The Private and Social Values of Wetlands: an Overview

J.W. Bennett and S.M. Whitten

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Contents

Summary

WETLANDS GENERATE values enjoyed by their owners and the wider community. Individual wetland owners manage wetlands to generate income through grazing, water storage and drainage and, in some cases, hunting and eco-tourism. These are private values from wetlands. Private owners, through the way they manage their wetlands, can change the availability of their wetlands for the recreational and wildlife protection uses that the community enjoys. Such uses generate the social or community values of wetlands. In this project, the trade-offs wetland owners and the community face when making decisions about how to use their wetlands were examined for two contrasting case studies:

- the Upper South East of South Australia (USESA); and
- the Murrumbidgee River Floodplain (MRF) between Wagga Wagga and Hay in New South Wales.

There were five main steps in the research:

1. modelling the changes in the physical attributes of wetlands resulting from alternative uses (biophysical modelling);

2. estimating the community's value of the commercial (private) and non-market (social) outputs of alternative wetland uses (economic valuation);

3. incorporating the value estimates into the biological modelling framework to establish the value trade-offs of alternative uses (bio-economic modelling);

4. investigating alternative policy frameworks that would give private wetland owners incentives to manage their wetlands in ways that maximise net community benefit; and,

5. generalising the research findings to wetlands throughout Australia.

The biophysical modelling found that relatively small changes to wetland management would lead to significant changes in the environmental outputs from wetlands. The changes in environmental outputs generated large non-monetary values to the wider community. However, generating the non-monetary benefits entails a significant monetary cost to the owners of the resources that are combined in wetlands (land, water, flora and fauna). Alternative policy options were explored that would facilitate, induce, and, in some cases, compel changes to wetland management. These incentives often feature transfers of wealth from the beneficiaries of wetland management to the wetland owners who are required to achieve the outcomes desired by society. Similar policy frameworks could be applied to the management of other wetland areas elsewhere in Australia. The information produced in the course of this project will help the community to achieve better use of wetland resources on private lands.

Project web site

The results presented in this overview report summarise a series of research reports from the "Private and Social Values of Wetlands" project. These reports are available in full or in a summarised newsletter version on the project web site: <apsem.anu.edu.au/staff/jbennettr.html>.

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The views and interpretations in this overview report are those of the authors and should not be attributed to any of the individuals or organisations that have assisted with the research.

1 The context

THE RESEARCH project entitled 'Private and Social Values of Wetlands' was funded under the National Wetlands Research and Development Program by Environment Australia and Land & Water Australia between 1997 and 2001.

The project focused on the management of wetlands located on private property. Wetlands are increasingly recognised as being of value to society, yet the history of their use in Australia has been one of widespread degradation due to grazing, cropping, clearing and draining for commercial gain. What remains of Australia's wetlands is predominantly located on private land. The danger this situation presents arises from an imbalance between the incentives wetland owners receive for either exploiting or protecting their wetlands. Wetland owners receive strong profit signals to exploit their wetlands but little if any financial reward has been available from wetland conservation.

Hence, the goal of the project was to explore the nature and extent of the different values derived from wetlands in a range of alternative uses. Furthermore, with knowledge of these values, the project was aimed at providing recommendations as to appropriate incentives that could be put in place to ensure that wetlands on private lands are managed to satisfy the requirements of their owners and society at large. In other words, the project investigated the forces driving wetland owners to manage their wetlands in the ways that they do and to determine if their management strategies satisfy the broader community. If it was found that they don't, then the project aimed to determine what can be done to ensure that the owners are given an incentive to change their management strategies to ensure wetland outcomes that are both good for them and good for the wider community.

The project therefore involved answering several key questions:

- What would happen if wetlands were to be managed differently from current practice? What would be the impacts on the production of marketed goods and services? What would be the impact on the quantity and environmental quality of the wetlands? This is referred to as the *biophysical modelling* phase of the project.
- What values do owners receive from their wetlands under the current and alternative management regimes? This is the *first stage of the economic modelling* phase of the project.
- What values does the broader community enjoy as a result of changes to wetland management strategies? This is *stage two of the economic modelling* phase.
- For each of the alternative wetland management strategies put forward, what is the net impact on society of a change from current practices, and which management strategy yields the greatest net social benefit? This involves an integration of the biophysical and economic modelling results and is referred to as the *bio-economic modelling* phase of the project.
- How can society organise matters so that wetland owners have an incentive to adopt the management strategy identified as preferable? This is referred to as the *policy analysis* phase of the project.

In this overview of the project, each of these questions is addressed. The research was structured around two case studies of wetland management on private lands. The first is centred on wetlands located in the Upper South East of South Australia (USESA) between Bool Lagoon and The Coorong. The second involves the wetlands located on the Murrumbidgee River Floodplain (MRF) between Wagga Wagga and Hay. The two case studies were selected because of their widely different biophysical and socio-economic characteristics so as to demonstrate the broad applicability of the analytical process established in the project.

Details of the project research reports referred to in the text are given in the bibliography.

2 Biophysical modelling

BIOPHYSICAL MODELLING involves the identification of factors that drive wetland values and then the prediction (including quantification) of the biophysical outcomes under different landscape-scale management strategies. The biophysical modelling was carried out within a spatial context chosen to encompass the area for which management changes are considered. At the same time, the scale must encompass all impacts of the management change, including those beyond the area that has changed management. That is, the complete impacts of management changes must be incorporated in the modelling. However, each management strategy that was considered involved changes to a relatively small proportion of total resource use within the case study areas. This relatively small proportion is referred to as 'the margin'.

2.1 Identification of economically relevant project impacts

As a precursor to the biophysical modelling, an extensive review of the literature available relating to wetlands in the case study areas, and the values drawn from wetlands more generally, was undertaken (see Research Reports 1 and 4). The literature review indicated an extensive array of values available from wetlands that can be divided between purely private values and values that are both private and social. These values are shown in Table 1 for the USESA case study area. The biophysical factors that drive these values were identified as a part of the literature review and in consultation with scientists with expertise either in the region or in the types of biophysical relationships in the case-study areas.

The second stage of the biophysical modelling phase involved the identification of the values affected by changes in land management. The impact of alternative strategies can be determined only with reference to what would occur without changes to management; that is, the 'business as usual' (BAU) case.

Once a comparison point was established, an array of potential management options was considered. These management options defined the set of alternative wetland management actions and the resulting biophysical outcomes. Additional options were rejected on the basis that they would not have a significant impact on the biophysical factors that drive wetland values, or their impacts were not sufficiently differentiated from one or more of the other options. In other words, the five alternative options selected for the USESA and the four selected for the MRF were considered to be representative of the total array of possible wetland management options that could be implemented in the case study areas. Details about how these options were derived can be found in Research Reports 3 and 6.

Table 1. Array of values drawn from wetlands in the Upper South East of South Australia

Pure private values	Private and social values
Grazing production	Flora and fauna values
Firewood and timber production	Beautify the farm and regional landscape
Water supply	Attract birds that help reduce pests
Drainage storage/basin	Existence values
Tourism	Flood mitigation
Recreation	Water quality benefits
Hunting	Natural fire break or hazard (wetland type dependent)
	Hunting and, to a small extent, fishing
	Public tourism and recreation
	Groundwater recharge
	Ecosystem values (for example carbon sequestration)

The five different management options that were considered in the USESA were:[1]

- improved management of existing wetlands—termed 'wetland retention' (improved quality);
- improved management of existing wetlands and conversion of agricultural pasture to wetlands—termed 'pro-wetland' (improved quality and increased quantity);
- improved management of existing wetlands and remnant vegetation, and conversion of agricultural pasture to wetlands and revegetation—termed

[1] All options considered in the USESA were in addition to completion of the Wetlands Waterlink Scheme as part of the USESA dryland salinity and flood management project. Hence, the BAU case for the USE included changes made under the Wetlands Waterlink Scheme.

'wetlands and remnants' (improved quality and increased quantity);
- large-scale adoption of farm forestry and other deep-rooted perennial species in addition to improved management of existing wetlands and remnant vegetation, and conversion of agricultural pasture to wetlands and revegetation– termed 'targeted agro-forestry' (improved quality and increased quantity); and,
- large-scale adoption of farm forestry and other deep-rooted perennial species without other changes to wetland or remnant management—termed 'targeted agro-forestry alone' (improved quality).

Similarly, the four management options considered for the MRF were:

- improved hydrological management of wetlands—termed 'water management' (improved quality and increased quantity);
- improved grazing management in wetlands—termed 'grazing management' (improved quality);
- improved timber harvesting management in wetlands—termed 'timber management' (improved quality); and
- combining water, timber and grazing management—termed 'combined strategies' (improved quality and increased quantity).

2.2 Physical quantification of impacts—'biophysical modelling'

The second phase of the biophysical modelling involved the specification of the likely impacts of differing levels and combinations of management changes on the biophysical outcomes. The impacts were defined as the differences between BAU and adopting the change to management over a 30-year period.

The set of definable impacts is defined at the margin (more specifically, the margin between the BAU and the strategy).[2] For example, in the USESA, the margin related to changing some or all of the land uses that are indicated in the right side of Figure 1.

In Table 2, the marginal physical impacts that would result from adopting each of the alternative management strategies defined for the USESA are reported. The marginal physical impacts are the difference between adopting the strategy and the physical outcomes if BAU continued. For example, if the 'targeted agro-forestry' strategy were adopted there would be 44,700 hectares less agricultural pasture than if BAU continued. However, there would also be 51,300 additional hectares of healthy remnant vegetation, and potentially an additional 35,200 visitor days spent in the area.

In Table 3, the marginal physical impacts for the set of strategies defined for the MRF are shown. For example, implementing the 'water management' strategy would require 41,700 ML of water to be purchased from irrigators and used to create an artificial flood in five out of six years. The flood would improve the health of 2,700 hectares of wetlands to the degree they could be termed healthy, and result in an increase in native woodland and wetland birds of 33% and native fish of 50% when compared with BAU in 15 years time.

[2] It is important to note that wetlands may continue to degrade under BAU, so there will be no cost-free option available. Hence, the comparison between the BAU and alternative management strategies explicitly incorporates any cost avoided as an element of the benefits of changing wetland management.

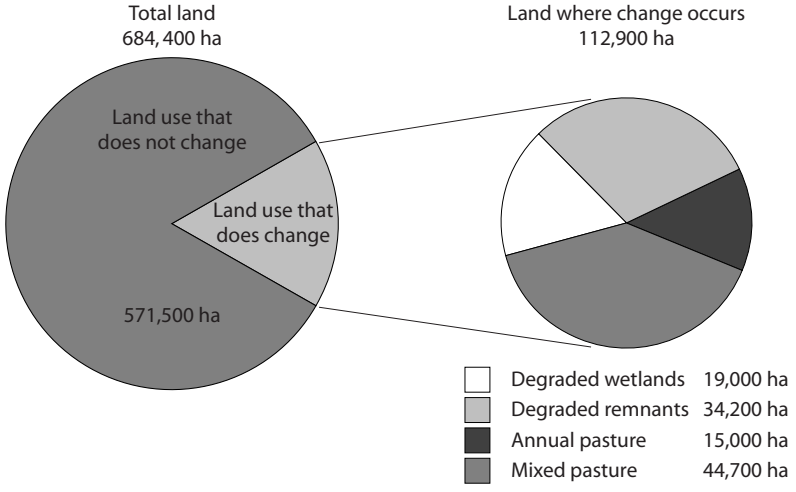

Figure 1. Biophysical status of 'business as usual' land use at the margin in the Upper South East of South Australia

Table 2. Difference between 'business as usual' and alternative strategies in the Upper South East of South Australia

Descriptive attributes	Unit	Wetland retention	Pro-wetlands	Wetlands and remnants	Targeted agro-forestry	Targeted agro-forestry alone
Agricultural productivity						
Agricultural pasture	ha (%)	0 (0.0)	–12,600 (–2.3)	–29,700 (–5.5)	–44,700 (–8.2)	–15,000 (–2.8)
Annual pasture	ha (%)	0 (0.0)	0 (0.0)	0 (0.0)	–15,000 (–100.0)	–15,000 (–100.0)
Perennial pasture	ha	0	0	0	15,000	15,000
Total productivity	dse[a] (%)	–16,400 (–0.5)	–79,800 (–2.4)	–257,700 (–7.7)	–341,100 (–10.2)	–83,400 (–2.5)
Farm forestry	ha	0	0	0	15,000	15,000
Environmental and management impacts						
Healthy wetlands	ha (%)	12,600 (28.6)	25,300 (57.1)	28,400 (64.3)	31,600 (71.4)	3,200 (7.1)
Degraded wetlands	ha (%)	–12,600 (–66.7)	–12,600 (–66.7)	–15,800 (–83.3)	–19,000 (–100.0)	–3,200 (–16.7)
Healthy remnants	ha (%)	0 (0.0)	0 (0.0)	51,300 (100.0)	51,300 (100.0)	0 (0.0)
Degraded remnants	ha (%)	0 (0.0)	0 (0.0)	–34,200 (–100.0)	–34,200 (–100.0)	0 (0.0)
Fencing required	km	400	900	2300	2400	100
Improved conservation status of species[b]	No.	15	17	22	22	0
Recreational impacts						
Number of ducks hunted	No. (%)	3000 (47.8)	4800 (76.2)	5300 (83.9)	5800 (91.6)	1000 (16.0)
Total tourist numbers	No. (%)	11,900 (187.4)	26,200 (411.8)	35,200 (553.5)	35,200 (553.5)	0 (0.0)

[a] Dry sheep equivalents
[b] Conservation status of flora and vertebrate fauna species only

Table 3. Difference between ' business as usual' and alternative strategies on the Murrumbidgee River Floodplain

Descriptive attributes	Unit	Water management	Grazing management	Timber management	Combined strategies
Water purchased from irrigation	ML (%)	41,700 (1.7)	0 (0.0)	0 (0.0)	41,700 (1.7)
Set stocking rate	ha (%)	0 (0.0)	–8300 (–38.1)	0 (0.0)	–8300 (–38.1)
Rotational or crash grazing management	ha (%)	0 (0.0)	–2300 (–9.6)	0 (0.0)	–2300 (–9.6)
No grazing	ha (%)	0 (0.0)	10,600 (172.4)	0 (0.0)	10,600 (172.4)
No logging	ha (%)	0 (0.0)	0 (0.0)	8800 (42.5)	8800 (42.5)
Fallen timber harvesting	ha (%)	0 (0.0)	0 (0.0)	–600 (–18.0)	–600 (–18.0)
Sustainable timber harvesting	ha (%)	0 (0.0)	0 (0.0)	–6100 (–42.6)	–6100 (–42.6)

Table 3. (cont'd) Difference between 'business as usual' and alternative strategies on the Murrumbidgee River Floodplain

Descriptive attributes	Unit	Water management	Grazing management	Timber management	Combined strategies
Unsustainable timber harvesting	ha (%)	0 (0.0)	0 (0.0)	–2000 (–50.0)	–2000 (–50.0)
Total productivity	dse (%)	0 (0.0)	–15,600 (–28.1)	0 (0.0)	–15,600 (–28.1)
Sawn timber yield	ha (%)	0 (0.0)	0 (0.0)	–15,300 (–43.9)	–15,300 (–43.9)
Residual timber yield	ha (%)	0 (0.0)	0 (0.0)	31,200 (–42.7)	31,200 (–42.7)
Fencing required	km (%)	0 (0.0)	700 (42.0)	0 (0.0)	700 (42.0)
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

3 Economic modelling

WHEREAS BIOPHYSICAL modelling is the compilation and analysis of the biological information that underlies private and social values, economic modelling is the compilation and analysis of the economic information required for a cost–benefit analysis. The economic modelling involves valuing the costs and benefits of achieving each of the marginal changes in the biophysical factors.

It is important to recognise that the economic modelling component refers to the change in *total community benefits* that would result from each potential management strategy and *not only* the monetary changes. The concept of economic modelling is based on the theory of economic surpluses. An economic surplus occurs where either the producer or consumer receives a net benefit. That is, a consumer surplus exists where consumers receive benefits in excess of the costs (monetary and non-monetary), while a producer surplus exists where the benefits of production (in terms of sale of goods and services and any other benefits) exceeds all costs of production (monetary and non-monetary).

3.1 Wetland owner values

Wetlands provide a number of monetary and non-monetary values to their owners. Some values, such as passive recreation, amenity and non-use values, are generated by wetlands in their natural state. Transforming the wetland to various degrees allows wetland owners to enjoy other values. Active recreation, including bushwalking, bird-watching, fishing and hunting, usually transforms wetlands to a lesser degree than grazing, timber harvesting and water harvesting. The literature survey undertaken before the biophysical modelling phase of the study revealed that relatively little was known about the importance of these values to wetland owners and how they are traded-off when management decisions are made. Surveys of wetland owners and managers in the two case study areas were used to gather information about the values held by wetland owners in the two case study areas. More information about the surveys and these values is available in Research Reports 2 and 5.

The major physical use values drawn from wetlands (both positive and negative) in the two case study areas are reported in Table 4. In both case study areas, nearly all wetland owners grazed their wetlands and most also used their wetland areas for pleasure or recreation.

Wetland owners also recognised a range of other values that are produced by their wetlands, some of which are given in Table 5. Three-quarters of wetland owners indicated that their wetlands are a place of beauty and help to conserve native plants and animals. Over 40% also indicated that their wetlands provide tourism or recreation opportunities.

Table 4. Wetland values identified by wetland owners (% of respondents)

Value	USESA[a] (%)	MRF[b] (%)
Wetland benefits		
Grazing	86	93
Hunting pest species	76	71
Hunting non-pest species	39	33
Fishing	16	35
Pleasure/recreation	88	73
Farm timber harvesting	36	45
Commercial timber harvesting	8	19
Water supply	26	63
Drainage sink	48	47
Irrigation supply/storage	n.a.	23
Wetland costs (severe or moderate problem)		
Weed source	26	37
Feral animal harbour	34	28
Nuisance animal harbour	38	30
Contributes to waterlogging	31	8
Contributes to soil salinity	33	6
Creates access problems	14	7
Attracts crop or pasture damaging birds	8	4
Loss of bogged stock	0	3
Noxious odours	22	14
Risk of disease from mosquitoes	n.a.	47

[a] Upper South East of South Australia
[b] Murrumbidgee River Floodplain

The majority of wetland owners undertook specific management practices directed at maintaining or improving the values they draw from wetland areas (63% on the MRF and 73% in the USESA). However, for many

wetland owners the values drawn from wetlands do not exceed the monetary costs they impose. When asked if their profits would increase if the wetlands were cleared and drained, 44% of MRF owners and 65% of USESA wetland owners indicated they would. A smaller percentage indicated they perceived a negative impact on their property values as a result of their wetlands (26% on the MRF and 57% in the USESA). When non-monetary benefits are included, for most wetland owners the total values they drew from wetlands equalled or exceeded the costs imposed. Overall, around 50% of owners in both case study areas indicated that their total benefits from wetlands (monetary and non-monetary) would exceed the monetary benefits available if their wetlands were drained.

Table 5. Farmers attitudes towards their wetlands (% of respondents)

Value	USESA[a] (%)	MRF[b] (%)
My wetlands provide a place of beauty	76	77
My wetlands conserve native plants and animals	72	74
My wetlands provide native fish habitat	20	39
My wetlands increase bird life which in turn decreases pests	65	67
My wetlands reduce water pollution	20	31
My wetlands help to trap and recycle nutrients	35	51
My wetlands recharge groundwater	n.a.	49
My wetlands help control floods	44	51
My wetlands help prevent soil erosion	14	27
My wetlands provide tourism/ recreation opportunities	43	42

Note: Percentages are those who indicated that their wetlands provided the value.
[a] Upper South East of South Australia
[b] Murrumbidgee River Floodplain

3.2 Recreational values

Wetlands provide a variety of recreational benefits to society. People enjoy visiting wetlands to watch birds, picnic and enjoy the views. In the USESA case study area, duck hunting is a popular recreational activity focused on the wetland areas. As a component of the economic modelling phase of the project, the travel cost method was applied to estimate the extent of the benefits generated by duck hunting.

The travel cost method uses the relationship that exists between people's purchases of marketed goods and services in connection with their journeys to a recreational site to infer a value for the site itself. In the USESA application, people attending a weekend shoot organised by Wetlands and Wildlife were interviewed to determine the location of their principal place of residence and how much it cost them to travel to the shoot.

On the basis of these data, a relationship between the costs of visiting the site and the number of hunters engaged in the weekend shoot was estimated. The mathematical manipulation of this relationship allowed the estimation of $51 as the benefit enjoyed, on average, by a hunter engaged in the shoot. This average, per-hunter value, was then extrapolated across the total number of hunters using the wetlands of the USESA in a typical year. Adjusting for the number of hunting trips undertaken informally by wetland owners and their guests, the aggregate duck hunting value was estimated to be of the order of $77,000 per annum. More information about the travel cost survey and estimation is available in Research Report 7.

Several points about the estimated value of wetlands in the USESA for duck hunting are worth noting. First, the value estimated relates to hunters' benefits only. Other values are also involved. The owners of wetlands who charge a fee for the use of their wetlands as duck hunting sites may also gain a surplus from their venture. For instance, Wetlands and Wildlife generated $6,000 from their organised shoot in February 2000. However, people other than the hunters and the wetland owners may suffer a cost because of the hunting that takes place. This is demonstrated by the significant anti-hunting pressure that was applied to the New South Wales Government, forcing it to ban duck hunting in its State. These costs were investigated in the study described in the next section.

Second, the benefits generated by duck hunting provide incentives for wetland owners to maintain their wetlands as viable habitats for ducks. In doing so, they also ensure the provision of wetland protection values that are enjoyed by the broader community. These values are also considered in the next section.

3.3 Broader community values

To estimate the wetland protection values enjoyed by members of the wider community who may not have even visited the wetlands, surveys of people living away from the wetlands were undertaken. The value estimation technique used in the surveys is known as environmental choice modelling. More information about the technique and how it was used in the study is available in Research Report 8.

For the USESA wetlands, residents of Naracoorte, Adelaide and Canberra were questioned. For the MRF, residents of Griffith, Wagga Wagga, Canberra and Adelaide were surveyed.

In the questionnaire, respondents were asked to make a sequence of choices between alternative 'futures' for the

wetlands under consideration. The alternatives between which respondents were asked to choose were described in terms of a number of wetland 'attributes'. For the USESA, the attributes were:

- Area of healthy wetlands
- Area of healthy remnant vegetation
- Number of threatened species that would benefit
- The number of ducks hunted.

For the MRF, the alternatives were described in terms of:

- Area of healthy wetlands
- Number of native birds (as a percentage of the 1800 population)
- Number of native fish (as a percentage of the 1800 population)
- Number of farmers leaving the region.

For both case-study areas, a fifth attribute—the cost of implementing the alternative management regime as a one-off levy on the respondent's income tax—was also included. In every choice made by the respondents, the current management regime was available as an option that would involve no income tax levy.

From the choices made by the respondents, it was possible to determine the relationship between the probability of an alternative being chosen and the magnitude of the attributes, as well as the socio-economic characteristics of the respondents. In other words, it is possible to see how people's choices are affected by changes in the wetland outcomes, and how different people are likely to make different choices. This in turn allows an investigation of what people are willing to give up from one option in order to secure another option. This notion of 'trading-off' between attributes can be honed down to the estimation of how much money respondents are willing to pay, on average, to secure increases in the non-monetary environmental attributes. The resultant attribute values are reported in Table 6.

In other words, in the USESA, respondents were, on average, willing to pay $4.81 to increase by one the number of threatened species protected through wetland management. For some USESA values the willingness to pay differed significantly depending on the characteristics of respondents. For example, respondents who were pro-conservation were willing to pay $1.51 for an additional 1000 ha of healthy wetlands, while other respondents wanted to be compensated $1.22. Similarly, people who did not hunt ducks wanted to be compensated $4.35 for each additional 1000 ducks hunted. In the MRF, respondents were estimated to be willing to pay $11.39 to have the area of healthy wetlands increased by 1000 hectares. Note that these same respondents wanted to be paid compensation of $5.73 per farmer if the wetland management strategies were to cause farmers to have to leave their properties.

The modelling of respondents' choices also allows the estimation of values for the outcomes of complete management strategies that involve changes in multiple attributes. For instance, consider the change in wetlands management in the USESA from the current situation to a strategy that involved the restoration of wetlands and remnants, the outcomes of which are detailed in Table 7. Note that the outcomes listed are predicted through the bio-economic modelling phase of the project.

Table 6. Attribute value estimates

Attribute	Value estimate ($ per unit)
Upper South East of South Australia	
Area of healthy wetlands (pro-conservation respondents per '000 ha)[a]	1.51
Area of healthy wetlands (other respondents per '000 ha) [a]	–1.22
Area of healthy remnant vegetation ('000 ha)	1.51
Number of threatened species that benefit	4.81
Number of ducks hunted (non-hunters per '000)	–4.35
Number of ducks hunted (hunters per '000)	3.01[b]
Murrumbidgee River Floodplain	
Area of healthy wetland ('000 ha)	11.39
Number of native birds (percentage of 1800 population)	0.55
Number of native fish (percentage of 1880 population)	0.34
Number of farmers leaving	–5.73

[a] Pro-conservation respondents reported favouring conservation over development, other respondents either favoured conservation and development equally or favoured development.

[b] The value of ducks hunted to duck hunters is not significantly different from zero at the 95 percent level of confidence due to the relatively small number of respondents who had hunted ducks.

Table 7. Alternative wetland management strategies in the Upper South East of South Australia

Attribute	Business as usual (BAU)	Wetlands and remnants strategy
Area of healthy wetlands (ha)	44,000	72,425
Area of healthy remnant vegetation (ha)	50,000	101,275
Threatened species that benefit	0	22
Number of ducks hunted	6,000	12,000

The value estimated for the change from the 'business as usual' to the 'wetlands and remnants' strategy is $131. That is, respondents were willing, on average, to pay $131 as a one-off sum, to have the wetlands improve in the manner described in Table 7.

The model of respondents' choices allows for the estimation of values for a wide array of potential wetland management strategy outcomes.

Similarly, estimates of value for various outcomes can be calculated for the MRF case study. For instance, the value estimated for an average respondent for the change described in Table 8 is $121.

Table 8. Alternative wetland management strategies on the Murrumbidgee River Floodplain

Attribute	Business as usual (BAU)	Water management strategy
Area of healthy wetlands (ha)	2300	5000
Number of native birds (%)	40	60
Number of native fish (%)	20	30
Number of farmers leaving	0	0

4 Bio-economic modelling

EACH WETLAND management strategy identified in the biophysical modelling phase of the project, including the BAU scenario, can be characterised by a set of biophysical outcomes. Estimates of the values of these outcomes were calculated during the economic modelling phase of the project. In the bio-economic stage of the project these two phases were integrated to determine which strategies provide net gains to society as a whole, relative to the continuation of the BAU scenario. In other words, the benefits of changing from the BAU scenario to each of the alternative strategies are compared with the costs of the change. The alternatives that yield positive net benefits to society can be regarded as preferable to the BAU situation, with the alternative that yields the highest net benefit as the most desirable.

For the USESA case study, five alternative wetland management strategies were investigated in the bio-economic modelling phase while four were investigated for the MRF. The alternatives were those established during the biophysical modelling phase. For each alternative, the benefits of changing management (including increased wider community wetland protection values, recreational hunting and tourism values) are weighed against the costs of changing (including rehabilitation costs such as fencing and foregone returns from agricultural activities undertaken in the wetlands before the change). More information about the biophysical modelling phase of the project is available in Research Reports 9 and 10.

Tables 9 and 10 list the benefits and costs of each alternative (relative to the BAU) for the two case studies.

Table 9. Aggregate cost–benefit analysis of management strategies for the Upper South East of South Australia

Cost or benefit	Wetland retention	Pro-wetlands	Wetlands and remnants	Targeted agro-forestry	Targeted agro-forestry alone
Changes to agricultural activities					
Pasture establishment and management costs saved	$0	$2,462,000	$4,963,000	$7,153,000	$2,189,000
Lost agricultural production	–$1,166,000	–$5,672,000	–$18,332,000	–$24,265,000	–$5,933,000
Net cost of farm forestry	$0	$0	$0	$4,595,000	$4,595,000
Sub-total	*–$1,166,000*	*–$3,210,000*	*–$13,369,000*	*–$12,517,000*	*$851,000*
Management costs of wetlands and remnants					
Capital costs of wetland rehabilitation	–$253,000	–$759,000	–$756,000	–$768,000	–$63,000
Capital costs of native vegetation rehabilitation[a]	$0	–$3,864,000	–$10,625,000	–$10,625,000	$0
Capital costs of fencing	–$1,137,000	–$2,436,000	–$5,883,000	–$6,167,000	$284,000
Ongoing management costs	–$1,614,000	–$3,231,000	–$9,894,000	–$9,999,000	–$404,000
Sub-total	*–$3,004,000*	*–$10,290,000*	*–$27,159,000*	*–$27,560,000*	*–$751,000*
Environmental values generated—consumers' surpluses					
Duck hunting	$85,000	$220,000	$238,000	$257,000	$25,000
Tourism	$531,000	$972,000	$1,492,000	$1,492,000	$0
Non-use values	$8,029,000	$8,120,000	$21,217,000	$20,759,000	–$3,983,000
Sub-total	*$8,645,000*	*$9,312,000*	*$22,947,000*	*$22,507,000*	*–$3,958,000*
Environmental values generated—producers' surpluses					
Duck hunting	$17,000	$43,000	$46,000	$50,000	$5,000
Tourism	$750,000	$1,836,000	$2,367,000	$2,367,000	$0

Table 9. (cont'd) Aggregate cost–benefit analysis of management strategies for the Upper South East of South Australia

Cost or benefit	Wetland retention	Pro-wetlands	Wetlands and remnants	Targeted agro-forestry	Targeted agro-forestry alone
Other wetland owner use values			*Not estimated*		
Sub-total	*$766,000*	*$1,879,000*	*$2,413,000*	*$2,417,000*	*$5,000*
Total environmental values	*$9,411,000*	*$11,191,000*	*$25,360,000*	*$24,923,000*	*–$3,953,000*
Total changes valued	**$5,242,000**	**–$2,309,000**	**–$15,168,000**	**–$15,154,000**	**–$3,853,000**

Note: Values are net present values of benefit and cost streams over 30 years using a 7% discount rate.
[a] Native vegetation rehabilitation includes revegetation of both wetlands and recreated terrestrial vegetation.

The results of the bio-economic modelling demonstrate that society as a whole would be better off if the private owners of wetlands undertook more wetland protection. That is, a social dividend could be achieved if wetland owners changed their management strategies to produce more of the social values of wetlands. The problem is that wetland owners are currently inadequately rewarded for providing these social values. From Tables 9 and 10 it is apparent that the prime recipients of benefits arising from the alternative management strategies are members of the broader community. However, the primary costs of adopting the alternatives are born by wetland owners. Those costs are not compensated by the benefits because the broader community benefits are not being mobilised to pay the wetland owners.

What is required is a set of arrangements that will mobilise the substantial benefits enjoyed by the broader community so that they can be used to pay wetland owners who decide to protect their wetlands. This calls for an analysis of the policy arrangements that drive the allocation of wetland resources.

Table 10. Aggregate cost–benefit analysis of management strategies for the Murrumbidgee River Floodplain

Cost or benefit	Water management	Grazing management	Timber management	Combined strategies
Changes to agricultural activities				
Lost agricultural production	$0	–$3,137,000	$0	–$3,137,000
Cost of providing watering points	$0	–$192,000	$0	–$191,000
Lost timber production	$0	$0	–$4,678,000	–$4,678,000
Sub-total	*$0*	*–$3,328,000*	*–$4,678,000*	*–$8,006,000*
Management costs of wetlands				
Capital costs of water acquisition	–$18,161,000	$0	$0	–$18,161,000
Capital costs of wetland rehabilitation	–$1,151,000	$0	$0	–$1,151,000
Capital costs of fencing	$0	–$1,261,000	$0	–$1,261,000
Capital costs of wetland revegetation	$0	–$209,000	$0	–$209,000
Ongoing costs of wetland management	–$566,000	–$1,187,000	$0	–$2,072,000
Income from future water sales	$6,246,000	$0	$0	$6,246,000
Sub-total	*–$13,633,000*	*–$2,657,000*	*$0*	*–$16,609,000*
Environmental values generated—consumer surpluses				
Recreation	$742,000	$1,842,000	$0	$3,078,000
Non-use values	$8,459,000	$9,212,000	$3,016,000	$11,832,000
Sub-total	*$9,201,000*	*$11,053,000*	*$3,016,000*	*$14,911,000*
Wetland owner use values		*not estimated*		
Total changes valued	**–$4,432,000**	**$5,068,000**	**–$1,661,000**	**–$9,704,000**

Note: Values are net present values of benefit and cost streams over 30 years using a 7% discount rate.

5 Policy analysis

BIO-ECONOMIC MODELLING involves the identification of biophysical management strategies that lead to the highest community benefits. Once an optimal strategy is determined, questions relating to policy arise. The major policy question is how to achieve the most beneficial outcome as indicated by the biophysical modelling. A change in wetland management may benefit society as a whole but the expected costs to wetland owners must exceed the expected benefits or the strategy would already be employed.[3] Hence, transfer of some of the benefits received by non-wetland owners to owners of wetlands is required in order to achieve the wetland management strategy. The output from the economic modelling provides some guidance for the development of policies to facilitate incentives for improved wetland management.

5.1 Current incentives

Information about the current incentives received by wetland owners was gathered as part of the survey of farmers. Just 21% of MRF and 33% of USESA wetland owners currently receive external incentives to undertake wetland management. One USESA wetland owner and two MRF wetland owners received tax incentives, eight USESA and nine MRF owners received materials (mainly fencing) and a similar number received free management advice from government agencies. More information about the use of current incentives and further incentives desired in the case study areas can be found in Research Reports 2 and 5.

The major incentives sought by wetland owners to help manage their wetlands were:

- financial assistance (including enhanced tax breaks);
- fencing assistance;
- free or low cost water for wetlands (MRF only);
- wetland and property management training/ assistance; and
- revegetation assistance.

The major constraint to adoption of specific wetland management strategies was found to be a lack of time or interest. The direct financial cost or the impact on profits was the second most dominant reason for not adopting specific strategies.

5.2 Potential policy options

Ways to access the broader community benefits through increased private sector contributions were sought via the examination of incentives facing wetland managers. The current set of policies generates a set of incentives that, in conjunction with the values held by managers, results in the private decisions that are made. Altering the current set of policies will change the incentive structure facing resource managers, possibly leading to different outcomes. The challenge is to identify alternative sets of policies that will improve wetland management and hence increase the benefits to society. Additional information about the policy options is contained in Research Report 11.

There are three broad policy frameworks that could be used to encourage increased social values of wetlands from privately owned land:

1. government could purchase the wetlands or otherwise force the management of wetlands for the production of the outputs it believes the community desires (a planned framework);
2. government could provide a policy framework that encourages wetland owners to seek the highest valued use for their wetlands but not provide any direct incentives to wetland owners (that is, no financial payments to wetland owners) (a market framework); or
3. government could provide a market policy framework and also provide direct incentives to wetland owners to increase production of wetland outputs beyond the level produced by the private sector alone (a mixed framework).

In the past, government has provided the majority of conservation outputs in Australia because they have generally been considered to be 'public goods' and as such preclude production by the private sector due to 'market failure'. However, market failure is often the result of an inadequate institutional structure rather than the nature of the goods and services produced. Hence,

[3] The possibility also exists that owners are simply unaware of the benefits. An appropriate extension program is called for in this situation.

private sector production can reduce or avoid the incidence of government failure.[4] Where the government uses regulation to attempt to enforce production (eg. land clearing restrictions) the costs of producing environmental outputs are not reduced but are imposed on current resource owners instead of the wider community that would benefit from the changes.

Altering the policy framework to reduce or remove some disincentives and to provide conduits for additional incentives could increase production of wetland outputs. However, because of the 'public good' nature of many wetland outputs, direct incentives increasing production are also likely to increase the wellbeing of society. Hence, the third policy framework was adopted in this project.

5.3 Policy suggestions for the Upper South East of South Australia

The private and social values of USESA wetlands are shown in Table 9. The major values generated by wetland rehabilitation and recreation are non-use values enjoyed by people who do not live near the wetlands. Hence, policies need to facilitate a transfer of resources from those who live away from wetlands to wetland owners. Policy options aimed at achieving this flow were considered at the local, state and federal levels.

The USESA wetlands lie within four local government areas. All local government areas in South Australia grant a rate rebate or exemption to lands covered by a Heritage Agreement (HA). As the incentive is designed to ensure production of an output, it is recommended that all lands managed primarily for conservation (as defined in a management plan) are eligible for a similar exemption or rate rebate. Sales of conservation land are subject to development restrictions by local governments and under state planning laws, including minimum land parcel sizes in some areas. It is recommended that such disincentives to land sales for conservation be minimised or removed along with state-level disincentives imposed by stamp duty and title subdivision fees.

There are several roles that the local or state government could undertake or assist with to promote tourism in the USESA:

- development of tourist infrastructure, including information about wetlands, and development of scenic drives, including stop-off points and assisting with access to specialist markets (such as bird-watching clubs);
- training for wetland owners who are interested in starting tourism ventures; and
- facilitating a USESA wetlands tourism organisation that would eventually stand alone.

State governments should also facilitate information transfer through voluntary organisations similar to 'Land for Wildlife' in Victoria, whereby interested landowners receive free information on wetland management. Encouragement of farm planning and extension programs targeting wetland owners not currently interested in conservation management may also be important. It is also suggested that state governments signal the importance of wetlands via their listing as being of international (Ramsar and Shorebirds networks), national or state importance and their inclusion in regional land management plans (as has largely occurred in the USESA).

Reform of property rights covering the resources that are combined in wetlands is generally a state government responsibility. In particular, laws that facilitate private sector ownership of partial property rights such as conservation covenants would need to be enacted at the state government level. The ability to enact conservation covenants would, by reducing the cost of achieving their desired outcome, increase the incentives to private sector groups to act.

Additional incentives to private sector conservation organisations could be granted at the federal level through the taxation system. Recent changes to the taxation system have increased the range of donations that are tax deductible. However, several extensions would allow for greater consistency across all types of donations and with other business activities including:

- ensuring the bargain or discount component of land sales to conservation groups is tax deductible;
- ensuring conservation covenants are tax deductible without sale of the land; and
- ensuring conservation groups are able to buy and sell a broad range of assets if required to achieve the conservation goals.

As indicated previously, community wellbeing may be increased by some direct contributions via government. The use of strategies that minimise inefficiencies in tax collection and redistribution, and in decision-making, can reduce the degree of government failure inherent in such contributions. Some suggestions include:

- broadening tax deductability of inputs to wetland management. The current Landcare tax deductions and rebates are little used for wetland management, suggesting that they are either inappropriate or too difficult to claim;
- requiring private sector conservation organisations to match spending by state government;

[4] An issue of whether government failure is worse than market failure arises where actions by the government sector 'crowd-out' actions by the non-government sector.

- focusing on binding constraints to management change. The large capital cost of wetland conversion in the USESA (comprising fencing, hydrological works and, potentially, revegetation) provides a significant barrier to wetland owners considering changing wetland management.

Several further issues need to be addressed in incentive design. Flexibility is required in applying the incentive regimes suggested above, in order to maximise the potential for innovation in wetland management. The regulatory environment should minimise the disincentives to wetland owners of either changing to, or continuing, wetland management for conservation outcomes. The degree to which the costs of changing wetland management can be shared by people living outside the regions, potentially interstate, is an important constraint on the extent of transfers that may be possible. Finally, the effectiveness of the policies employed may depend in part on the scheduling application and the total package proposed.

5.4 Policy suggestions for the Murrumbidgee River Floodplain

The private and social values of wetlands in the MRF are shown in Table 10. As in the USESA, the major values generated by a change of wetland management are non-use values enjoyed by people who do not live near the wetlands. Hence, the array of tools suggested to achieve a transfer to wetland owners is similar to that proposed in for the USESA region. Additional information on the incentives mentioned below is contained in Research Report 11.

There is no rate relief for wetland owners who choose to manage their wetlands to produce conservation outcomes, unless they are listed under Voluntary Conservation Agreements with the NSW National Parks and Wildlife Service. Hence, wetland owners face ongoing costs for wetland management equal to those applied to income-generating lands. Similar disincentives due to parcel size restrictions and subdivision charges also apply in NSW as in the USESA and should be minimised. Consideration should also be given to ensuring that development restrictions (including floodplain ordinances) do not act as a disincentive to rehabilitation works such as removing levees, weed control and other floodplain wetland management works.

The potential for conservation covenants to achieve continued or increased production of wetland outputs in the MRF is at least as high as in the USESA. Similar institutions could also be developed to allow wetland owners to access benefits from changing timber-harvesting practices and the benefits of allowing fishing access. MRF wetland owners should also be encouraged to improve wetland management through the provision of information programs and incentives to complete farm management plans. Signalling wetland importance via inclusion in regional planning initiatives is also important in the MRF.

The largest single cost of achieving significant changes in wetland health on the MRF is the purchase of sufficient water to facilitate an artificial flood. It is suggested that a trust would be the best organisational structure to hold the water title and make decisions about when to flood and when to sell water.

To help maximise the benefits of such a trust, completion of the water-reform process already under way is necessary. Use of institutions similar to conservation covenants, but applied to the water rights, would also reduce costs.

Similar taxation and grant incentives are suggested at the federal and state levels for the MRF as for the USESA. An additional taxation consideration is to avoid granting tax incentives for water storages constructed in wetlands.

As in the USESA, it is important that regulations governing floodplain wetlands and the incentive structure created continue to encourage innovation and an entrepreneurial spirit in wetland management and avoid disincentives to wetland conservation. Policy scheduling and cost-sharing issues are also equally important in the MRF.

5.5 Generalisation to wetlands throughout Australia

The considerable overlap between the incentives suggested in the USESA and MRF provides some guidance for policy change for wetland management across the whole of Australia. These policy measures include facilitative measures such as information provision, additional flexibility in the application of conservation covenants, signalling via listing and inclusion in plans and taxation incentives at the state and federal levels. Other incentives require additional targeting or analysis to ensure that the benefits of application exceed their costs. For example, the application of grants programs requires additional analysis. Similarly, the importance of tourism in the USESA, and possible constraints to rehabilitation via floodplain protection laws and tax concessions to water storage construction in the MRF, are regionally specific.

6 Conclusions

THE RESEARCH undertaken over the course of this project has demonstrated the extent of the values provided for society through the increased protection of wetlands on private land. It has also identified the forces that work to degrade those wetlands. Those forces are the result of particular policy settings that are well established in the community. However, the research has also demonstrated that these policy settings can be replaced with alternatives that will provide more appropriate incentives for wetland owners to cater for the requirements of society as a whole.

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