THE PRIVATE AND SOCIAL VALUES OF WETLANDS

AN OVERVIEW

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1. The context

The Private and Social Values of Wetlands was a research project funded under the National Wetlands Research and Development Program by Environment Australia and Land and Water Australia between 1998 and 2001.

The focus of the project was 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 are predominantly located on private land. The danger this situation presents arises from an imbalance between the incentives wetland owners receive for exploiting and 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 activities.

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 incentive measures 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 was tasked with finding out 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 a number of 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 do 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 institutional analysis phase of the project.

In this final report for the project, each of these questions will be addressed. The research is structured around two case studies of wetland management on private lands. The first is centred on wetlands located in the Upper South East (USE) of South Australia 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.

2. Bio-physical 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 literature review of the information 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 in nature. These values are indicated in Table 1 for the USE case study area.

Table 1: Array of values drawn from wetlands in the USE region

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 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 and/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 only be determined with reference to what would occur without changes to management, that is, the 'business as usual' case (BAU).

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 that their impacts were not sufficiently differentiated from one or more of the other options. In other words, the five alternative options selected for the USE and the four selected for the MRF were considered to be representative of the total array of possible 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.

The five different management options that were considered in the USE were:

- Improved management of existing wetlands – termed wetland retention (improved quality);
- Improved management of existing wetlands and conversion of agricultural pasture to wetlands – termed pro-wetlands (improved quality and increased quantity);
- Improved management of existing wetlands and remnant vegetation and conversion of agricultural pasture to wetlands and revegetation – termed 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 – termed targeted agro-forestry without other changes to wetland or remnant management (improved quality).

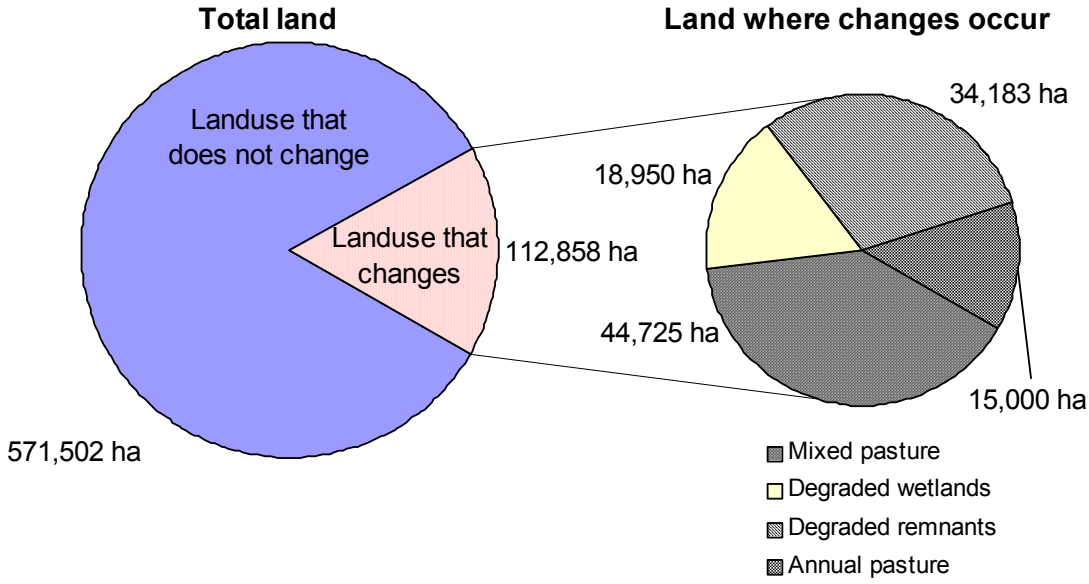
Similarly, the four management options considered for the MRF were:

- 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 the 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). For example, in the USE, the margin related to changing some or all of the landuses that are indicated in the right side of Figure 1.

Figure 1: Biophysical status of BAU landuse at the margin in the USE region



In Table 2, the marginal physical impacts that would result from adopting each of the alternative management strategies defined for the USE are reported. The marginal physical impacts are the difference between adopting the strategy and the physical outcomes if BAU continued. For example, if the 'cumulative farm forestry' strategy were adopted there would be 44,725 hectares less agricultural pasture than if BAU continued. However, there would also be 51,275 additional hectares of healthy remnant vegetation and potentially an additional 35,150 visitor days spent in the area.

Table 2: Difference between 'BAU' and alternative strategies in the USE

Descriptive Attributes	Unit	Wetland retention	Pro-wetlands	Wetlands and remnants	Cumulative farm forestry	Farm forestry alone
Agricultural productivity						
Agricultural pasture	ha	0	-12,633	-29,725	-44,725	-15,000
	(%)	*(0.0)*	*(-2.3)*	*(-5.5)*	*(-8.2)*	*(-2.8)*
Annual pasture	ha	0	0	0	-15,000	-15,000
	(%)	*(0.0)*	*(0.0)*	*(0.0)*	*(-100.0)*	*(-100.0)*
Perennial pasture	ha	0	0	0	15,000	15,000
Total productivity	dse	-16392	-79771	-257728	-341093	-83365
	(%)	*(-0.5)*	*(-2.4)*	*(-7.7)*	*(-10.2)*	*(-2.5)*
Farm forestry	ha	0	0	0	15,000	15,000
Environmental and management impacts						
Healthy wetlands	ha	12,633	25,267	28,425	31,584	3158
	(%)	*(28.6)*	*(57.1)*	*(64.3)*	*(71.4)*	*(7.1)*
Degraded wetlands	ha	-12,633	-12,633	-15,792	-18,950	-3158
	(%)	*(-66.7)*	*(-66.7)*	*(-83.3)*	*(-100.0)*	*(-16.7)*
Healthy remnants	ha	0	0	51,275	51,275	0
	(%)	*(0.0)*	*(0.0)*	*(100.0)*	*(100.0)*	*(0.0)*
Degraded remnants	ha	0	0	-34,183	-34,183	0
	(%)	*(0.0)*	*(0.0)*	*(-100.0)*	*(-100.0)*	*(0.0)*
Fencing required	km	442	948	2289	2399	111
Improved conservation status of species*	No.	15	17	22	22	0
Recreational impacts						
Number of ducks hunted	No.	3009	4795	5281	5767	1008
	(%)	*(47.8)*	*(76.2)*	*(83.9)*	*(91.6)*	*(16.0)*
Total tourist numbers	No.	11,900	26,150	35,150	35,150	0
	(%)	*(187.4)*	*(411.8)*	*(553.5)*	*(553.5)*	*(0.0)*

* Conservation status of flora and vertebrate fauna species only

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 to BAU in fifteen years time.

Table 3: Difference between 'BAU' and alternative strategies on the MRF

Descriptive Attributes	Unit	Water management	Grazing management	Timber management	Combined strategies
Water purchased from	Ml	41,700	0	0	41,700
irrigation	*(%)*	*(1.7)*	*(0.0)*	*(0.0)*	*(1.7)*
Set stocking rate	ha	0	-8259	0	-8259
	(%)	*(0.0)*	*(-38.1)*	*(0.0)*	*(-38.1)*
Rotational or crash	ha	0	-2296	0	-2296
grazing management	*(%)*	*(0.0)*	*(-9.6)*	*(0.0)*	*(-9.6)*
No grazing	ha	0	10,555	0	10,555
	(%)	*(0.0)*	*(172.4)*	*(0.0)*	*(172.4)*
No logging	ha	0	0	8745	8745
	(%)	*(0.0)*	*(0.0)*	*(42.5)*	*(42.5)*
Fallen timber harvesting	ha	0	0	-596	-596
	(%)	*(0.0)*	*(0.0)*	*(-18.0)*	*(-18.0)*
Sustainable timber	ha	0	0	-6111	-6111
Harvesting	*(%)*	*(0.0)*	*(0.0)*	*(-42.6)*	*(-42.6)*
Unsustainable timber	ha	0	0	-2039	-2039
harvesting	*(%)*	*(0.0)*	*(0.0)*	*(-50.0)*	*(-50.0)*
Total productivity	dse	0	-15,539	0	-15,539
	(%)	*(0.0)*	*(-28.1)*	*(0.0)*	*(-28.1)*
Sawn timber yield	ha	0	0	-15,280	-15,280
	(%)	*(0.0)*	*(0.0)*	*(-43.9)*	*(-43.9)*
Residual timber yield	ha	0	0	31,156	31,156
	(%)	*(0.0)*	*(0.0)*	*(-42.7)*	*(-42.7)*
Fencing required	km	0	718	0	718
	(%)	*(0.0)*	*(42.0)*	*(0.0)*	*(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 can be regarded as valuing the costs and benefits of 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 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 wetland 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 transform wetlands to a lesser degree than grazing and timber and water harvesting. The literature survey undertaken prior to 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.

Table 4: Wetland owner values

Value	USE	MRF
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 mosquitos	n.a.	47%

Wetland owners also recognised a range of other values that are produced by their wetlands, some of which are shown 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 percent also indicated that their wetlands provide tourism or recreation opportunities.

Table 5: Farmers attitudes towards their wetlands

Value	USE	MRF
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.

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 USE). 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 percent of MRF owners and 65 percent of USE wetland owners indicated they would. A smaller percentage indicated they perceived a negative impact on their property value as a result of their wetlands (26% on the MRF and 57% in the USE). When non-monetary benefits are included, the total values drawn from wetlands by their owners equalled or exceeded the costs imposed for a majority of wetland owners. Overall, 51 percent of MRF owners and 50 percent of USE owners indicated that the total benefits of wetlands (monetary and non-monetary) would exceed the monetary benefits available if their wetlands were drained.

3.2 Recreational values

Wetlands provide a variety of recreational benefits to society. People enjoy visiting wetlands to watch birds, picnic and to enjoy the views. In the Upper South East case study area, a popular recreational activity that is focused on the wetland areas is duck hunting. As a component of the economic modelling phase of the project, an application of the travel cost method was performed 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 USE application, people attending a weekend shoot organised by Wetlands and Wildlife were interviewed to determine the location of their principal place of residence and the extent of their costs incurred in travelling 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 the benefit enjoyed, on average, by a hunter engaged in the shoot at $51.33. This average, per hunter value was then extrapolated across the total number of hunters using the wetlands of the

USE in a typical year. Adjusting for the number of hunting trips undertaken informally by wetland owners and their guests, an aggregate duck hunting value was estimated to be in the order of $76,995 per annum. More information about the travel cost survey and estimation is available in Research Report 6.

A number of points are worth noting regarding the estimated value of wetlands in the USE for duck hunting purposes. First, the value estimated relates only to hunters' benefits. 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 $5,880 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. For instance, significant anti-hunting pressure was applied to the NSW Government, forcing it to ban duck hunting in that 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 the subject of 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, a survey of people living away from the wetlands was undertaken. The value estimation technique used in the survey 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 USE wetlands, residents of Naracoorte, Adelaide and Canberra were questioned. For the MRF, residents of Griffith, Wagga Wagga, Canberra and Adelaide were asked.

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 USE, 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 peoples' 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.

Table 6 Attribute value estimates

Case study region	**Attribute**	**Value estimate ($ per unit)**
Upper South East	Area of healthy wetlands (1000 ha)	Not significant
	Area of healthy remnant vegetation (1000 ha)	1.51
	Number of threatened species that benefit	4.81
	Number of ducks hunted	Not significant
Murrumbidgee River floodplain	Area of healthy wetland (1000 ha)	11.39
	Number of native birds (% of 1800 population)	0.55
	Number of native fish (% of 1880 population)	0.34
	Number of farmers leaving	-5.73

In other words, in the USE, respondents were, on average, willing to pay $4.81 to increase by one, the number of threatened species protected through wetland management. In the MRF, respondents were estimated to have a value of over $11 to have the area of healthy wetlands increased by 1000 hectares. Note that these same respondents wanted to be paid compensation of over $5 if the wetland management strategies were to cause a farmer to have to leave their property.

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 USE 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 7: Alternative wetland management strategies in the Upper South East

Attribute	Business as usual	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, on average, were willing to pay as a one-off sum, $131 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 in 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 are integrated to determine which strategies provide net gains to the society as a whole relative to the continuation of the business as usual scenario. In other words, the benefits of changing from the business as usual scenario to each of the alternative strategies are compared against the costs of the change. The alternatives that yield positive net benefits to society can be regarded as preferable to the BAU situation. The alternative that yields the highest net benefit is the most desirable.

For the USE 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 other tourism values, etc) are weighed up against the costs of changing (including rehabilitation costs such as fencing and foregone returns from agricultural activities undertaken in the wetlands prior to the change). More information about the biophysical modelling phase of the project is available in Research Reports 9 and 10.

Listings of the benefits and costs of each alternative (relative tot eh BAU) for the two case studies are set out in Table 9 and Table 10.

Table 9: USE aggregate cost-benefit analysis of management strategies

Cost or benefit	Wetland retention	Pro-wetlands	Wetlands and remnants	Cumulative farm forestry	Farm forestry alone
Changes to agricultural activities					
Pasture establishment and management costs saved	$ 0	-$2,462,102	-$ 4,963,320	-$ 7,152,602	-$2,189,461
Cost of lost agricultural productivity	-$1,165,657	-$5,671,625	-$18,331,514	-$24,264,850	-$5,933,698
Net cost of farm forestry	$ 0	$ 0	$ 0	$ 4,594,792	$4,594,792
Sub-total	*-$ 932,526*	*-$2,075,198*	*-$ 9,701,891*	*-$ 7,664,486*	*$2,037,294*
Management costs of wetlands and remnants					
Capital costs of wetland rehabilitation	-$ 253,140	-$ 759,419	-$ 756,333	-$ 768,184	-$ 63,285
Capital costs of native vegetation rehabilitation*	$ 0	-$ 3,864,226	-$10,625,118	-$10,625,118	$ 0
Capital costs of fencing	-$ 1,136,653	-$ 2,435,686	-$ 5,883,255	-$ 6,167,418	$284,163
Ongoing management costs	-$ 1,614,360	-$ 3,230,818	-$ 9,894,406	-$ 9,999,339	-$403,590
Sub-total	*-$ 3,004,152*	*-$10,290,148*	*-$27,159,112*	*-$27,560,059*	*-$751,038*
Environmental values generated – consumers' surpluses					
Duck hunting	$ 85,328	$ 219,621	$ 238,149	$ 256,667	$ 25,343
Tourism	$ 530,855	$ 972,116	$ 1,491,546	$ 1,491,546	$ 0
Non-use values	$8,028,760	$8,119,980	$21,216,840	$20,758,543	-$3,983,009
Sub-total	*$8,644,942*	*$9,311,717*	*$22,946,534*	*$22,506,755*	*-$3,957,666*
Environmental values generated – producers' surpluses					
Duck hunting	$ 16,623	$ 42,786	$ 46,396	$ 50,003	$ 4,937
Tourism	$ 749,769	$1,836,267	$2,366,683	$2,366,683	$ 0
Other wetland owner use values			*Not estimated*		
Sub-total	*$ 766,392*	*$ 1,879,053*	*$ 2,413,079*	*$ 2,416,686*	*$ 4,937*
Total environmental values	*$9,411,335*	*$11,190,770*	*$25,359,613*	*$24,923,442*	*-$3,952,729*
Total changes valued	**$5,241,525**	**-$ 2,308,900**	**-$15,167,694**	**-$15,154,073**	**-$3,853,212**

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

* 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 management activities. 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 Table 9 and Table 10 it is apparent that the prime source of benefits arsing from the alternative management strategies is 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.

Table 10: MRF aggregate cost-benefit analysis of management strategies

Cost or benefit	Water management	Grazing management	Timber management	Combined strategies
Changes to agricultural activities				
Lost agricultural productivity	$ 0	-$2,729,385	$ 0	-$ 2,729,385
Cost of providing watering points	$ 0	-$ 191,549	$ 0	-$ 191,549
Lost timber production	$ 0	$ 0	-$7,850,685	-$ 7,850,685
Sub-total	*$ 0*	*-$2,920,934*	*-$7,850,685*	*-$10,771,618*
Management costs of wetlands				
Capital costs of water acquisition	-$18,161,201	$ 0	$ 0	-$18,161,201
Capital costs of wetland rehabilitation	-$ 1,151,129	$ 0	$ 0	-$ 1,151,129
Capital costs of wetland revegetation	$ 0	-$1,261,135	$ 0	-$ 1,261,135
Capital costs of fencing	$ 0	-$ 134,017	$ 0	-$ 134,017
Ongoing costs of water management	-$ 566,157	-$1,187,156	$ 0	-$ 2,072,250
Ongoing wetland management costs	$ 4,972,155	$ 0	$ 0	$ 4,972,155
Sub-total	*-$14,906,331*	*-$2,582,308*	*$ 0*	*-$17,807,576*
Environmental values generated – consumers' surpluses				
Recreation	$8,458,507	$ 9,211,723	$3,016,335	$11,832,400
Non-use values	$ 934,731	$ 2,319,517	$ 0	$ 3,877,402
Sub-total	*$9,393,238*	*$11,531,240*	*$3,016,335*	*$15,709,802*
Wetland owner use values		*Not estimated*		
Total changes valued	**-$5,513,094**	**$ 6,027,999**	**-$4,834,350**	**-$12,869,393**

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

5. Institutional analysis

Bio-economic modelling involves identifying biophysical management strategies that lead to the highest community benefits. Once an optimal strategy in terms of community benefits 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 management strategy 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.[1] Hence there will be a need to transfer some of the benefits received by non-wetland owners to owners of wetlands in order to achieve the wetland management strategy. The output from the economic modelling provides some guidance for developing policies to facilitate incentives for improved wetland management.

5.1 Current incentives

As part of the survey of farmers information about the current incentives received by wetland owners was gathered. Just 21 percent of MRF and 33 percent of USE

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

wetland owners currently receive incentives to undertake wetland management. One USE wetland owner and 2 MRF wetland owners received tax incentives, 3 USE and 9 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 that were desired 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 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 incentive structures

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 institutions generates a set of incentives that, in conjunction with the values held by managers, result in the private decisions that are made. Altering the current set of institutions will change the incentive structure facing resource managers, possibly leading to different outcomes. The challenge is to identify alternative sets of institutions that will improve wetland management and hence increase the benefits to society. Additional information about the institutions and incentives is contained in Research Report 11.

There are broad policy three frameworks that could be used to provide wetland outputs 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;
2. The government could provide an institutional 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); or,
3. The government could provide such an institutional framework and also provide direct incentives to wetland owners to increase production of wetland outputs beyond the level produced by the private sector alone.

Government has historically 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, private sector production can

reduce or avoid the incidence of government failure.[2] Where the government uses regulation to attempt to enforce production (for example 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 institutional 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 well being of society. Hence the third model was adopted in this project.

5.3 Institution and incentive suggestions for the USE

The private and social values of USE wetlands were 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 institutions and incentives need to facilitate a transfer of resources from those who live away from wetlands to wetland owners. Institutions and incentives aimed at achieving this flow were considered at the local, state and federal levels.

The USE wetlands lie within five local government areas. Lands covered by a Heritage Agreement (HA) are exempt from rates in South Australia. As the incentive is designed to ensure production of an output it is recommended that all lands managed primarily for conservation purposes (as defined in a management plan) are eligible for a similar exemption or rate rebate. Sales of conservation land are subject to development applications and may be subject to minimum land parcel sizes. It is recommended that such disincentives are minimised or removed.

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

- development of tourist infrastructure including information about wetlands, 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 USE wetlands tourism organisation that would eventually stand alone.

Reform of property rights covering the resources that are combined in wetlands is generally a State government responsibility. In particular laws that would facilitated 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 increase the incentives to private sector groups to act by reducing the cost of achieving their desired outcomes.

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

[2] 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.

extensions would allow for greater consistency across all types of donation and with other business activities including:

- ensuring large donations can be deducted over a similar time period as business losses;
- ensuring the bargain or discount component of land sales to conservation groups is tax deductible;
- ensuring conservation covenants are tax deductible; 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 well being may be increased by some direct contributions via government. Using strategies that would minimise inefficiencies in tax collection and redistribution and 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 they are either inappropriate or too difficult to claim.
- requiring matching contributions from state government or private sector conservation organisations.
- focusing on binding constraints to management change. The large capital cost of wetland conversion in the USE (comprising fencing, hydrological works and potentially revegetation) provides a significant barrier to wetland owners considering changing wetland management.

Two further issues need to be addressed in incentive design. Firstly, flexibility in applying the incentive regimes suggested above is required in order to maximise the potential for innovation in wetland management. Secondly, the regulatory environment should minimise the disincentives to wetland owners of either changing to, or continuing, wetland management for conservation outcomes.

5.4 Institution and incentive suggestions for the MRF

The private and social values of wetlands in the MRF were shown in Table 10. As in the USE, 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 USE 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. Similar parcel size restrictions also apply. Hence, wetland owners face ongoing costs for wetland management equal to those applied to income generating lands.

Wetland tourism is not likely to become a major industry in the region. Niche tourism markets may exist for wetlands in the area and information for wetland owners wishing to enter these markets is likely to be a useful incentive to foster wetland conservation.

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 USE. 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.

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 the best organisational structure to hold the water title and make decisions about when to flood and when to sell water is a trust.

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

As in the USE, 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.

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 at work that are continuing to result in the degradation of those wetlands. These forces are the result of particular institutional settings that are well established in the community. However, the research has also demonstrated that these institutional arrangements 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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