 0.107, 331	−0.042, 0.469, 305	8.009, 0.091, 349	0.097, 0.953, 349
	Plant + protect	1.432, 0.231, 359	0.008, 0.873, 358	−1.357, 0.175, 352	−0.079, 0.147, 341	1.032, 0.793, 351	0.05, 0.397, 283	1.793, 0.181, 344	−0.692, 0.489, 341	−0.052, 0.356, 316	3.285, 0.511, 358	3.561, 0.169, 362
Supply of free materials	Rot. grazing	**6.486, 0.011, 385***	0.046, 0.368, 381	−1.658, 0.097, 375	−0.075, 0.160, 357	4.35, 0.226, 373	−0.046, 0.405, 327	0.328, 0.567, 365	−1.473, 0.141, 363	−**.125, 0.022, 338***	**16.285, 0.003, 382****	0.705, 0.703, 386
	↓ Fertiliser	1.844, 0.174, 338	0.015, 0.785, 335	−1.143, 0.253, 329	−0.029, 0.605, 316	1.673, 0.643, 328	0.033, 0.607, 250	0.317, 0.574, 322	−1.207, 0.228, 331	−0.052, 0.375, 296	7.343, 0.119, 356	0.435, 0.804, 339
	Rest paddock	1.258, 0.262, 358	0.01, 0.844, 356	−1.026, 0.305, 350	−0.018, 0.747, 337	7.578, 0.056, 349	**.193, 0.001, 274****	2.596, 0.107, 341	−**2.24, 0.025, 339***	−0.026, 0.643, 314	9.268, 0.055, 360	2.35, 0.309, 360
	Plant + protect	**8.25, 0.004, 387****	0.03, 0.552, 385	−**2.81, 0.005, 377****	−0.021, 0.684, 364	3.956, 0.266, 378	**.152, 0.008, 306****	**4.956, 0.026, 369***	−1.93, 0.054, 365	−0.08, 0.143, 340	3.700, 0.448, 378	**8.295, 0.016, 390***
Legal regulations	Rot. grazing	**0.000, 0.992, 352****	−**0.108, 0.044, 348***	−1.595, 0.111, 342	0.014, 0.807, 326	2.669, 0.446, 342	−0.054, 0.352, 299	0.049, 0.825, 333	−0.459, 0.647, 335	0.041, 0.469, 309	2.263, 0.687, 359	0.573, 0.751, 352

(*continued on next page*)

Table A1 (*continued*)

Policy option		Gender	Age	Job[a]	Off-farm income[b]	Succession plans[c]	Adoption history[d]	Scattered tree protection[e]	Landcare member[f]	Farm profit[g]	Farm type[h]	State[i]
		H, *p*, *n*	r_s, *p*, *n*	*Z*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	*Z*, *p*, *n*	r_s, *p*, *n*	*H*, *p*, *n*	*H*, *p*, *n*
	↓ Fertiliser	0.134, 0.714, 331	−0.1, 0.072, 328	−0.951, 0.342, 322	0.009, 0.880, 310	0.445, 0.931, 323	**.160, 0.011, 249***	0.29, 0.590, 314	−0.77, 0.441, 325	0.063, 0.282, 291	2.679, 0.613, 345	3.547, 0.170, 330
	Rest paddock	**0.007, 0.933, 335****	−0.093, 0.090, 333	−1.034, 0.301, 326	0.011, 0.846, 317	1.461, 0.691, 328	**.128, 0.042, 254***	0.008, 0.930, 317	−0.845, 0.398, 325	0.079, 0.179, 294	2.181, 0.703, 329	4.329, 0.115, 335
	Plant + protect	**0.014, 0.907, 343***	−**0.106, 0.050, 341***	−1.22, 0.223, 335	0.019, 0.739, 325	1.095, 0.778, 336	0.087, 0.158, 268	0.863, 0.353, 325	−1.112, 0.266, 316	0.102, 0.078, 303	8.339, 0.080, 342	**9.321, 0.009, 343****
Certification systems	Rot. grazing	**5.371, 0.02, 354***	−0.036, 0.498, 350	−1.116, 0.264, 346	−0.022, 0.694, 334	1.955, 0.582, 345	0.063, 0.275, 299	2.31, 0.129, 336	−0.899, 0.369, 340	−0.043, 0.450, 317	**12.872, 0.012, 358***	1.883, 0.390, 355
	↓ Fertiliser	**8.286, 0.004, 337****	0.02, 0.716, 334	−0.723, 0.47, 329	−0.012, 0.828, 317	1.888, 0.596, 328	0.117, 0.062, 255	3.102, 0.078, 321	−0.603, 0.547, 333	−0.022, 0.709, 300	**9.854, 0.043, 349****	1.065, 0.587, 337
	Rest paddock	**13.932, 0.000, 331****	−0.003, 0.954, 329	−1.318, 0.187, 324	0.032, 0.571, 315	0.156, 0.984, 324	**.144, 0.021, 256***	**4.655, 0.031, 315***	−1.572, 0.116, 342	−0.024, 0.680, 295	**16.339, 0.003, 325***	0.377, 0.828, 332
	Plant + protect	**5.823, 0.016, 346***	0.034, 0.529, 344	−**2.319, 0.020, 338***	−0.033, 0.553, 328	0.552, 0.907, 337	0.108, 0.075, 271	**5.863, 0.015, 330***	−1.099, 0.272, 341	−0.024, 0.673, 310	**9.837, 0.043, 354****	2.412, 0.299, 349

Gender, succession plans, scattered tree protection, farm type and state were analysed using the Kruskal Wallis *H* test; Age, off-farm income, adoption history and farm profit using Speamans Rank Order Correlation (two-tailed), and job and Landcare membership using the Mann Whitney *U* test. A Bonferroni correction was not applied as it was overly conservative for an exploratory analysis such as this, which seeks to identify potential relationships. Significant relationships are indicated by bold text and * (0.05 level) or ** (0.01 level).

[a] Whether respondent was a farmer or non-farmer (non-farmers had a primary occupation other than farming, while also managing land for agricultural production).

[b] Proportion of household income earned off-farm.

[c] Whether respondent planned to pass the property down within the family; sell the property to family; sell the property outside the family; or didn't know what they would do with the property.

[d] Whether respondent had adopted management practice (i.e. short duration rotational grazing; reduced fertiliser use; resting and reseeding paddocks; or planting and protecting seedlings).

[e] Whether landholder had taken action to protect scattered trees on their farm.

[f] Whether landholder was a member of a Landcare group.

[g] Reported on-farm profit (or loss) in last financial year.

[h] Whether respondent was a sheep grazier, beef grazier, mixed sheep-beef grazier, or mixed cropping-grazing farmer.

[i] Whether respondent managed land in New South Wales, Victoria or Queensland.

views about land management, and other values and perceptions, interact to produce a view about a policy instrument, and demographic characteristics are not always a strong predictor, a point also highlighted by Siebert et al. (2006).

5.6. Implications for policy design

These results suggest two straightforward conclusions: (i) any policy instrument will be more effective if applied to encourage behaviours (management practices) already well accepted by and familiar to landholders, than to encourage behaviours that are unfamiliar and viewed as unacceptable; and (ii) different policy instruments may be needed depending on the extent of landholder familiarity with, acceptance and experience of the management practice the instrument is intended to encourage.

It is therefore just as important for policy makers to invest in identifying and evaluating the different management practices that can be used to address conservation on privately owned land as it is to evaluate which instruments are likely to be most effective. Many conservation challenges can be addressed using multiple types of management practice change; in the case of scattered trees, at least four different types of change can make a significant difference. Supporting a diverse range of management practices that can address a conservation problem is more likely to provide a management practice-policy instrument combination that suits a range of landholder circumstances than relying on encouraging a single practice change. This finding suggests a need to not only ensure policy instruments are consistent with the broader policy regime and governance framework in which they are embedded (Howlett, 2009), but to also design them to match the specific land management change they are intended to encourage. This requires in-depth examination of optimal design of each instrument (Broch and Vedel, 2012) to meet the unique characteristics of the management practice.

In the case of scattered tree decline, lower investment in policy instruments is likely to be needed to encourage uptake of short-duration rotational grazing and planting and protection of seedlings compared to reduction of fertiliser use or resting and reseeding paddocks, irrespective of the policy instrument used. If seeking to encourage further activity in these areas by landholders who have already used these practices, use of information and training and voluntary community-based programs may be most effective and efficient.

Similar to other studies of complex policy problems, our results suggest that relying on a single instrument to achieve widespread uptake of a practice is likely to be less effective than using a mixed instrument approach (Gunningham and Sinclair, 1999; Santos et al., 2006; Howlett and Rayner, 2007). A mixed instrument approach can meet the preferences of a wider range of landholders, and also enables the complementary use of instruments to provide a more effective outcome (Gunningham and Sinclair, 1999). For example, combining information and training with short-term financial instruments enables the ease of comprehension of the former to be combined with the higher dependability and efficiency of short-term financial payments. Mixed instrument packages can be used to target the specific characteristics of management practices that present barriers to uptake more effectively than single instrument approaches, and can be better targeted to different stages of uptake. In early stages of uptake of a new and unfamiliar management practice, investment in instruments focused on increasing familiarity and acceptability may be needed in addition to incentive or regulation based instruments. Over time, as the practice becomes more widely accepted, the mix of instruments can be reduced to a core set that maintain ongoing use of what has become more familiar and acceptable. A mixed instrument approach requires care; further work is needed to identify whether and how the instruments we explored can complement each other versus providing redundant functions (Gunningham and Sinclair, 1999).

The approach we are suggesting is more costly to design and implement than a 'one size fits all' approach. Unless carefully targeted, it has potential to be more costly overall despite achieving more widespread uptake. While there is debate about how best to evaluate the cost effectiveness of conservation actions (e.g. Laycock et al., 2009; Hockley, 2010), in general identifying the optimal mix of policy instruments and management practices requires assessing the relative conservation benefits of achieving uptake of a particular management practice versus the cost of investing in policy instruments needed to achieve that uptake. In our study, this requires identifying how effective each management practice is in reversing scattered tree decline, versus the cost of the policy instruments needed to achieve adequate uptake of those practices. If achieving widespread uptake of short-duration rotational grazing is adequate to achieve significant reversal of decline, it may be most efficient to target a policy program to this management practice alone, as it is relatively well accepted and likely to require less costly policy intervention to achieve uptake compared to resting and reseeding paddocks. However, a more complex package of options that also includes instruments encouraging planting and protecting of seedlings and resting and reseeding paddocks will likely achieve action on a larger area of land, as landholders who are unable or unwilling to consider short-duration grazing will have alternative options, as will those on land with no parent trees to provide a seed source for regeneration.

6. Conclusions

Choosing effective policy instruments to achieve conservation goals on privately owned land is a difficult task, and the case of scattered tree conservation is no exception. Our paper highlights the importance of understanding the interaction between a particular management practice, and the policy instruments designed to achieve uptake of the practice.

Previous studies have identified a need to use a mix of policy instruments to achieve a given management change. Our results suggest it is equally important that landholders are provided with multiple management practice options to achieve a given conservation outcome. In particular, using a mix of instruments and facilitating uptake of more than one land management practice is preferable to a 'one size fits all' approach if attempting to achieve widespread and cost-efficient adoption of conservation practices across a landscape of privately owned land. This more complex approach enables targeting of instruments to the diversity of landholder circumstances, and provides landholders with flexibility in aligning their response with their socioeconomic circumstances and land management priorities. Where feasible, flexible and shorter-term instruments such as provision of financial support, free materials and information and training should be utilised, with landholders wary of instruments such as certification that involve considerable ongoing administration or long-term contracts. As a landholder's previous experience with using a management practice significantly influences the types of policy instruments they prefer, designing policy instruments in staged phases to match differing stages of uptake is likely to assist in successful achievement of on-ground outcomes.

These recommendations may appear on face value to complicate policy instrument choice and design, rather than make it simpler. It certainly does require an increase in investment in the design phase of conservation policy, particularly to evaluate the ecological and economic costs and benefits of different management practice-policy instrument mixes. We believe that the

targeted design of staged mixed-instrument approaches has potential to achieve greater on-ground change at less cost compared to the blanket application of single instruments and management practice changes in the well-meaning, but often misplaced, hope that they will achieve widespread transformation of landholder practice.

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Appendix A

See Table A1.

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