Social values of privately owned wetland resources

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ABSTRACT

Farmers prize the relatively fertile valley floors and flood plains across Australia and elsewhere. But important wetlands are often located in these areas. This is the case in the Upper South East of South Australia and on the Murrumbidgee River Floodplain in NSW. The agricultural production values desired by farmers potentially conflict with the wetland conservation values enjoyed by both farmers and the wider community. These include recreational uses and biodiversity protection. A demand for changes to wetland policy may reflect conflicts between decisions made by farmers that enhance their private values and those necessary to maintain the social values of wetlands. However, good policy is reliant on information about both the private and social values generated by wetlands. In this paper we report the use of a choice modelling survey to estimate the social values generated by an array of alternative wetland management options. The results indicate that policies resulting in changes to wetland management could increase the net social benefits generated by wetlands in these regions.

Key words: wetlands, values, choice modelling

1. Introduction

Many wetlands across Australia and worldwide are located on private land. These wetlands generate private values to wetland owners and social values that extend to the wider community. Wetland owners capture the benefits generated by some wetland outputs, such as the use of wetlands for grazing. However, both wetland owners and other community members may enjoy the social values generated by wetlands such as recreation and biodiversity conservation. These values are potentially conflicting, but management decisions by wetland owners alone can alter both the private and social values generated by these wetlands. Hence, society may wish to develop policy options that would alter the framework within which management decisions are made. Policy development considerations should take into account the net social value and distribution of values generated by alternative wetland management strategies.

In this paper, the focus is on the estimation of a sub-set of social values generated by wetland ecosystems in two case study areas – the Upper South East (USE) of South Australia (SA) and the Murrumbidgee River Floodplain (MRF) in New South Wales (NSW). These values include the costs and benefits of changing wetland management to part or all of the community. For example, beneficial values are generated by the maintenance of healthy ecosystems (biodiversity values) while increased numbers of ducks hunted generates a benefit to one segment of the community (duck hunters) and a cost to another (those who are concerned by duck hunting). These values are primarily non-monetary, non-use, values of changing wetland management.

There are a number of potential valuation methods that could be used to estimate these values including contingent valuation and choice modelling (CM). Each of these methods involves a sample of community members comparing one or more alternative management strategies. Only CM can be used to generate direct estimates for multiple outcomes that can be incorporated into a benefit-cost framework from a single survey exercise.

The paper is divided into six sections. In the next section, some background to the case study areas is provided. In the third section, a brief overview of the research methodology is provided. The application of the choice modelling technique and a summary of the results are the foci in the fourth section. The fifth section comprises a brief discussion of the use of the CM results within a benefit-

cost framework to generate conclusions regarding the potential for changing wetland management to increase social well being. A short conclusion completes the paper in section six.

2. Background to case study areas

The locations of the two case studies are shown in Figure 1. The first is the USE of SA. Over 63,000 hectares of wetlands remain in the USE, of which about 60 percent (38,000ha) are located on private land. Some of these wetlands meet the criteria for nomination as wetlands of international importance under the Ramsar Convention[1] (White 1997). USE wetlands provide a range of values to their owners and wider society. These range from commercial benefits from the grazing of sheep and cattle, through to the enjoyment gained by people who value the continued maintenance of the viability of populations of endangered species in the region.

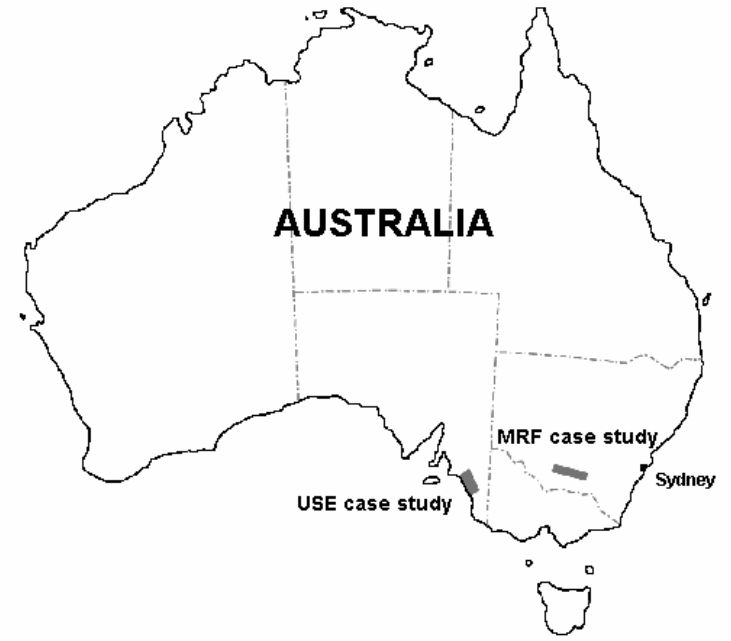

Figure 1: Location of case study areas

The second case study area is the MRF between Wagga Wagga and Hay in NSW. More than 47,000 hectares of wetlands are located on the Murrumbidgee River floodplain between Wagga Wagga and Hay Weir. Over 70 percent of these wetlands are located on private land (36,000 ha). Several of the wetlands in the study area are listed in 'A Directory of Important Wetlands in Australia' (Environment Australia 2001).

Many USE wetlands have been drained or otherwise degraded by grazing management practices. In the MRF, few wetlands have been drained relative to the USE, but most wetlands on the floodplain are too dry due to reduced flooding. Other MRF wetlands closely linked with the river have become too wet due to water releases for irrigated cropping and pasture production. Wetlands in the MRF have also been degraded by logging, grazing and to a lesser extent, irrigation drainage management practices. Current land and water management practices are largely motivated by the private values generated from irrigation, grazing and timber production. Private values in the USE region are largely confined to wetland owners while those in the MRF are divided between wetland owners (benefits resulting from grazing, logging and some irrigation) and irrigators downstream.

3. Research framework

The estimation of social values of wetlands on private land is embedded within a broader analysis shown in Figure 2. There are four key elements to this framework:

1. Biophysical modelling – what physical changes to wetlands can be expected from alternative wetland management options and what resources are required to achieve these changes;
2. Economic modelling – what monetary and non-monetary costs and benefits do different wetland management options generate;
3. Bio-economic integration – combining the biophysical and economic modelling to estimate the net impact on the community of alternative wetland management options; and,
4. Policy – how to achieve any wetland management changes that are desired.

Within each element the outcomes of continuing the current management strategy is compared against alternative options.

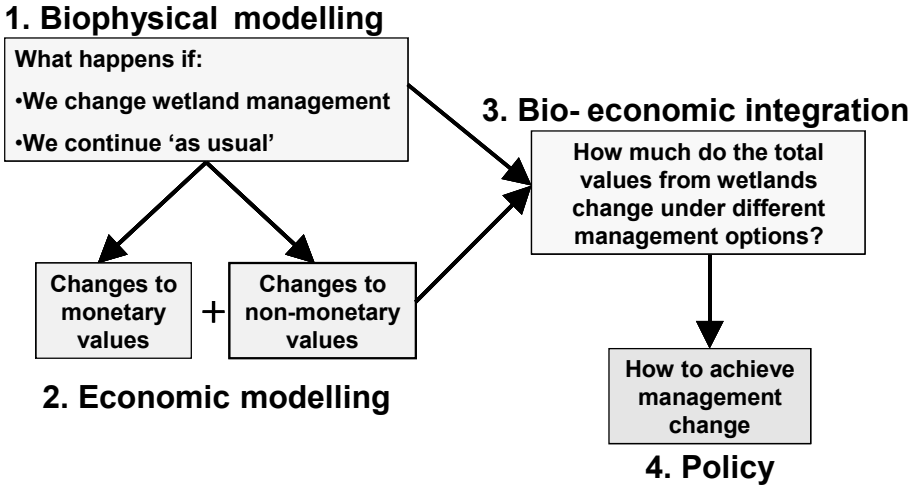

Figure 2: Conceptual model of research framework

The focus in this paper is on reporting estimates of the non-monetary, non-use values of wetlands. These values are a component of the economic modelling undertaken in step 2 of the analysis. In order to estimate these values it is first necessary to define what is valued and how changes to wetland management impact on these values.

Defining and measuring the physical scale of changes to wetlands is an element of the biophysical modelling. In each case study area, a biophysical model was developed to identify the outcomes of changing wetland management. The biophysical model involved defining the outcome of continuing current management compared to several alternative wetland management strategies in each case study area. From this model several alternative future wetland outcomes could be defined. For example, changes to biodiversity or agricultural outcomes could be predicted. A summary of the outcomes from the MRF biophysical model is shown in Table 1. For example, changing grazing management would reduce the area grazed (by 10,600 hectares) and the total agricultural production (by 15,500 dse[2]) in the MRF but increase the area of healthy wetlands (by 6700 hectares).[3]

Table 1: MRF biophysical attributes relative to continuing 'business as usual'

Descriptive Attributes	Unit	Water management	Grazing management	Timber management	Combined strategies
Water purchased from irrigation	Ml	41,700	0	0	41,700
Set stocking rate	ha	0	-8300	0	-8300
Rotational or crash grazing management	ha	0	-2300	0	-2300
No grazing	ha	0	10,600	0	10,600
No logging	ha	0	0	8700	8700
Fallen timber harvesting	ha	0	0	-600	-600
Sustainable timber harvesting	ha	0	0	-6100	-6100
Unsustainable timber harvesting	ha	0	0	-2000	-2000
Total productivity	dse	0	-15,500	0	-15,500
Sawn timber yield	ha	0	0	-15,300	-15,300
Residual timber yield	ha	0	0	31,200	31,200
Fencing required	km	0	700	0	700
Best information ecological outcomes in fifteen years					
Additional healthy wetlands	ha.	2700	6700	0	11200
Additional wetland and woodland birds	%	33	20	20	75
Additional native fish	%	50	25	25	100

4. Choice modelling environmental valuation technique

A number of alternative techniques have been developed to estimate the values of changes to non-monetary, non-use environmental goods. For some wetland goods these values can be estimated through relationships they may have with marketed goods. For example, the travel cost method uses the monetary cost incurred by duck hunters in travelling to enjoy their sport to reveal the value they receive from wetland protection (see for example Whitten and Bennett 2002). However, for many non-monetary values the only practical way of estimation is via community surveys in which respondents are asked about their preferences for environmental outcomes. One such method is CM.

CM offers a number of advantages over related techniques for the estimation of non-market, non-use values of wetlands for inclusion in a benefit-cost framework. These benefits include:

- estimated values (consumer surpluses) that are directly comparable within a benefit-cost framework;
- only one survey is required to estimate values for a number of different management options thus significantly reducing estimation costs; and,
- CM is a robust proven methodology in the contexts in which it would be applied (see for example Morrison, Bennett and Blamey 1999).[4]

4.1 What is 'Choice Modelling'?

In a CM survey, a sample of people is asked to choose their preferred options for future wetland management from a number of alternatives. All alternatives are described using a common set of outcome 'attributes'. These 'attributes' may include measures of biodiversity health or visual

impacts of changes that represent the differing non-monetary environmental characteristics of the alternative outcomes. An additional attribute is the monetary cost that would have to be paid by the respondents to achieve the specified outcome.
By analysing the choices respondents make in response to the attribute tradeoffs presented in a questionnaire, it is possible to observe how much of one attribute they are willing to give up in order to get more of another. Because one of the attributes is monetary, the CM results can be used to estimate the 'willingness to pay', or value, respondents hold for environmental improvements in wetlands.

4.2 Developing the CM application

Two key steps in developing any CM application are defining appropriate attributes and designing a suitable questionnaire. CM attributes are used to describe the outcomes of alternative wetland management strategies. These attributes must be measurable, of significance to policy makers and easily communicable to the wider community in the survey format (Bennett and Adamowicz 2001). The USE and MRF CM attributes were drawn from the biophysical models developed for these case study areas (see Section 3) and refined using a number of focus groups[5]. The attributes used in the CM study are shown in Table 2.

Table 2: CM attributes

USE CM attributes
Once-off payment via income tax to cover costs of changing wetland management
Area of healthy wetlands
Area of healthy remnant vegetation
Number of threatened species that would benefit
The number of ducks hunted
MRF CM attributes
Once-off payment via income tax to cover costs of changing wetland management
Area of healthy wetlands
Number of native birds (% of pre-1800 population)
Number of native fish (% of pre-1800 population)
Number of farmers leaving the region.

Once attributes are defined, the key issue in questionnaire design is the presentation of the choice sets. Choice set design is inherently complex because of the difficult tradeoffs asked of respondents. Therefore, a number of different formats were trialled. An example of the choice set used in the USE CM questionnaire is shown in Figure 3. This final choice set design was achieved after several iterations. The design has several key differences to that initially trialled in focus groups:
the choice options are read horizontally (rather than vertically);
the labels 'I pay' and 'What I get' were added to clarify the trade-offs facing respondents; and,
icons represent the attribute levels rather than numbers. The icon levels were shown in a key that folded out to allow it to be viewed by respondents while completing the choice sets.
The USE and MRF questionnaires were the first in Australia to use icons instead of numbers in a CM survey.

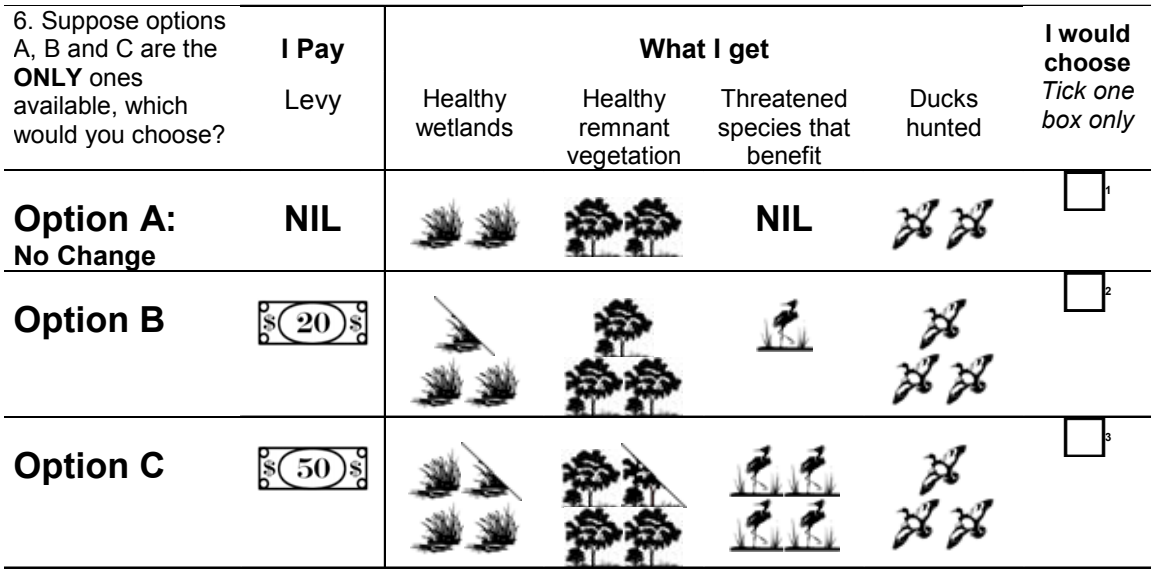

Figure 3: Final choice set design for USE CM questionnaire

4.3 Applying CM to the USE and MRF Case Studies

A total of 4,800 surveys about the future management of wetlands on the MRF and USE were sent to households in the Murrumbidgee region of New South Wales, the Australian Capital Territory and Adelaide and Naracoorte in SA. A response rate of just over 30 percent was achieved for both surveys (see Appendix Table A1 for a summary or responses and characteristics). This rate compares favourably with other mail out CM surveys in Australia. Respondents tended to self-select, being older, more highly educated, more likely to be male and wealthier than the Australian average (ABS 1997).

Table 3: Estimates of attribute values

MRF attributes [a]	**Unit price** [b]
Wetland area (/ 1000 ha)	$11.39
Native birds (/ 1% pre 1800 pop.)	$0.55
Native fish (/ 1% pre 1800 pop.)	$0.34
Farmers leaving (/ farmer)	-$5.73
USE attributes	
Healthy wetlands (non-green [c] / 1000 ha)	-$1.22
Healthy wetlands (green [c] / 1000 ha)	$1.51
Healthy wetlands (average / 10000 ha)	-$0.61[d]
Healthy remnant vegetation (/ 1000 ha)	$0.92
Threatened Species (/ specie)	$4.81
Ducks hunted (non-hunters / 1000)	-$4.35
Ducks hunted (hunters / 1000)	$3.01[d]
Ducks hunted (average / 1000)	-$1.79[d]

[a] One-off average willingness to pay per household.

[b] MRF prices at the midpoint of the survey levels.

[c] 'Green' versus 'non-green' respondents defined by response to question about development preferences.

[d] Not significant at the 95 percent level of confidence.

Respondents' average willingness to pay for the MRF and USE wetland attributes are reported in Table 3.[6] On average, respondents to the MRF questionnaire were willing to pay (per household as a one-off payment) $11.39 for an extra 1000 hectares of healthy wetlands, $0.55 for a one percent increase in the population of native wetland and woodland birds and $0.34 for a one percent increase in the population of native fish. A result of the CM survey with important policy implications is the high willingness to pay respondents had to avoid farmers having to leave the land as a result of changes to wetland management ($5.73 per farmer).

5. Discussion

The CM estimates for wetland attributes described in Section 4 comprise just one of several costs and benefits from changing wetland management in the USE and MRF. For a judgement to be made about the potential for development of alternative wetland policy options these estimates need to be integrated with the biophysical modelling and other costs and benefits of changing wetland management. That is, the change in total community benefits that would result from adoption of each potential management strategy must be evaluated.

Tables 4 and 5 show an integrative cost-benefit analysis for several MRF and USE wetland management strategies respectively relative to the business as usual outcome. The CM survey data reported in Section Four is used to estimate the values generated by the bundles of changes to wetland management. These values are shown as 'Non-market CM estimates' in Tables 4 and 5. For instance, the estimated value to residents in the Murrumbidgee catchment from a change to 'water management' in MRF wetlands is $8.5m.[7] Similar results were derived for the USE case study.

Table 4: Values from alternative MRF wetland management compared to 'business as usual'

Cost or benefit	**Water management**	**Grazing management**	**Timber management**	**Combined strategies**
Monetary Costs to wetland owners	-$ 1,717,000	-$ 5,992,000	-$4,678,000	-$12,706,000
Other monetary costs (may also be to wetland owners)	-$11,915,000	$ 0	-$ 0	-$11,915,000
Net monetary benefits	*-$13,633,000*	*-$ 5,992,000*	*-$4,678,000*	*-$25,622,000*
Recreation values	$ 742,000	$ 1,842,000	$ 0	$ 3,078,000
Non-use CM estimates	$ 8,459,000	$ 9,212,000	$3,016,000	$11,832,000
Non-monetary benefits	*$ 9,201,000*	*$11,053,000*	*$3,016,000*	*$14,911,000*
Total net benefits	-$ 4,432,000	$ 5,061,000	-$1,661,000	-$ 9,711,000

Note: Values are net present values of relevant producers' and consumers' surplus streams over 30. A 7% discount rate was used in all cases except non-use CM values where a present value was estimated as a once-off payment. More information about these values can be found in Whitten and Bennett (2001b)

Table 5: Values from alternative USE wetland management compared to 'business as usual'

Cost or benefit	**Wetland retention**	**Pro-wetlands**	**Wetlands and remnants**
Monetary costs to wetland owners	-$3,004,000	-$ 7,828,000	-$22,196,000
Other monetary costs (in part to wetland owners)	-$1,166,000	-$ 5,672,000	-$18,332,000
Monetary benefits to wetland owners	$ 26,000	$ 66,000	$ 72,000
Other monetary benefits (in part to wetland owners)	$ 726,000	$ 1,779,000	$ 2,293,000
Net monetary benefits	*-$3,418,000*	*-$11,655,000*	*-$38,163,000*
Recreation values (including to duck hunters)	$ 616,000	$ 1,192,000	$ 1,730,000
Non-monetary benefits to the wider community	$8,029,000	$ 8,120,000	$21,217,000
Non-monetary benefits	*$8,645,000*	*$ 9,312,000*	*$22,947,000*
Total net benefits	***$5,227,000***	***-$ 2,343,000***	***-$15,217,000***

Note: Values are net present values of relevant producers' and consumers' surplus streams over 30. A 7% discount rate was used in all cases except non-use CM values where a present value was estimated as a once-off payment. More information about these values can be found in Whitten and Bennett (2001c)

In the MRF only the grazing management strategy yields a net benefit to society ($5.5m). The costs of changing wetland management can be divided between those confined to wetland owners and those that are more broadly distributed (but which may also include wetland owners). For example, in the MRF the largest costs direct to wetland owners are loss of timber and grazing outputs and the capital costs of wetland rehabilitation and fencing. The largest cost to the wider community is acquisition of sufficient water to create an artificial flood for the 'water management' and 'combined management' strategies.

Conversely, the majority of benefits in the MRF and USE are accrued by individuals who do not live near the wetlands. They are the non-use benefits that were valued using the CM technique. These values are very sensitive to the extrapolation rules applied. For example, the environmental value estimates generated from the wetlands set out in Table 3 only relate to people living in the Murrumbidgee catchment. Inclusion of values for those living in the remainder of NSW (at 25 percent of catchment resident values) or of those living in Adelaide is sufficient to induce a net benefit for all strategies. Detailed discussion of the cost-benefit analysis, including sensitivity testing, can be found in Whitten and Bennett (2001b and 2001c).

Application of an integrated bio-economic model involves combining a biophysical model of alternative resource management outcomes and an economic model of the relative values these outcomes generate. The bio-economic model facilitates identification of whether a change in wetland management could generate greater benefits to the community than the current strategy. The major policy question is how to move from current wetland management to a strategy generating more benefits to the community. Specifically, the policy question is how to ensure adoption when the expected costs to wetland owners exceed their expected benefits. In this case there will likely be a need to transfer some of the benefits received by non-wetland owners to owners of wetlands in order to achieve the proposed change to wetland management. While the output from the bio-economic modelling provides some guidance for developing such policies this question falls beyond the scope of this paper. Furthermore, developing and implementing such policies will also involve costs that are not considered in the analysis framework described in this paper.

Conclusions

Wetlands on private land in the USE and MRF regions of NSW and SA generate significant values to wetland owners and to the wider community. In this paper, a robust set of estimates of the relative values generated by changing wetland management compared to continuing current wetland management strategies were reported from the application of the Choice Modelling valuation technique. Changing wetland management could yield significant values to the community within and beyond the USE and MRF case study areas. These values are combined with estimates of the cost to wetland owners and others in the community from changing wetland management and of the benefits to recreational users of changing wetland management. The resultant integrated bio-economic model showed that changing wetland management could yield a net benefit to the community.

The CM approach reported in this paper has a number of strengths. First, a single questionnaire was used to generate estimates for a number of resource management options. Second, the use of icons to simplify the trade-offs to respondents was a first in Australia. Finally, the inclusion of the non-monetary impacts of changing wetland management that may be viewed unfavourably by respondents may have improved the balance of the responses and validity of the results.

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[1] The Ramsar International Convention on the conservation of wetlands was signed in Ramsar, Iran in 1971.

[2] A dry sheep equivalent (dse) is a measure of the carrying capacity of pastures or land. One dry sheep equivalent is defined as a wether (castrated male sheep) eating sufficient feed to maintain 50 kilograms live-weight. Other animals are rated in dse according to the relative amount they eat.

[3] More information on the management changes proposed can be found in Whitten and Bennett (2004).

[4] While the CM method is robust and proven in the context further development may be warranted to increase response rates and confidence in research outputs.

[5] Focus groups are a planned discussion involving between eight and ten participants who are randomly recruited from the target population and guided by a facilitator. They were used as a tool to assist in CM attribute selection and questionnaire design.

[6] CM results for each case study area are shown in Appendix tables A2 and A3.

[7] This estimate is determined by the extrapolation of the average value to 30% of the target population, thus reflecting the assumption that non-respondents have zero values. This is a conservative assumption that avoids the complexities associated with a non-representative sample. It is also conservative as it assumes people living outside the Murrumbidgee catchment hold no values for MRF wetlands. Population characteristics for age, sex, income and education are used in place of respondent proportions by substituting the relevant ABS census data.