

Landholder participation in native vegetation management in irrigation areas

By Emily Mendham, Joanne Millar and Allan Curtis

Emily Mendham is a researcher with the Institute of Land, Water and Society at Charles Sturt University (PO Box 789 Albury, NSW 2640, Australia. Tel.: 02 60519839; Fax: 02 60519897; Email: emendham@csu.edu.au), Dr Joanne Millar is a researcher with the Institute of Land, Water and Society at Charles Sturt University (PO Box 789 Albury, NSW 2640, Australia. Tel.: 02 60519859; Fax: 02 60519897; Email: jmillar@csu.edu.au) and Professor Allan Curtis is the Director of the Institute for Land, Water and Society (PO Box 789, Albury, NSW 2640, Australia. Tel.: 02 60519730; Fax: 02 60519797; Email: acurtis@csu.edu.au). The project was undertaken to provide information on how to improve uptake of recommended vegetation management practices in the Murray Irrigation Region of southern New South Wales.

Summary Landholder adoption of conservation practices has been extensively researched in dryland areas, but there has been less research into the adoption of biodiversity conservation practices in irrigation areas. The Murray Catchment Management Authority (MCMA) and Murray Irrigation Limited (MIL) in south-west New South Wales offer landholders monetary incentives to enhance native vegetation management. However, uptake of the incentives and recommended practices has been slower in the irrigation areas than in dryland areas serviced by the MCMA. We explored landholder participation in native vegetation management in the MIL area using semistructured interviews with landholders and extension staff. Our findings suggest there are important differences between irrigation and dryland contexts. Landholders in irrigation districts face higher opportunity costs and are more likely to mistrust government intentions. Other constraints to adoption include lack of financial resources, restricted time to carry out works and a high turnover of extension staff. Landholders adopted recommended vegetation management practices because those practices matched their values and goals. The importance of regular contact with a positive and enthusiastic extension officer was also evident. These findings have important implications for conservation policies and programs. Extension should move beyond arousing interest and include substantial follow-up contact to maintain landholder motivation and confidence, as well as provide recognition for past landholder efforts. Incentive programs should be designed to provide wider landholder support with different entry points allowing participants to adapt, learn and build confidence. Incentives should address the constraints experienced by landholders, particularly at times of peak workloads and during drought. Work targets set for field staff can be too high and result in program staff focusing on accomplishing on-ground work, rather than developing irrigators' longer-term commitment to vegetation conservation.

Key words biodiversity conservation, irrigation, landholder adoption, Murray Irrigation, native vegetation.

Introduction

Research exploring landholder adoption has largely focused on production and sustainable agriculture technologies (e.g. Rogers 1962; Fujisaka 1994; Pretty 1995; Abadi Ghadim & Pannell 2003; Nicholson *et al.* 2003). Landholder adoption of biodiversity conservation practices has been more recent and less thoroughly investigated, with most studies in dryland contexts (e.g. Dettmann *et al.* 2000; Wilson & Hart 2001). Data availability on adoption of biodiversity conservation practices in irrigation areas is limited. Different constraints will apply to different land use enterprises and innovations (Guerin 1999).

In this paper, we discuss the findings of research conducted in 2005 exploring landholder adoption of recommended practices for native vegetation management in the Murray Irrigation Ltd (MIL) area, located in

the west of the Murray Catchment Management Authority (MCMA) area in southern New South Wales (Fig. 1). The MCMA area encompasses both dryland agriculture (located in the east of the catchment including the South-West Slopes) and irrigation areas in the west of the catchment. The MCMA is responsible for natural resource management in the region. Vegetation incentives and targets are consistent across the whole catchment (MIL deliver the MCMA incentives and comply with MCMA targets). Four irrigation districts make up the MIL Area: Berriquin, Denimein, Cadell and Wakool. Agriculture is the major industry and employer in the area, with 90% of agriculture dependent on irrigation and the main agricultural produce being rice (Murray Irrigation 2002a).

The Murray Land and Water Management Plan (LWMP) was developed to address rising water tables and salinity in the area, and is

delivered by MIL (Murray Irrigation 2002b). Farm planning, irrigation recycling and the protection and enhancement of regional native vegetation are three essential components of the Murray LWMP. Monetary incentives are offered to assist landholders protect native vegetation through actions such as fencing and revegetation (Murray Incentives Group 2004). To be eligible for these incentives, landholders must undertake current recommended practices (CRP) for vegetation management, which include revegetating at least a 30-m-wide strip of vegetation, or fencing a minimum of 2 ha of remnant vegetation. These thresholds are used to identify work that is deemed to constitute a public conservation service, as opposed to smaller-scale works considered to provide a private value for the landholder.

The stimulus for this research was a realization that although landholders had

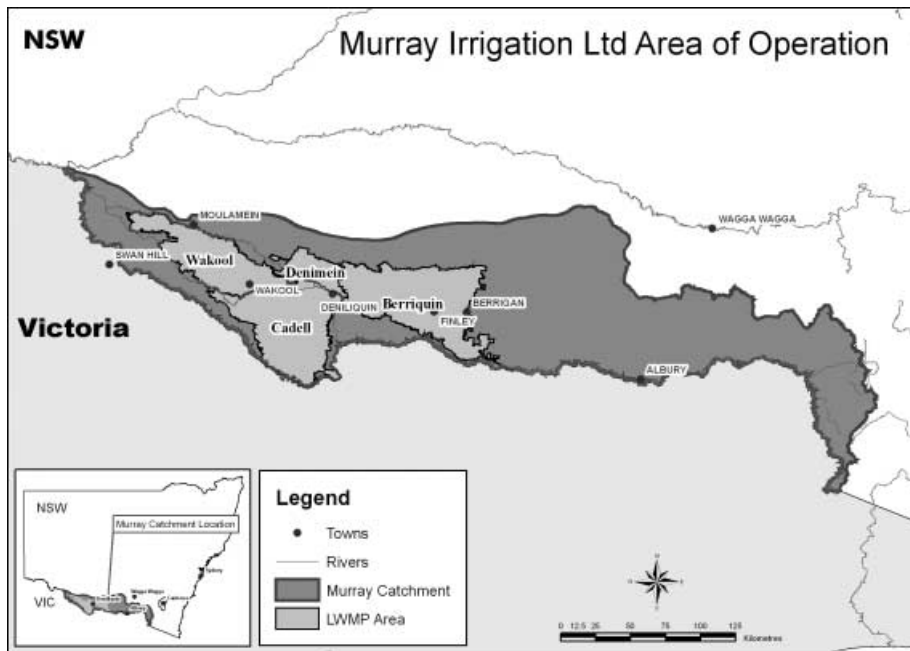


Figure 1. Location of the study: Murray Irrigation's area of operation.

widely adopted two aspects of the plans (farm planning and irrigation recycling), landholder implementation of CRP for native vegetation was much lower. There was concern at the time that targets set for native vegetation enhancement would not be met.

In the remaining sections of this paper, we provide a brief review of the literature on landholder adoption of conservation practices, outline the methods used to conduct the study and present our key findings. We conclude with a discussion of the reasons why adoption rates and constraints to native vegetation management are different for irrigation areas and outline implications of our key findings for ecological restoration policy and management.

Understanding landholder adoption of conservation practices

Theoretical frameworks on landholder adoption have evolved over the last 60 years in line with changing issues for agriculture, environmental management, public perceptions and government policies (Rogers 1962; Röling 1988; Pretty 1995; Vanclay & Lawrence 1995; Morris 2006). Assumptions

that landholders should or will adopt technologies recommended by scientists via extension agents (known as the transfer of technology) have largely been replaced with participatory approaches aimed at sharing knowledge and learning between scientists, farmers, extension agents, policy-makers and industry (Pretty 1995; Curtis & De Lacy 1996; Nicholson *et al.* 2003). Experiences with working more closely with landholders have generated new insights into factors which influence landholder adoption and participation in natural resource management (Cramb 2000; Curtis *et al.* 2001; Morris & Winter 2002).

Literature on landholder adoption generally concludes that landholders will adopt recommended practices if it fits with their goals and they have the capacity to implement the practice (Vanclay & Lawrence 1995; Cramb 2000; Morris 2006). Pannell *et al.* (2006) go on to identify four broad sets of factors that provided a useful structure for understanding adoption of native vegetation management practices for this study: the personal characteristics of the landholder; the social and environmental context in which landholders operate; the nature of the practice; and the process of learning in which the landholder is engaged.

Personal and family context

Family and personal goals, including financial security, are generally the highest priority for farm families (Wilson & Hart 2001; Cary *et al.* 2002; Morris 2006). Landholders' personal characteristics such as their age, attitudes towards risk and motivation levels also influence adoption (Nicholson *et al.* 2003; Vanclay 2004). Awareness of environmental issues and having an environmental ethic can be important for adoption, but are usually not sufficient on their own to overcome constraints such as lack of confidence in practices or insufficient management expertise (Curtis *et al.* 2001).

Landholder occupation can also influence adoption; access to off-farm income can increase financial security. However, it is possible that landholders earning most of their income off-farm will be reluctant to invest in unprofitable on-farm enterprises (Barr *et al.* 2000). More hours working off-farm may also mean less time available for property management which will act to limit adoption of practices that are time consuming (Dettmann *et al.* 2000). On the other hand, non-farmers may bring new ideas, skills and financial resources and in some cases may be more likely to respond to calls for biodiversity conservation (Curtis & De Lacy 1996).

Social and environmental context

Adoption is less likely if CRP do not fit with existing enterprises or conflict with social norms such as valuing local industries and communities (Cary *et al.* 2002). For example, the introduction of farm forestry in some traditional grazing areas in Australia has met with community concern about loss of livestock revenue, lowering of groundwater and declining community services (Curtis & Race 1996). Prevailing policies and government regulations can also have a significant effect on landholder willingness to take up certain incentives, particularly if they do not support or understand policies or fear a loss of rights (Fujisaka 1994; Curtis *et al.* 2001; Morris 2006).

On the other hand, social networks and membership of organizations such as Landcare can have a positive influence on adoption (Curtis & De Lacy 1996; Morris &

Winter 2002). Involvement in activities of Landcare and industry-based groups can enhance landholder knowledge and management skills, develop trust in the advice of extension staff and build confidence in recommended practices: elements which are critical for adoption to occur (Pannell *et al.* 2006).

Nature of the practice and learning process

Characteristics of a practice that influence adoption include its relative advantage, geographical applicability, trialability and observability. Relative advantage is normally interpreted in terms of the financial risk, complexity or flexibility of a practice to the adopter compared to the practice it supersedes (Rogers 1962). Practices which have impacts or advantages that are easily observable are more likely to be adopted so there is a clear need for the development of locally relevant practices (Cary *et al.* 2002; Millar & Photakoun 2006). The extent to which a practice allows for partial adoption, facilitates trialling, and promotes the acquisition of personal experience and confidence increases the likelihood of adoption (Vanclay 2004).

Knowledge and confidence in a practice influence landholders' capacity to change (Curtis *et al.* 2001). Learning encompasses improvements in skill as well as reductions in uncertainty. As landholders trial a practice and become more confident in the benefits of that practice, they are more likely to continue or scale up its implementation (Rogers 1962). It is useful to think of adoption as an innovation-decision process (Guerin & Guerin 1994). An important point to be made is that trialling a CRP does not necessarily equal adoption or long-term commitment to a practice. Landholders accessing incentive programs to fund on-ground works may trial a practice but decide not to continue (Pannell *et al.* 2006).

Government-funded extension has moved away from purely production focused and one-to-one methods to group-based extension focused on natural resource management (Cary *et al.* 2002). Groups are seen as an effective way of facilitating the interaction of local and scientific knowledge to solve problems and encourage innovation (Millar & Curtis 1997). Three fundamental elements

are that of learning by doing, learning from peers, and acting with a perspective that goes beyond property boundaries (Curtis 2003). At the same time, there has been a reduction in the number of extension staff providing face-to-face extension services (Barr & Cary 2000). There are criticisms of the group approach, which include high transaction costs and placing responsibility on locals for addressing what are often systemic issues (Vanclay & Lawrence 1995; Black 2000).

Data collection and analysis

Qualitative methods were employed to better understand landholder adoption of native vegetation CRP in the MIL area. Between March and May 2005, 24 landholders from the four LWMP areas were separately interviewed to explore their experiences with native vegetation management and their perceptions of the incentives offered by MIL. Interviews were also conducted with three native vegetation extension officers working in the area and a group interview was held with 10 MIL LWMP implementation officers.

The research team drew on the local knowledge of MIL staff to identify landholders to be interviewed. MIL staff were asked to provide a list of possible participants (above the number required for interview)

from across the LWMP area from three categories: (i) landholders who have undertaken works to MIL current standards for vegetation CRP (fencing at least 2 ha of remnant vegetation or revegetating a 30-m-wide strip of vegetation); (ii) landholders whom the MIL staff feel may take up incentives (these often included landholders who had undertaken self-funded works or vegetation works through previous programs with smaller criteria); and (iii) landholders whom the staff feel would not take up incentives offered. A random sample was taken from this list, which included seven landholders who have undertaken native vegetation works to the LWMP standards, and 17 landholders who have not conducted works to the standards (these may include farmers who have conducted other vegetation works but not to the current standards). This ratio was chosen as landholders who have not taken up vegetation CRP make up the majority of landholders and this is where the greatest potential for increased uptake lies. Landholders were sampled from across the LWMP area to obtain a geographical spread.

Knowledge of the literature on landholder adoption and preliminary discussions with key informants, including LWMP officers, informed development of the interview guides (Tables 1 and 2). The interview guides allowed the interviewer to remain

Table 1. Interview guide used to conduct the semistructured interviews with landholders

| | |
|---|--|
| Background (15 min) | <ul style="list-style-type: none"> • How long have you been on the property? • How many members of the family work on-farm/off-farm? • What is the size of the property? • What enterprises? • What are your interests? |
| Goals (15 min) | <ul style="list-style-type: none"> • Why do you (like) live here (district or property)? • What are you attempting to achieve on your property? • What are your long-term goals and plans? |
| Native Vegetation (30 min) | <ul style="list-style-type: none"> • What remnant vegetation do you have on your property? • How do you manage your RNV? • Why is it important/not important? • What are your plans? |
| Perception of support and services available (30 min) | <ul style="list-style-type: none"> • What would be useful to you to assist in managing your RNV? • Have you heard of incentives offered by MI? If yes, how? Your views? • What remnant vegetation works have you carried out? |
| Information Sources (15 min) | <ul style="list-style-type: none"> • Have you attended any field days/short courses/government programs? • Where do you get your information from? |

Table 2. Interview guide used to conduct the semistructured group interview with extension staff

-
- What motivates some farmers to take up incentives and/or adopt best management practices (does one rely on the other)?
 - What are the reasons for the low uptake of native vegetation incentives in your region?
 - Is there a problem or issue with the targets set, type of incentives offered or the way they are marketed?
 - What is the best way to involve landholders in actively managing native vegetation?
-

open and flexible in pursuing topics brought up by the participant during the interview process (Minichiello *et al.* 1995; Rossman & Rallis 2003).

Interview data were transcribed verbatim. The broad categories defined from the literature, such as landholder goals and family succession, provided a starting point for analysis. Key topics (e.g. 'farm size'), interviewee experiences with native vegetation management, and perceptions of the opportunities and constraints associated with native vegetation enhancement, were combined into common themes (e.g. 'values and goals'). Quotes or evidence were then attached to each of these categories. The key reasons for adoption or non-adoption and differences or commonalities between landholder experiences and perceptions were categorized. This process allowed local contextual issues important to the interviewees to come to the fore. The qualitative analysis computer software NVIVO version 2.0 was used to assist in organizing the data.

Factors influencing landholder adoption of native vegetation CRP in an irrigation area

Our research suggests that factors influencing landholder decisions to adopt vegetation CRP in MIL area are consistent with those identified by the broader literature, but some factors are more influential than in dryland areas. These factors relate to the nature of irrigation farming practices and more recent introduction of ecological management and restoration programs. The following findings highlight some of the major factors relating to adoption of vegetation management incentives and practices in the irrigation area studied.

It's what my personal values are

Adoption occurred if the practice matched landholder goals or values (for production and/or conservation). Several farmers who had adopted vegetation CRP expressed a strong stewardship ethic and conservation values. These were particularly evident in landholders who had undertaken other conservation-related works, additional to vegetation CRP.

When you get to my age, which is not very old, you start to realize you are not here for very long at all. So you have some obligation to leave what we have been involved in, in the best condition. In my 50 years, I've seen things done to the environment and I'd like to see that not continue. That might be a big ask, and I suppose in a small way I'd like to reverse it, like with the [conservation] project, it's just a gesture I suppose. (Farmer 11)

However, a stewardship ethic and conservation values were also evident in landholders who had not undertaken vegetation CRP but had engaged in vegetation management through previous programs with different criteria (e.g. Greening Australia).

We don't believe you should irrigate all your farm. And we've made a conscious effort not to do that. We have dryland cropping and can fit in an area like that that's regeneration area or whatever quite happily. (Farmer 9)

Production, financial and labour constraints

Landholders who had undertaken CRP would be prepared to do more, and landholders who have yet to access incentives would

be interested in undertaking works if economic constraints were removed. The incentives available were perceived by some to be seriously inadequate in situations where production loss was going to occur as a result of undertaking the practice. For example, the following farmer had undertaken CRP but was financially unable to take any further land out of production, despite indicating a strong desire to conduct further conservation works.

Locking up country that we are actually cutting wood out of now, well that's just going to impact. So there's no incentive there to - if you can't derive an income. (Farmer 5)

The drought and a depressed regional economy have compounded poor levels of on-property income to the extent that financial and labour capacity was often identified as primary constraints to adoption.

If things had gone in normal years all of that would have been locked up 2 years ago, done, finished. You can't spend it if you ain't got it, you can but don't want to get the bank in that far - they're already a bit twitchy. (Farmer 15)

Farmers who have adopted native vegetation CRP in the MIL area have usually done so on areas that were of little production value or in areas where native vegetation would enhance production. If vegetation CRP did not fit with the existing farming system, such as fencing out land currently in production, only small-scale adoption of remnant vegetation protection could be expected.

The majority of paddocks have been cleared pretty intensively and parts that are left are usually parts where you can't get water to so you can easily fence them off. (Farmer 2)

Several landholders said they could not plant trees to the current 30-m criterion owing to the small size of their properties and others had requests for funding rejected because they did not meet the current criteria. As a result, the interviewees expressed disappointment and frustration and were reluctant to undertake future vegetation work.

They come in and say you got to do this, you've got to do that. You're not going to get anywhere ordering farmers: go in and work with them, encourage them to add a little bit more land perhaps, but don't make such rigid rules because not everywhere is the same.

(Farmer 3)

People don't know how to go about it or start

Vegetation management has not been part of farm planning in the MIL region until relatively recently (the current criteria and incentives for vegetation management were introduced into the plans in 1999/2000). The absence of a strong history of Landcare in the irrigation region was also identified as a factor contributing to general lack of confidence in vegetation CRP.

People don't know how to go about it or start. In Denimein, Wakool and Cadell they had incentives in the past set by MIL –10-m wide. Landholders learnt, got comfortable and confident. There were no past incentives in Berriquin, except some Greening Australia funds. But now they are being asked under the new catchment criteria to do 2 ha, 30-m wide, with no background experience of starting small and feeling confident, then moving to larger areas. (NRM Officer 6)

High turnover of MIL staff was mentioned as a constraint to developing rapport and landholder trust, and hindering those landholders who may take longer to decide whether or not to adopt a practice.

But they seem to have high staff turnover, which makes it really difficult to establish relationships with anybody there, so that you have some consistency of contact. (Farmer 8)

It was also revealed that identifying work targets for individual staff was placing extension officers under pressure to achieve targets rather than providing high quality ongoing support for landholders and achieving the best vegetation outcomes. Current vegetation extension staff indicated they lacked sufficient resources and time to provide adequate follow-up support to landholders who have conducted vegetation CRP.

If you're going to improve vegetation it requires management, management requires knowledge, knowledge requires support and understanding. We can't even meet the first initial visits let alone go back and help those people with management. (NRM Officer 1)

What the farmer wants is one-to-one extension

The quality of extension officers and the relationship established with them was vitally important in raising landholder awareness of the practice and maintaining long-term commitment to ongoing management. Follow-up visits and explanation provided by the extension officers (such as the return of native grasses and orchids, or explanation of failures such as the lack of germination following direct seeding owing to lack of rain) were critical in sustaining landholder confidence in and commitment to vegetation CRP. The enthusiasm and positive outlook of some vegetation officers was a key ingredient in maintaining landholder motivation and fostering pride.

What the farmer wants is that one-on-one thing. And he wants you to go on his place, and show him how it's going to work, how it's going to benefit him and how it's going to benefit his farm operation. (NRM Officer 2)

Perception of government agencies

A general suspicion of government was identified by the NRM extension officers as a major constraint to adoption of incentives for native vegetation management in the MIL region. A fear of the long-term consequences of accepting government money, such as future restrictions on farm management, was also expressed.

Here's the target, here's the incentive, or else – fantastic way to piss people off. How about provide people with information in a clever and concise way – here's vegetation, here's why we need it, what can we do about it? They completely skipped that process. (NRM Officer 5)

Some landholders are keen to fence off, understand the incentives, but are hesitant because they want to know will it affect

me in the longer term – will someone come back and dictate to me what I can do. That is the reason a lot of people aren't getting involved. They believe that if they take money it is binding them to something. (NRM Officer 7)

Most landholders held the opinion that the rural community is unfairly and harshly judged by the wider community, especially considering land clearing was mandatory for maintaining leases until relatively recently. Our interviewees felt that the wider Australian public view rice growers as people who wantonly degrade the country, and this was identified as a possible constraint to adoption of vegetation practices.

The work that has been done by the farmers is not valued or recognized. Landholders are upset and have their backs up over this lack of recognition and undervaluing of the work that they have completed. (NRM Officer 6)

Discussion and conclusions

The findings from our research on adoption of conservation practices in an irrigation area are largely consistent with wider literature on landholder adoption including the adoption framework presented in this paper. Although farmer goals and attitudes, environmental values and awareness of issues are important factors leading to trialling and adoption of conservation practices, they are insufficient on their own to ensure adoption as other authors have found (Vanclay & Lawrence 1995; Curtis *et al.* 2001; Cary *et al.* 2002; Curtis & Robertson 2003; Morris 2006). Financial capacity, management skills, extension support, flexibility of incentives and farmer confidence in practices were also important influences on the adoption of native vegetation CRP in the MIL region.

However, we suggest there are important differences between dryland and irrigation contexts, which influence landholder adoption of conservation practices. The relatively recent history of vegetation clearing and rapid introduction of NRM regulations, including water reforms, has led to a climate of anxiety, fear and a mistrust of government intentions in the irrigation district studied. Landholder's perceptions that their

contributions to ecological management has not been recognized and the high opportunity cost associated with taking irrigated land out of production, appear to have had a significant bearing on landholder adoption of vegetation management practices in the MIL area. Given the additional overlay of drought and economic hardship, it is not surprising that landholders were reluctant to adopt the improved vegetation management practices, despite a strong stewardship ethic being expressed by many of the interviewees.

Our research highlighted the importance of providers of extension services being flexible and adopting a longer-term time frame as they work with landholders.

Two potential areas for improved extension can be identified. First, it is important for government and CMA to invest in extension staff who can build landholder confidence, foster environmental values and build trust in government. This research highlights the broader national issue (in both dryland and irrigation contexts) of reliance on, and withdrawal of, one-to-one extension services (Vanclay & Lawrence 1995). Agencies must endeavor to create employment conditions that encourage well-trained and enthusiastic extension staff to remain in irrigation communities for longer periods of time to build rapport and encourage the adoption of conservation practices. Extension should move beyond arousing interest in CRP to include substantial follow-up contact to maintain landholder motivation. Uptake of recommended practices does not necessarily mean farmers will be able to continue managing conservation assets. Extension staff needs to be able to spend more time with landholders to enhance commitment to ecological management over the long-term.

Second, there needs to be less emphasis on achieving targets and more flexibility in program delivery. Incentive programs should be designed to provide wider landholder support. It is important for programs not to exclude people willing to participate in improving ecological management on their farms. Programs should allow for trialability, partial adoption and different entry points allowing participants to adapt, learn and build confidence and commitment to vegetation (Pannell *et al.* 2006). This is particularly important in irrigation areas with

the relatively recent introduction of vegetation programs and limited previous exposure to vegetation CRP. Alternative forms of engagement should be encouraged to increase landholder commitment to conservation. For example, MIL is conducting wildlife surveys on farms, which are proving popular with the farming community.

Improvements can also be made in terms of enhanced incentives. The high opportunity costs associated with taking land out of production suggests that there is a strong case for higher levels of incentive payments to landholders. This is particularly important given the limited financial capacity of many irrigation farmers, especially during times of drought and low water allocations. Stewardship payments or incentives packages that cover the costs of ongoing site management and opportunity costs should be considered by agencies.

It also needs to be recognized that substantial work is being undertaken by those not accessing incentives. Several landholders in this study had conducted self-funded works, through a previous Greening Australia program or Landcare. These findings suggest that measurements of incentive uptake may underestimate the level of landholder commitment to conservation.

Acknowledgements

The authors wish to thank the participants in this research who gave so generously of their time. This research was funded by Murray Irrigation Limited. The authors also wish to thank the Murray-Darling Freshwater Research Centre for their support of this research, and Simon McDonald of the Spatial Data Analysis Unit, CSU, for cartographic services. We also thank the anonymous reviewers who provided valuable comments.

References

- Abadi Ghadim A. and Pannell D. (2003) Risk attitudes and risk perceptions of crop producers in Western Australia. In: *Risk Management and the Environment: Agriculture in Perspective* (eds B. A. Babcock, R. W. Traser and J. N. Lekakis), pp. 113–133. Kluwer, Dordrecht, The Netherlands.
- Barr N. and Cary J. (2000) *Influencing Improved Natural Resource Management on Farms*. Commonwealth of Australia, Canberra, ACT.
- Barr N., Ridges S., Anderson N. *et al.* (2000) *Adjusting for Catchment Management: Structural Adjustment and its Implications for Catchment in the Murray-Darling Basin*. Dryland Technical Report no. 2, Murray-Darling Basin Commission, Canberra, ACT.
- Black A. (2000) Extension theory and practice: A review. *Australian Journal of Experimental Agriculture* **40**, 493–502.
- Cary J., Webb T. and Barr N. (2002) *Understanding Landholders' Capacity to Change to Sustainable Practices: Insights about Practice Adoption and Social Capacity for Change*. Commonwealth of Australia, Canberra, ACT.
- Cramb R. A. (2000) Processes influencing the successful adoption of new technologies by smallholders. In: *Working with Farmers: The Key to Adoption of Forage Technologies. Proceedings of an International Workshop Held in Cagayan de Oro City, Mindanao, Philippines from 12–15 October 1999* (eds W. Stur, P. Home, J. B. Hacker and P. C. Kerridge), pp. 11–22. Australian Centre for International Agricultural Research, Canberra, ACT.
- Curtis A. (2003) The Landcare experience. In: *Managing Australia's Environment* (eds S. Dovers and S. Wild River), pp. 443–460. The Federation Press, Sydney, NSW.
- Curtis A. and De Lacy T. (1996) Landcare in Australia: Does it make a difference? *Journal of Environmental Management* **46**, 119–147.
- Curtis A. and Race D. (1996) *Review of Socio-Economic Factors Affecting Regional Farm Forestry Development in Australia*. Charles Sturt University, Albury, NSW.
- Curtis A. and Robertson A. (2003) Understanding landholder management of river frontages: The Goulburn Broken. *Ecological Management & Restoration* **4**, 45–54.
- Curtis A., Lockwood M. and MacKay J. (2001) Exploring landholder willingness and capacity to manage dryland salinity in the Goulburn-Broken Catchment. *Australian Journal of Environmental Management* **8**, 20–31.
- Dettmann P. D., Hamilton S. D. and Curtis A. (2000) Understanding landholder values and intentions to improve remnant vegetation management in Australia: The box-ironbark case study. *Journal of Sustainable Agriculture* **16**, 93–105.
- Fujisaka S. (1994) Learning from six reasons why farmers do not adopt innovation intended to improve sustainability of upland agriculture. *Agricultural Systems* **46**, 409–425.
- Guerin T. (1999) An Australian perspective on the constraints to the transfer and adoption of innovations in land management. *Environmental Conservation* **26**, 289–304.
- Guerin L. and Guerin T. (1994) Constraints to the adoption of innovations in agricultural research and environmental management: A review. *Australian Journal of Experimental Agriculture* **34**, 549–571.
- Millar J. and Curtis A. (1997) Moving farmer knowledge beyond the farm gate: An Australian study of farmer knowledge in-group learning. *European Journal of Agricultural Education and Extension* **4**, 133–142.
- Millar J. and Photakoun V. (2006) Pathways to improving livelihoods in the uplands of Laos: Researching and improving extension practice. *Proceedings of the Fourth Australasia Pacific Extension Conference*. [Accessed 1 Sept 2006]. Available from URL: <http://www.apen.org.au>.

- Minichiello V., Aroni R., Timewell E. and Alexander L. (1995) *In-depth Interviewing: Principles, Techniques, Analysis*, 2nd edn. Addison-Wesley Longman Australia, Melbourne, Vic.
- Morris C. (2006) Negotiating the boundary between state-led and farmer approaches to knowing nature: An analysis of UK agri-environment schemes. *Geoforum* **37**, 113–127.
- Morris C. and Winter M. (2002) Barn owls, bumble bees and beetles: UK agriculture, biodiversity and biodiversity action planning. *Journal of Environmental Planning and Management* **45**, 653–671.
- Murray Incentives Group (2004) *Incentives Delivery for the Murray Catchment Blueprint – 5 August 2004*. Murray Catchment Authority, Albury, NSW.
- Murray Irrigation (2002a) *Murray Land and Water Management Plans*. [Accessed 8 Feb 2006.] Available from URL: <http://www.murrayirrigation.com.au/files/3290709.pdf>.
- Murray Irrigation (2002b) *Murray Land and Water Management Plan Overview*. Murray Irrigation Limited, Deniliquin, NSW.
- Nicholson C., Barr N., Kentish A. et al. (2003) A research-extension model for encouraging the adoption of productive and sustainable practice in high rainfall areas. *Australian Journal of Experimental Agriculture* **43**, 685–694.
- Pannell D. J., Marshall G. R., Barr N., Curtis A., Vanclay F. and Wilkinson R. (2006) Understanding and promoting adoption of conservation technologies by rural landholders. *Australian Journal of Experimental Agriculture* **46**, 1407–1424.
- Pretty J. (1995) *Regenerating Agriculture: Policies and Practice for Sustainability and Self-Reliance*. Joseph Henry Press, Washington, DC.
- Rogers E. (1962) *The Diffusion of Innovations*. The Free Press, New York.
- Röling N. (1988) *Extension Science: Information Systems in Agricultural Development*. Cambridge University Press, Cambridge, UK.
- Rossman G. and Rallis S. (2003) *Learning in the Field: An Introduction to Qualitative Research*, 2nd edn. Sage Publications, California.
- Vanclay F. (2004) Social principles for agricultural extension to assist in the promotion of natural resource management. *Australian Journal of Experimental Agriculture* **44**, 213–223.
- Vanclay F. and Lawrence G. (1995) *A Sociology of Agricultural Extension*. Central Queensland University Press, Rockhampton, Qld.
- Wilson G. A. and Hart K. (2001) Farmer participation in agri-environmental schemes: Towards conservation-oriented thinking? *Sociologia Ruralis* **41**, 254–274.