Understanding landholder management of river frontages: The Goulburn Broken

By Allan Curtis and Alistar Robertson

This paper is based on research carried out by Allan Curtis, Program Leader, Social Sciences, Bureau of Rural Sciences (PO Box 858, Canberra, ACT 2601, Australia. Tel: +61-2 6272 3382. Email: Allan.Curtis@brs.gov.au) and Alistar Robertson, previously Director, Johnstone Centre for Research in Natural Resources and Society, Charles Sturt University Albury. (Current address: Faculty of Natural and Agricultural Sciences, University of Western Australia, Crawley, WA 6009, Australia.) *The research discussed in the paper was part of a larger project undertaken by the Goulburn Broken Catchment Management Authority (GBCMA) and funded by Land & Water Australia to assess the impacts of grazing on the condition of riparian zones in the GBCMA region.*

Summary In this paper we discuss the findings of research exploring landholder adoption of practices expected to improve the management of river frontages. This research was part of a larger project undertaken by the Goulburn Broken Catchment Management Authority (GBCMA) to assess the impacts of grazing on the condition of riparian zones in the GBCMA region. Our research employed a postal survey to a random selection of all river frontage owners in the GBCMA. Research findings highlighted the limited adoption of most current recommended practices (CRP) such as watering stock off-stream and fencing to manage stock access to river frontages. Higher adoption of CRP (in particular fencing) was correlated with greater knowledge of river frontage function and factors affecting river frontage condition; higher importance attached to the environmental, social and economic values of frontages; non-farming occupations; and higher confidence in the efficacy of CRP. These findings have important implications for managers and scientists. There has been a large investment in community education in the GBCMA and survey findings suggest this has been an effective strategy. At the same time, there should be changes in the approach to community education. It seems there is much to be done to improve the acceptability of fencing frontages along large rivers. Appeals to adopt CRP also need to move beyond a narrow focus on farmers and the benefits of increased agricultural production and embrace the range of landholders and the different values they attach to their frontages. Most respondents had no on-property profit and survey data indicated that financial constraints were an important factor limiting the adoption of CRP, particularly among farmers. There was considerable interest in taking up a grant scheme that would provide a higher level of support than is usually offered by government. These findings highlight the important role of economic incentives in assisting private landholders undertake conservation work along river frontages.

Key words *catchment management, Goulburn Broken, riparian, river frontage.*

Introduction

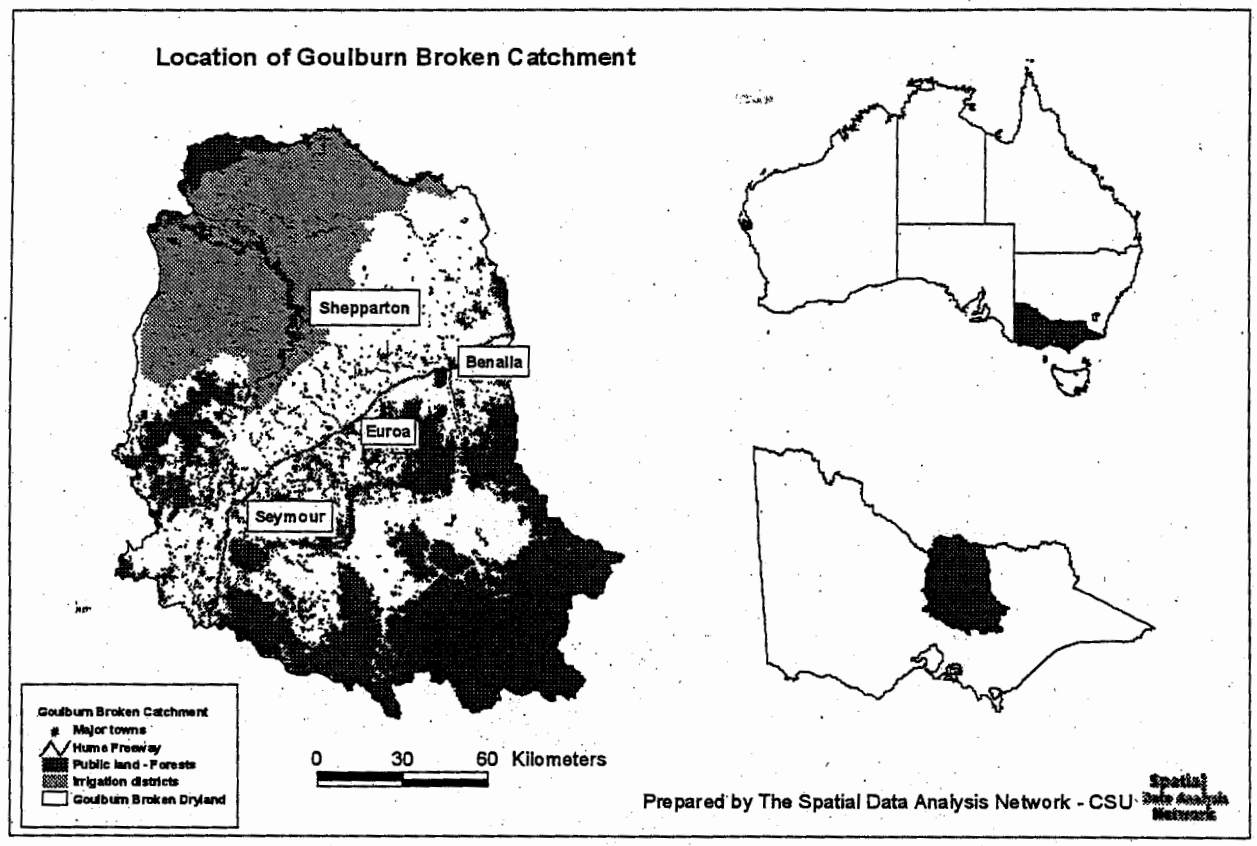
Riparian areas perform important ecological functions (Naiman & Decamps 1997). At the same time, riverine areas have been the focus of human settlement and agriculture, which are powerful forces contributing to environmental degradation in Australia (ABS 1996). A large portion of riparian land is owned or managed by private landholders. While some factors controlling riparian condition operate at spatial and temporal scales beyond the influence of these land managers, there is evidence that private landholders have had a major influence on the degradation of riparian habitats (Jansen & Robertson 2001).

In this paper we discuss the findings of a study undertaken in 2001 that explored landholder adoption of current recommended practices (CRP) expected to improve the condition of river frontages, including watering stock off-stream, fencing to manage stock access to river frontages, and revegetation of frontages. This research involved a case study in the Goulburn Broken Catchment (GBC) of north-east Victoria (Fig. 1). The primary data collection instrument was a postal survey to a random sample of all river frontage owners across the GBC. The postal survey was part of a larger Land & Water Australia project managed by the Goulburn Broken Catchment Management Authority (GBCMA). The research objectives relevant to this paper are listed below. However, the focus of the paper is on discussion of findings related to objective two: exploring landholder adoption of recommended practices. Readers interested in accessing information about other aspects of the postal survey are referred to the detailed research report (Curtis *et al.* 2001a).

Key research objectives were to: (i) identify the level of adoption of selected CRP for improving the management of river frontages; (ii) investigate the relative importance of factors expected to explain differences in the adoption of CRP, and (iii) explore the potential impact on adoption of cost-sharing arrangements that provide payments to landholders for rehabilitation work and the active management of river frontages.

Background

In this section we provide a summary of recent Australian research examining the adoption of CRP, including practices not assessed in our survey of river frontage



owners in the GBC. This review allowed us to identify the independent variables likely to affect the adoption of CRP for improved management of river frontages in the GBC.

In the past, governments have assumed that poor adoption of CRP arose because landholders were unaware of important land degradation issues; lacked sufficient knowledge and skills; or had attitudes that emphasized short-term economic returns over maintaining the long-term health of the land (ASCC 1991). There has been a large investment of resources over the past 10 years in awareness raising and education programs, including those carried out by Landcare groups. There is evidence that these activities do contribute to increased awareness and understanding and that these changes enhance landholder capacity to adopt a wide range of CRP (Vanclay 1992; Curtis & De Lacy 1996). However, most landholders already have a strong stewardship ethic and differences in attitudes have generally not been linked to increased adoption of CRP (Vanclay 1992; Curtis & De Lacy 1998).

Recent experience in Australia suggests that increased awareness and understanding of issues and congruent attitudes are necessary but not sufficient to ensure adoption of CRP at levels likely to achieve improvement in resource condition at the landscape scale (Curtis *et al.* 2001b). There is abundant evidence that many landholders, including those in dryland areas of the GBC, have very limited on-property incomes and that this is a critical constraint to adoption of CRP (Barr *et al.* 2000; Curtis *et al.* 2001b). It is also unlikely that many dryland landholders will generate substantial income from new enterprises such as olives, wine grapes and farm forestry (Stirzacker *et al.* 2000; Curtis *et al.* 2001b). Indeed, part of the explanation for low adoption of some improved grazing or cropping systems is that landholders lack confidence in the CRP because they know that the cost of such CRP either cannot be accommodated within industry profits and/or they are still suboptimal in terms of ecological sustainability. For example, most of the recommended plant-based 'improved management' systems, including introduced perennial pasture in higher rainfall zones (> 600 mm), 'leak' water and contribute to ground water flows that mobilize salt (Walker *et al.* 1999). Problems also arise if CRP or new enterprises are complex, do not fit with existing enterprises, conflict with existing social norms or are perceived as being risky (Vanclay 1992; Curtis & Race 1996; Barr & Cary 2000).

Financial pressures were expected to lead to the amalgamation of smaller grazing properties into larger units. While some amalgamation has occurred, there has not been large-scale consolidation of properties, and the trend has not been uniform across the Murray-Darling Basin (Barr *et al.* 2000). Within commuting distance of capital cities and larger regional centres (e.g. Melbourne and Shepparton in the case of the GBC), there has been considerable subdivision of existing holdings into lifestyle farming enterprises for retirees and people with off-farm work. Non-farmers and retirees may respond less quickly to economic signals; be more

averse to risking off-property income in on-property enterprises; and will probably have less time for on-property management (Barr *et al.* 2000; Curtis *et al.* 2001b). On the other hand, non-farmers may bring new ideas, skills and financial resources that contribute to the renewal of local communities and they may be more likely to respond to appeals for biodiversity conservation (Curtis & De Lacy 1996).

Australia has an ageing rural population with life expectancy increasing and younger people drifting from rural areas to the more prosperous and attractive lifestyles in urban centres (Haberkorn *et al.* 1999). We can no longer assume that a substantial proportion of the intergenerational transfer of properties will occur within families. Where family succession is unlikely, property owners may be less willing to invest in CRP or new enterprises. In an era of reduced farm profitability and lower land prices, particularly where demand for rural subdivisions is not high, some landholders may feel they are locked into living on their properties in retirement. With increasing life expectancy, this trend could delay intergenerational property transfer. These elderly property owners may also be less willing to invest in recommended practice or new enterprises.

Discontinuity between the source and impact of issues, particularly those related to water degradation, adds a further complication. Many landholders in the upper reaches of catchments are either not experiencing these problems, believe they can live with them or are unaware or unconcerned about contributing to downstream impacts (Curtis *et al.* 2001b). Landholders are also increasingly aware that they are being asked to implement work that has community benefits in terms of biodiversity conservation, improved public health and protecting cultural heritage, public infrastructure and export income (agriculture and tourism). They also understand that many of the problems that they are being asked to address have resulted from previous government policies. Establishment of the Natural Heritage Trust, with the federal government sharing the costs of large-scale on-ground work on private land, was an acknowledgement of the legitimacy of these arguments (Curtis & Lockwood 2000).

Effecting behavioural change in private landholders is a complex task. Experience suggests that no single instrument will address the underlying reasons for non-adoption (Vanclay 1997; Lockwood *et al.* 2002).

The postal survey

Drawing on the above literature and within the constraints of a mail survey, the authors identified the following topics for inclusion in the survey as independent variables likely to explain differences in the level of adoption of CRP:

- awareness of river frontage condition;
- knowledge of river frontage function and factors affecting river frontage condition;
- values attached to river frontages;
- attitudes to working with others and the government; the role of scientists; and towards conservation;
- occupation;
- confidence in CRP (such as fencing river frontages to manage stock access, revegetating river frontages);
- constraints to better management;
- extent of business and property planning;
- Landcare membership;
- involvement in government programs;
- on- and off-property income (financial capacity);
- on- and off-property work (available time);
- enterprise mix;
- age (stage of life);
- education; and
- gender.

The authors identified a small number of CRP that could be used as dependent variables in analyses seeking to explain differences in the level of adoption. These CRP were identified on the basis that they addressed the causes of riparian degradation processes and were the focus of current efforts to address riparian degradation in the GBCMA (GBCMA 2001); and that respondents were likely to be able to provide accurate information quickly. The CRP included in this study are: (i) length of river/creek frontage fenced at the time of the survey to allow better management of stock access to the water way; (ii) length of fencing erected near the river/creek since the start of 1996 (past 5 years) to manage stock access to the water way; (iii) number of trees/shrubs planted since 1996 (past 5 years) along the river/creek frontage (within 40 m of each bank); (iv) estimated cost of pest animal and weed control carried out on the river/creek frontage during 1999 and 2000; (v) during 2000, did stock graze any part of your river/stream frontage for more than a week at a time? (Circle yes or no.); (vi) during 2000, did stock access drinking water from any part of your river/stream frontage for more than a week at a time? (Circle yes or no.).

A 12-page survey booklet was mailed to 203 individual property owners selected at random from 3721 property owners on Land Victoria databases of crown frontage owners and Goulburn Murray Water diversion customers. After allowing for recent changes of address and other circumstances, including the removal of those with small urban allotments, 93 useable surveys were returned for a final response rate of 63%.

Multiple stepwise regression and discriminant analysis were performed to determine the extent that a number of independent variables identified by bivariate correlations or χ^2 tests contributed to the observed scores on a dependent variable such as the adoption of a CRP. Discriminant analysis was used when the dependent variable was dichotomous (e.g. yes/no).

Findings

Adoption of current recommended practices

Respondents appeared to be making slow progress towards the adoption of CRP for improved management of their river frontages. Most respondents said they had not undertaken fencing or revegetation work and that stock were usually able to

access the river frontage for grazing and for drinking water. On the other hand, most respondents were undertaking pest animal and weed control and two-thirds of the fencing activity reported had occurred in the past 5 years (Table 1).

Explaining adoption of current recommended practices

Awareness of river frontage condition

It was thought that higher awareness of the extent of river frontage degradation would motivate adoption of CRP. Respondents were asked to provide an assessment of the condition of their river frontage. No attempt was made to compare landholder and expert assessments. In this study, there were no correlations between respondent's assessments of river frontage condition and the adoption of CRP.

Knowledge of ecological functions and processes

Survey data suggested most respondents had a sound understanding of some of the less widely publicised functions or ecological processes in river frontages (differences between willows and gum trees; role of dead trees and ground litter). On the other hand, there was a substantial minority of frontage owners who either had no information, were misinformed or were reluctant to acknowledge the critical roles that clearing and stock grazing have had in contributing to river frontage degradation (Table 2).

There was a significant relationship between adoption of the CRP for limiting stock access to water courses for drinking water and better knowledge about 'the impact of grazing on native vegetation' (Table 3). There was also a significant positive relationship between better knowledge about the 'role of willows and gums as a source of nutrients' and the CRP for limiting stock access to water courses for both drinking water and grazing (Table 3). These findings suggested that differences in knowledge of river frontage function and the factors affecting river frontage condition had contributed to differences in the adoption of CRP.

Values attached to river frontages

Respondents were asked to provide an assessment of the importance of 16 topics exploring the values they attributed to their river frontage. Eight topics explored the importance of the environmental functions of river frontages, five topics related to economic attributes of frontages, and three related to social attributes (Table 4). By summing a respondent's scores on indi-

Table 1. Adoption of current recommended practices: Goulburn Broken river frontage study, 2001 (n = 93)

Topics (n = 92)	% responding activity done	Situation at Jan. 2001 (median)
Distance along the river/creek where the frontage is fenced allowing stock access to the waterway to be managed	46%	500 metres
Length of fencing erected near the river/creek since the start of 1996 (5 years) to manage stock access to the waterway	26%	300 metres
Number of tree/shrubs planted since 1996 (5 years) along the river/creek frontage (within 40 m of each bank)	40%	50 trees
Estimated cost of pest animal and weed control carried out in river/creek frontage during 1999 and 2000	55%	$300
During 2000, did you control stock access to the waterway for grazing? (stock only had access to any part of frontage for < a week at a time)	36%	
During 2000, did you control stock access to the waterway for drinking water? (stock only had access to any part of frontage for < a week at a time)	33%	

Table 2. Knowledge of river frontage management: Goulburn Broken river frontage study, 2001 (n = 93)

Statement	No.	Agree/ strongly agree	Not sure	Disagree/ strongly disagree
Dead trees or sticks on the ground in river/creek frontages are important habitat for native birds and animals	88	76%	14%	10%
Clearing for grazing or cropping has substantially reduced the existence and diversity of native vegetation on river/creek frontages	88	69%	10%	21%
Grazing of domestic stock has had a major impact on the existence and diversity of native vegetation on river/creek frontages[a]	91	46%	18%	37%
Willows are different to gum trees as a source of nutrients in rivers/creeks[a]	90	60%	22%	18%

Score: 1 = strongly disagree through to 5 = strongly agree.
[a]These statements were expressed in the negative in the original survey.

Table 3. Independent variables correlated with the adoption of current recommended practices: Goulburn Broken river frontage study, 2001 (n = 93)

Independent variables	Total frontage fenced	Frontage fenced in past 5 years	Trees/shrubs planted in last 5 years	Cost of pest animal/weed control	Limited stock access for drinking	Limited stock access for grazing
Knowledge						
Grazing of domestic stock has a major impact on native vegetation on river/creek frontages					**F = 11.912, P = 0.021**	**F = 329.46, P = 0.003**
Willows are different to gum trees as a source of nutrients in rivers/creeks					χ^2 = 9.734, P = 0.045	χ^2 = 13.21, P = 0.010
Economic values						
Economic index		r_s = 0.295, P = 0.013			χ^2 = 26.96, P < 0.001	χ^2 = 18.74, P < 0.001
Provides access to water for stock					**F = 9.29, P = 0.029**	**F = 56.935, P = 0.004**
Provides additional land for grazing stock					χ^2 = 27.46, P < 0.001	χ^2 = 20.66, P < 0.001
Adds to the market value of the property	**t = 2.440, P = 0.018**		r_s = 0.351, P = 0.009			
Social values						
Social index.					χ^2 = 5.387, P = 0.020	
Is an attractive area of the property	r_s = 0.307, P = 0.029					
Environmental values						
Environmental index			r_s = 0.287, P = 0.019			
Demographic/background						
Property size					**F = 329.46, P = 0.003**	**F = 9.286, P = 0.029**
Farmer by occupation					χ^2 = 8.125, P = 0.004	χ^2 = 10.68, P = 0.001
On-property profit				r_s = –0.313, P = 0.040		χ^2 = 5.428, P = 0.020
Hours worked on-property					χ^2 = 9.441, P = 0.002	χ^2 = 7.482, P = 0.006
Plan for property succession					χ^2 = 5.581, P = 0.019	χ^2 = 4.864, P = 0.027
Government funding						
Support from government programs for work on your frontage over the past 5 years. (Yes)			r_s = 0.396, P = 0.022			

Underline denotes a significant negative relationship and **bold** indicates a significant relationship under multivariate analysis.

Table 4. Importance of values attached to river frontage: Goulburn Broken river frontage study, 2001 (N = 93)

Statement about value	No.	Important/very important	Some	Minimal/not important	Mean score
Is an attractive area of the property[c]	92	84%	12%	3%	4.35
Place where native birds live[a]	92	87%	7%	6%	4.26
Adds to market value of the property[b]	92	77%	11%	12%	4.10
Vegetation on the frontage holds the banks and stops them crumbling[a]	92	77%	11%	12%	4.10
Links up with other vegetation and allows native birds and animals to move about for food and breeding[a]	92	73%	14%	13%	3.95
Where native animals live on land[a]	92	64%	19%	17%	3.76
Provides woody matter such as snags that offer protection for fish and other animals that live in the river/creek[a]	91	61%	21%	19%	3.63
Provides a place for recreation for family and friends[c]	92	61%	15%	24%	3.59
A source of nutrients for in-stream food chains[a]	89	59%	17%	25%	3.55
Provides access to water for stock[b]	90	62%	9%	29%	3.53
In-stream vegetation traps and stabilizes sand/gravel[a]	89	46%	23%	31%	3.27
Provides important shade and shelter for stock[b]	86	47%	14%	39%	2.97
Place for family and friends to fish[c]	92	38%	16%	46%	2.88
Acts as a filter catching sediment and/or nutrients in overland flows before they reach the river/creek[a]	89	33%	16%	52%	2.64
Provides additional land for grazing stock, particularly in summer[b]	92	33%	17%	50%	2.63
Harvesting timber for fence posts and fire wood[b]	88	4%	5%	91%	1.38

Mean score where 1 = not important through to 5 = very important.
[a]Environment value, [b]Economic value, [c]Social value.

vidual items, it was possible to calculate the environmental, economic and social values index score for each respondent.

Most respondents placed a high value on their river frontages. For example, 11 of the 16 topics had mean scores above three out of a possible five and there were four topics with mean scores above four (Table 4). When ranked by mean scores, the three most highly ranked topics included one from each of the environmental, economic and social value sets. Respondents valued their river frontages more highly for their environmental and social attributes compared to their economic attributes. Three of the five topics from the economic values set, including those related to the benefits of grazing, timber harvesting and stock shelter, were among the five lowest ranked topics according to their mean scores (Table 4).

Our analyses also suggested that the values attached to river frontages had contributed to differences in the adoption of CRP. There was a significant positive relationship between higher scores on an index measuring the importance of a range of environmental values and adoption for trees/shrubs planted (Table 3).

There was a negative relationship between adoption of CRP for limiting stock access to the river frontage for grazing and to drinking water and scores on the overall economic values index (Table 3). A higher score on the statements that the frontage 'provided access to water for stock' and 'additional land for grazing' was significantly correlated with lower adoption of CRP (Table 3). At the same time, there was a significant positive correlation between the river frontage 'adds to the market value of the property' and adoption of CRP for total distance of the frontage fenced and trees/shrubs planted (Table 3).

A higher score on the social values index was significantly linked with lower adoption of the CRP regarding limiting stock access to the river frontage for drinking water (Table 3). However, a higher score for 'is an attractive area of the property' was significantly linked with higher adoption of the CRP for total distance of the frontage fenced (Table 3).

As will be explained, differences between farming and non-farming occupations may explain some of the negative links between economic values and the adoption of CRP. It must be remembered that in this study almost all respondents attached a high level of importance to at least one of the listed environmental, economic and social values of river frontages. This information emphasized the importance of moving beyond a narrow range of appeals when promoting improved management of river frontages.

Attitudes

Most respondents held positive attitudes about the roles and responsibilities of various stakeholders in river frontage management; towards conservation generally as measured by the New Environmental Paradigm (NEP) (Dunlap & Van Liere 1978); and about the role of scientists in natural resource management. The measures used identified no significant positive relationships between these attitudes and adoption of CRP. These findings are consistent with earlier research suggesting that most landholders hold positive attitudes towards conservation and that attitudes are a poor predictor of conservation behaviour.

Farmer and non-farmer occupations

Compared to non-farmers, farmers worked significantly more hours on-property, had significantly larger properties, and were more likely to indicate 'their family had agreed to a plan for the transfer of the farm to the next generation' (Table 5). There was a consistent pattern of these variables (hours worked, property size, succession planning) being linked with increased stock access to river frontages for grazing and drinking water (Table 3). In turn, farmers were significantly more likely than non-farmers to allow stock to access their river frontages for both grazing and drinking water (Table 5). It seems that the lower adoption of these CRP by farmers was linked to the importance of on-property income to farmers and to the significantly higher importance that farmers attach to the economic values of their river frontages (Table 5).

Farmers were a minority occupation group (only 37%) among survey respondents. The majority of river frontage owners were non-farmers, comprised of professionals (30%), retirees (20%) and tradespeople (10%). Many of the non-farmer river frontage owners appear to be more interested in the environmental, aesthetic and recreational values of their frontages, and possibly, the impact of river frontage condition on property values. In turn, non-farmers are less likely to be concerned about the potential economic impacts of taking on CRP for improved river frontage management. At the same time, farmers managed significantly larger properties, including a substantial proportion of the river frontages in this study (59%) and they will need to be reassured that adoption of CRP will enhance rather than reduce their on-property viability. Again, it is a case of different appeals for different folks.

Confidence in efficacy of CRP

Contrary to the views of the scientists involved in this project, most respondents thought that set stocking where animals are left to graze in paddocks for long periods, was better than intensive grazing for short periods in terms of retaining native vegetation in paddocks with river frontages (Table 6). Although most respondents agreed with the general statements that fencing river frontages and watering stock off-stream were aspects of improved river frontage management, substantial minorities (23%) disagreed (Table 6).

Higher confidence in the efficacy of watering stock off-stream was linked to higher adoption of fencing and trees/shrubs planted (Table 7). However, there were no positive relationships between the adoption of CRP and higher confidence in the efficacy of fencing or intensive grazing. While most respondents agreed with the general statement that fencing is an essential part of the work required to revegetate river/creek frontages, it is clear that many respondents held strong reservations about particular aspects of the efficacy of fencing river frontages (Table 6). It seems these concerns are impacting on the adoption of fencing. Analyses using the five more specific statements assessing confidence in fencing produced significant positive correlations between higher confidence and the adoption of related CRP (Table 7).

Table 5. Differences between farmers and non-farmers: Goulburn Broken river frontage study, 2001 (farmers $n = 31$, non-farmers $n = 53$)

Independent variables	Farmers % Yes or (median)	Non-farmers % Yes or (median)	Test χ^2	Test d.f.	Significance
Property size	188.4 ha	9.6 ha	36.427	1	<0.001
On-property profit	69%	17%	22.159	1	<0.001
Hours worked on-property	50	6	42.009	1	<0.001
Off-property income as a proportion of total household income	40%	90%	27.404	4	<0.001
Agreed to a plan for the transfer of the farm to the next generation	41%	20%	4.517	1	0.040
Economic values index	3.6	2.6	17.926	1	<0.001
Controlled stock access to river frontage for drinking water	10%	39%	8.125	1	0.004
Controlled stock access to river frontage for grazing	10%	45%	10.677	1	0.001

Financial and other constraints to adoption

Most respondents rated the cost of materials and equipment; flood events; insufficient time and access to labour; and access to on-site technical advice as important constraints affecting their capacity to improve the management of their river frontages. The GBCMA provides financial support to landholders in high priority areas for fencing, revegetation and the installation of off-stream watering points where stock have previously been watered from the waterway through a Waterway Grant Scheme (WGS). The WGS provides support for fencing at between $2 and $6.50 per metre; supplies native plants and guards for revegetation works; and for off-stream watering, pays up to 75% of all costs. The WGS therefore involves a higher cost-share by government than has typically been the case with Natural Heritage Trust programs. Given the limitations of space in the survey, it was not possible to include the different scenarios needed to collect sufficient data to model the impact of a range of cost-sharing options on adoption. However, questions in the survey did assess the extent that a scheme such as the WGS would motivate the wider population of land owners to undertake additional work on their river frontages. Forty-two per cent of survey respondents said that they would apply for a grant over the next 2 years if such a scheme operated in their area. Almost all of these river frontage owners said that access to this support would result in them completing work beyond that which they had planned.

Earlier research in the Goulburn Broken Dryland established that low on-property profitability was a significant constraint to the adoption of a range of CRP (Curtis *et al.* 2001b). In this study of river frontages, there were some correlations between on-property profitability and adoption of CRP (Table 3). Indeed, only 37% of these respondents had any on-property profit and economic concerns appeared to be an important factor limiting the adoption of CRP, particularly by farmers. There was also a significant positive correlation between government funding received over the past 5 years and river frontage work undertaken (Table 3). It is our view that low on-property profitability and the expense of remedial work for which there is a mix of public and private benefits are important constraints to adoption. As explained, a substantial proportion of survey respondents said stronger cost-sharing through an expanded WGS would allow them to undertake additional conservation work in their river frontages.

Conclusions

Differences in knowledge of river frontage function and factors affecting river frontage condition were linked with differences in the adoption of CRP. This finding suggests there is considerable scope for community education to increase the adoption of CRP by increasing landholder knowledge of the important functions of river frontages and of their generally degraded condition.

Most respondents gave a high level of importance to at least one of the listed environmental, economic and social values that landholders frequently attach to river frontages. Overall, river frontages were valued more highly for their environmental and social attributes compared to their economic attributes. Values attached to river frontages were also linked with differences in the adoption of CRP. Most respondents, including those owners of lifestyle properties, valued river frontages as attractive places to live and were aware of the positive impact of their river frontages on property values. These findings emphasized the importance of multi-faceted appeals and the need to move beyond a narrow focus on concerns about the potential economic impacts of CRP.

Farming as an occupation was linked to lower adoption of CRP and this link

Table 6. Confidence in current recommended practices: Goulburn Broken river frontage study, 2001 (n = 93)

Statement	n	Agree/ strongly agree	Not sure	Disagree/ strongly disagree
Fencing to manage stock access is an essential part of the work required to revegetate river/creek frontages	89	67%	11%	23%
Intensive grazing for short periods is usually better than set stocking for retaining native vegetation in paddocks with river/creek frontages[a]	88	14%	27%	60%
The time and expense involved in watering stock off-stream is justified by improvement in river/creek bank stability and water quality	88	49%	28%	23%
Statement	**n**	**Important/ very important**	**Some**	**Minimal/ not important**
In most places, fencing river/creek frontages is not practical because floods will damage fences	90	52%	12%	36%
Fencing out river/creek frontages will create harbour for pest animals	86	51%	17%	30%
Fencing out river/creek frontages will make it difficult to water stock	88	46%	13%	40%
Fencing out river/creek frontages will increase management time	85	39%	18%	43%
Fencing out river/creek frontages will reduce the area for grazing or cropping	86	27%	17%	54%

Mean score where 1 = strongly disagree through to 5 = strongly agree.

[a]In the original survey this statement began with set stocking as the preferred practice.

Table 7. Relationships between confidence in CRP and adoption of CRP: Goulburn Broken river frontage study, 2001 ($n = 93$)

Statements assessing level of confidence in CRP	Total frontage fenced	Frontage fenced in past 5 years	Trees/shrubs planted in last 5 years	Cost of pest animal/weed control	Controlled stock access for drinking	Controlled stock access for grazing
The time and expense involved in watering stock off-stream is justified by the improvement in river/creek bank stability and water quality	$r_s = 0.338$, $P = 0.005$		$r_s = 0.287$, $P = 0.026$			
Fencing to manage stock access is an essential part of the work required to revegetate river/creek					$\chi^2 = 22.02$, $P = 0.001$	$\chi^2 = 19.84$, $P = 0.001$
Intensive grazing for short periods is usually better than set stocking for retaining native vegetation in river frontages[a]			$r_s = 0.304$, $P = 0.016$			
Fencing out river frontages will not reduce the area for grazing or cropping[a]					$\chi^2 = 22.02$, $P = 0.001$	$\chi^2 = 19.84$, $P = 0.001$
Fencing out river/creek frontages will not create harbour for pest animals[a]					$\chi^2 = 12.71$, $P = 0.026$	$\chi^2 = 11.94$, $P = 0.036$
Fencing out river/creek frontages will not make it difficult to water stock[a]					$\chi^2 = 29.77$, $P < 0.001$	$\chi^2 = 29.31$, $P < 0.001$
Fencing out river/creek frontages will not increase management time[a]	**$t = -3.285$, $P = 0.002$**				$\chi^2 = 14.68$, $P = 0.012$	$\chi^2 = 15.21$, $P = 0.010$
In most places fencing out river frontages is not practical because floods will damage fences[a]	$r_s = -0.305$, $P = 0.004$					

The first three statements assessed overall views about the efficacy of CRP.
[a]Statements expressed in the negative in the original survey and in Table 6.
Underline denotes a significant negative relationship and **bold** indicates a significant relationship under multivariate analysis.

appeared to be explained, at least in part, by the higher importance farmers attached to the economic values of their river frontages. Although farmers were a minority of the survey respondents, they owned significantly larger properties than did non-farmers and continue to be important river frontage managers. Farmer concerns about the potential economic impacts of CRP will need to be addressed, perhaps through modifications to CRP or by stronger cost sharing. Notwithstanding this point, it seems that program managers may have focused too heavily on farmers. The GBCMA operates a highly respected riparian management program but our analysis of postal survey data established that landholders involved in these programs were atypical of the wider population of frontage owners (Curtis *et al.* 2001a). GBCMA project participants were significantly more likely to have been farmers by occupation, manage larger properties, be older and be members of Landcare (Curtis *et al.* 2001a).

Few respondents had any on-property profit and economic concerns appeared to be an important factor limiting the adoption of CRP, particularly by farmers. Respondents indicated they would increase their adoption of CRP if they were able to access a GBCMA program that provides for stronger cost sharing than is normally available from government. Even this program only provides for up to 75% of the cost of on-ground work. The existing GBCMA program makes no provision for the costs of maintaining fencing or ongoing pest weed and animal control and there has been no reimbursement of income forgone as a result of changed landuse. Recent research by the authors suggests that stronger cost sharing that includes the full cost of on-ground work, a payment for active management and income forgone (opportunity cost) can make a substantial improvement in landholder adoption of CRP and the attainment of catchment targets for revegetation (Curtis *et al.* 2002).

Although most respondents agreed that fencing and watering stock off-stream were aspects of improved river frontage management, most had reservations about some aspects of the efficacy of fencing,

watering stock off-stream and intensively grazing frontages for short periods of time. Concerns about the efficacy of these CRP appeared to be impacting on their adoption. Managers and scientists need to reassess current approaches to fencing river frontages, particularly the larger river systems such as the Goulburn. Community education activities, often using groups and local demonstrations of CRP, should be an important element of this work. Attention must also be given to demonstrating the merits of intensively grazing river frontages.

Most respondents held positive attitudes about the roles and responsibilities of various stakeholders in river frontage management and towards conservation generally. There were no significant positive correlations between these attitudes and adoption of CRP. This finding is consistent with what is becoming a large body of Australian research exploring the adoption of conservation practices by private landholders. It seems that those attempting to change land and water management practices should focus on awareness raising, improving knowledge and skills and on enhancing the acceptability of specific CRP. Appeals for the adoption of CRP must also embrace the range of values that different landholders attach to their river frontages. At the same time, economic constraints are a critical issue for many landholders. For others, having sufficient time or being physically able to undertake rehabilitation work are critical issues. Access to skilled labour can be one strategy for overcoming these constraints.

While attitudes are generally positive, this study in the GBC and our recent research in the Ovens Catchment suggests that there are some landholders who hold anticonservation attitudes or are unlikely to respond to incentives schemes regardless of the level of cost-sharing offered. Under these circumstances and where high priority areas are involved, one option is to establish a revolving fund and intervene through the strategic purchase of properties as they come onto the market. Using this approach a new management regime can be established and then protected by a covenant prior to resale on the open market. Our research in the Ovens suggests that a revolving fund could be more successful than an incentive program in accomplishing catchment targets (Curtis *et al.* 2002).

While everyone is different, there is no need to respond to every landholder. This research has highlighted some of the key social and economic variables that need to be considered by those developing an effective mix of policy options within a region. The critical point is to develop a mix of options and then allow landholders to select those that best meet their needs.

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