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River and wetland health in the Lake Eyre Basin – an economic perspective

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Introduction

Many of the world's natural resources form part of the economic sphere, and rivers and wetlands are no exception. For example, considerable amounts of the world's water resources are diverted for irrigated agriculture, providing economic value through production of food and fibre. Many mining developments also use water resources in their production. There are also social, economic and environmental costs of such developments which are often not well accounted for; these are described as externalities and can be a cause of market failure.

Economists include the environment in economic assessments by deriving monetary values. This requires estimation of values for changes in environmental quality, which is often a difficult challenge as natural resources are typically not traded in markets but many policy decisions are influenced by economic values. Rivers and wetlands and their dependent biodiversity have values which need to be measured to provide an open and transparent recognition of the impacts of economic development activities. For example, a key question for the Lake Eyre Basin rivers is to identify the costs and benefits of irrigation or mining developments, two of the highest profile potentially deleterious developments affecting the rivers. There are no economic valuations of the rivers and wetlands in the Lake Eyre Basin, but there is increasing understanding of the importance of identifying the economic value of changes to environment quality in developed rivers. Consequently, I use current understanding of the economic values of the environment for the developed nearby Murray–Darling Basin to illustrate the magnitude of likely values in the Lake Eyre Basin.

Economic values of the environment

There are two types of economic values for the environment: use and non-use values (Morrison and Hatton-MacDonald 2010). First, use value comes from using a good (e.g. water) either directly or indirectly. For example, direct use includes recreation by locals and tourists to the river (see Chapter 13), and amenity value from living near an environment in good condition. Direct use also includes commercial fishing and grazing livestock on the rivers and floodplains of the Lake Eyre Basin (Fig. 18.1; see Chapters 10 and 11). Indirect use values reflect the indirect benefits to people from environmental quality. This might include the organisms in the environment. For example, waterbirds may help control locust plagues; trees provide shade for livestock; and wetlands improve water quality. These direct and indirect use values are often called ecosystem service values.

Fig. 18.1. There are many direct economic benefits from the rivers of the Lake Eyre Basin, including pastoralism and increasingly tourism, with visitors keen to experience the wonder of the outback rivers such as the Thomson River near Longreach (photo, A. Emmott).

Non-use values are different from direct or indirect use of the resource. For example, many people live a long way from the Lake Eyre Basin but they still care about its long-term sustainability, even if they never visit it. For example, people in Brisbane or Sydney may be willing to pay to maintain its quality. This type of value is called an existence or non-use value (Pearce and Markandya 1989). Non-use values occur for several reasons. People might simply value existence; care about it for their children or grandchildren; care that others have the opportunity to experience its environment; or feel it is their stewardship or spiritual responsibility to look after the Lake Eyre Basin. This was indicated during the proposed development of Cooper Creek in 1995 (see Chapter 17), when there was a groundswell of concern from communities around Australia about the potential impact on the values of the Lake Eyre Channel Country (see Chapter 7). These non-use values are likely to dominate any economic value assessment because the people living away from such a remote region dominate the numbers who gain their direct use value from the region.

Together, these use and non-use values make up total economic value. It is possible to identify the total use value for the Lake Eyre Basin rivers and wetlands. We could measure how much income is derived for all of the pastoralists who derive an income from the floods of the Lake Eyre Basin. We could also conceivably measure the impact of tourism from the

Lake Eyre Basin rivers, though neither of these valuation exercises has previously been done. Contrastingly, it is only possible to identify a change in non-use value. Thus economists calculate the total use but their estimate of non-use value focuses on how value changes with a new resource use option. Economists cannot calculate the total use and non-use value of a wetland or river.

Measuring the economic value of the environment

How does an economist estimate the economic values of the wetlands and rivers of the Lake Eyre Basin? There are three broad sets of approaches. First, market-based techniques can be used to estimate economic values for direct and indirect uses of the environment. This includes the productivity approach, which estimates change in economic value. For example, it would be possible to measure the loss of economic value of flooding for grazing in the Channel Country of the Lake Eyre Basin, if irrigation diverted water from the Thomson River upstream. Further, in the group of market-based techniques, replacement or damage costs can be used to estimate values where there is a loss of an ecosystem service and there is a need to develop an alternative to replace the service. For example, destruction or degradation of a wetland may remove its ecosystem service of purifying water or tourist value, requiring a replacement water source. This may require establishing a new water treatment plant or treating water to a higher level of quality where the cost of replacement indicates the value of the resource. This approach could be used in the context of rehabilitating the pollution effects of the Lady Annie Mine (see Chapter 19). Another example is the reductions in flows to the lower River Murray, which required governments to spend more than $2.4 billion, including a desalination plant for Adelaide that was highly reliant on the River Murray for its water supply (Kingsford *et al.* 2011).

The second set of approaches is the revealed preference techniques. These use information from related markets to estimate values. One commonly used technique is the travel cost approach for estimating recreational use values. For example, we can tell something about the recreation value people have for a destination such as a wetland by how much they would spend in getting to their location in terms of travel cost and time. People are clearly prepared to spend a lot of money visiting Lake Eyre (see Chapter 13). We know that as the cost goes up, people tend to visit less often and consequently it would be expected that there may be proportionally less visitation for people further away. This relationship allows estimation of a demand curve for identifying recreation value. A second revealed preference technique is hedonic pricing, which involves using property prices to identify environmental values. An expectation is that house prices change with environmental quality; this technique separates the change in economic value due to changes in environmental quality from the characteristics of the house or community. This informs about the amenity value of the local environment. For example, if there were a decline in the vegetation of the Channel Country along the Diamantina River, this might affect property values.

Finally, there are stated preference techniques, with contingent valuation and choice modelling, the two most widely used. Contingent valuation involves estimating non-market values through directly questioning respondents about their willingness to pay for specific

Table 18.1. Example of choice modelling, comparing different features of river health from the River Murray (based on MacDonald *et al.* 2011). Respondents could be asked to choose one of the three options (A, B, C), assuming this was their only choice.

Features	Maintain current (option A)	Improve quality of the River Murray and Coorong (option B)	Improve quality of the River Murray and Coorong (option C)
Waterbird breeding along the River Murray	Every 10 years	Every seven years	Every year
Native fish	10% of original population	20% of original population	40% of original population
Healthy riverside vegetation	50% of original area	60% of original area	60% of original area
Waterbird habitat in the Coorong	Poor quality	Good quality	Poor quality
Household cost ($/year for 10 years)	$0	$50	$250

options. Respondents are presented with a description of a change (e.g. a project to improve the quality of a wetland), and a question is asked to identify their willingness to pay for this change to occur. Respondents evaluate a single scenario, indicating whether they would vote in favour or against it, or how much they would be willing to pay to achieve the scenario. For example, would you vote in a referendum in favour of every householder in New South Wales paying $100 to restore the Macquarie Marshes, a wetland affected by water resource development (see Chapter 16)?

Choice modelling has become increasingly popular, particularly in Australia. In choice modelling, the goods and questions are described and asked differently to those in contingent valuation. In choice modelling, respondents evaluate several scenarios, defined using a fixed set of attributes which change across scenarios. For example, this may include changes to the area of native vegetation or number of native fish (Table 18.1). Respondents would then choose between alternatives described, using these features and a household cost. Before making such a choice, they would also receive information about the environmental condition of the river, based on the latest current understanding, what has led to any decline, and what options are available to improve environmental quality. These choices are repeated for individuals several times. The repeated choices provide insight into how respondents' choices change with different levels of the attributes and household cost. This provides a measure of how much respondents are willing to pay for each attribute. For example, if increasing the frequency of waterbird breeding by a year has the same effect on the probability of people choosing an option as reducing household costs by $20, this indicates that household willingness to pay to increase frequency of waterbird breeding by a year is on average $20.

Economic value of rivers and wetlands – the Murray–Darling Basin

Wetlands and rivers around the world have considerable economic value, as has been demonstrated using these methods (Brander *et al.* 2006). In Australia, there is also growing understanding of the economic value of wetlands and rivers of the Murray–Darling Basin (Table 18.2).

Table 18.2. Summary of estimates of the economic value of different ecological attributes of wetlands in the Murray–Darling Basin, based on what households are willing to pay (based on Morrison and Hatton-MacDonald 2010).

Ecological attributes	Description	Economic value (per household)	References
Native floodplain vegetation	Additional 1000 ha of healthy vegetation	$1–5	Whitten and Bennett 2001; Morrison and Bennett 2004; Hatton-MacDonald and Morrison 2005; Bennett *et al.* 2008b
	1% improvement in area of healthy vegetation	$2.20–5.70, apart from $13.72 for River Murray	Morrison and Bennett 2004; Rolfe *et al.* 2006; Bennett *et al.* 2008a
Native fish species and populations	Native fish species present 1% increase in native fish populations	$3.30–3.50 per species $0.50–5.10, apart from $15.40 for River Murray	Morrison and Bennett 2004 Whitten and Bennett 2001; Bennett *et al.* 2008a; Bennett *et al.* 2008b
Waterbird breeding	Willingness to pay to increase the frequency of colonial waterbird breeding in major wetlands in the Murray–Darling Basin	$14–34/year (increased frequency), apart from $65/year for River Murray	Morrison *et al.* 1999; Morrison 2002; Morrison *et al.* 2002
Waterbirds and other species	Habitat for endangered/ protected/ threatened species Number of waterbirds and other species with sustainable populations	$4.3–7.4 per species $3.9 per species	Morrison 1999; Whitten and Bennett 2001; Morrison 2002; Morrison *et al.* 2002; Morrison and Bennett 2004 Bennett *et al.* 2008a

Using the value estimates presented in Table 18.2, economic values for the different attributes of wetlands and rivers were identified for each of the 19 catchments of the Murray–Darling Basin (Table 18.3). These values were extrapolated across households in the state in which the catchment was predominantly located, except for the River Murray where estimates were for all states and territories.

These value estimates were then used to identify the economic benefits associated with the Murray–Darling Basin Plan (Centre for International Economics 2011). This involved collecting background information for each of the catchments in the Murray–Darling Basin about how much different ecological attributes were improved by the Murray–Darling Basin Plan, which included increasing water for the environment. The expected change in each ecological attribute was then multiplied by the household value for a unit change, in each of the attributes, and then by the number of households, after adjusting for non-respondents. The least conservative approach for aggregating economic value assumed that all households in the state where a catchment was located had the average sample value. Non-respondents to

Table 18.3. Estimates of economic values in dollars per household (present value, NA = not applicable) of four ecological attributes of the 19 catchments in the Murray–Darling Basin (Morrison and Hatton-MacDonald 2010).

Catchment	Ecological attribute			
	1% increase in native vegetation	1% increase in native fish populations	One-year increase in frequency of colonial waterbird breeding	Unit increase in number of waterbirds and other species present
Barwon–Darling	2.26	0.46	13.87	2.25
Border Rivers	2.19	0.46	NA	1.10
Campaspe	5.69	5.06	NA	3.89
Condamine–Balonne	2.63	0.46	13.87	1.10
Mt Lofty Ranges	5.69	5.06	NA	3.89
Goulburn–Broken	5.69	5.06	NA	3.89
Gwydir	2.19	0.46	13.87	1.10
Lachlan	2.19	0.46	13.87	1.10
Loddon–Avoca	5.69	5.06	NA	3.89
Macquarie–Castlereagh	2.19	0.46	33.08	1.10
Moonie	2.63	0.46	13.87	1.10
Murray	13.72	12.80	65.11	3.43
Murrumbidgee	2.26	0.46	13.87	2.25
Namoi	2.19	0.46	NA	1.10
Ovens	5.69	5.06	NA	3.89
Paroo	2.63	0.46	13.87	1.10
Snowy Mountains Scheme	NA	NA	NA	NA
Warrego	2.63	0.46	NA	1.10
Wimmera	2.19	0.46	NA	1.10

the survey were unlikely to have the same economic value as respondents and so adjustments were made for this (Morrison and Hatton-Macdonald 2010). Values were aggregated only for the Murray River, across Australian households in all states and territories. However, sensitivity analysis determined the effects of either fully or partly extrapolating values for these wetlands, to households outside their state. Most of the value estimates were for single-year payments. In the few cases where willingness to pay involved payment over more than one year, amounts in later years were discounted and summed. This allowed an estimation of non-use values across the Murray–Darling Basin and produced a range of non-use values for a unit change in each of the four attributes, after aggregation across households (Table 18.4).

Such estimates allowed policy-makers to consider the economic benefit for the environment, of providing more water (i.e. improving the rivers which were seriously degraded), across the 19 river catchments. Each value estimated the non-use value for the community of a unit change in the attribute, such as a 1% change in native fish populations.

Table 18.4. Estimated economic values ($) per household (present value, NA = not applicable) of improvements in four ecological attributes for each of 19 river catchments, across the Murray–Darling Basin (Morrison and Hatton-Macdonald 2010).

For all catchments apart from the River Murray, values (Table 18.3) were aggregated across all households in the state where the catchment was located (with an adjustment for non-respondents).

Catchment	Ecological attribute			
	1% increase in native vegetation	1% increase in native fish populations	1 year increase in frequency of colonial waterbird breeding	Unit increase in number of waterbirds and other species present
Barwon–Darling	$3 594 000	$667 000	$24 693 000	$3 578 000
Border Rivers	$2 437 000	$414 000	NA	$1 086 000
Campaspe	$3 363 000	$2 990 000	NA	$2 299 000
Condamine–Balonne	$2 926 000	$414 000	$15 337 000	$1 086 000
Mt Lofty Ranges	$1 494 000	$1 329 000	NA	$1 022 000
Goulburn–Broken	$5 019 000	$4 463 000	NA	$3 431 000
Gwydir	$3 482 000	$667 000	$24 693 000	$1 749 000
Lachlan	$3 482 000	$667 000	$24 693 000	$1 749 000
Loddon–Avoca	$3 363 000	$2 990 000	NA	$2 299 000
Macquarie-Castlereagh	$3 482 000	$667 000	$58 802 000	$1 749 000
Moonie	$1 961 000	$277 000	NA	$728 000
Murray[a]	$79 098 000	$73 794 000	$375 369 000	$12 203 000
Murrumbidgee	$3 594 000	$667 000	$24 693 000	$3 578 000
Namoi	$3 482 000	$667 000	NA	$1 749 000
Ovens	$3 363 000	$2 990 000	NA	$2 299 000
Paroo	$2 598 000	$414 000	$15 337 000	$1 086 000
Snowy Mountains Scheme	NA	NA	NA	NA
Warrego	$2 598 000	$414 000	NA	$1 086 000
Wimmera	$2 660 000	$509 000	NA	$1 336 000

[a] Values from Table 18.3 were aggregated across all Australian households (with an adjustment for non-respondents).

To make use of these value estimates in a cost–benefit analysis, changes in attributes needed to be estimated, along with changes in policy position. For example, if native fish populations in a catchment changed by 10%, due to improvements in fish habitat, then the estimate (Table 18.4) for the appropriate catchment needed to be multiplied by 10.

In addition, the recreation values in each catchment have economic value, which can be estimated where identifiable. General recreation was valued at $55.40 per trip; recreation at dams or lakes was valued at $35.98 per trip; recreational trips at wetlands ranged from $270.13 to $561.28 per trip; while fishing at dams or lakes was valued at $355.90 per trip.

To calculate the aggregate change in recreation value, the change in the total number of visits would need to be calculated and then multiplied by the appropriate value. Changes in recreation value can be added to the change in non-use values to calculate the change in total

Fig. 18.2. The Coorong, Lower Lakes and Murray Mouth are listed as a wetland of international importance with environmental values, with significant economic values (Tables 18.5 and 18.6).

economic value. Values for the Coorong wetland were estimated separately, given its significant economic value, with an improvement from poor to good quality estimated to deliver $4.3 billion in non-use value (MacDonald *et al.* 2011).

The Centre for International Economics (2011) subsequently estimated the economic value of environmental benefits from the Murray–Darling Basin Plan. In this cost–benefit analysis, values were included only for changes in native fish populations, the frequency of waterbird breeding and the state of the Coorong, Lower Lakes and Murray Mouth (Fig. 18.2) because of a lack of ecological response data for the other ecological attributes. Aggregate value estimates (net present benefit) were $3750 million for a 3000 GL/year reallocation, $4760 million for a 3500 GL/year reallocation, and $5430 million for a 4000 GL/year reallocation of irrigation water to the environment, excluding an improved Coorong, which increased the overall estimate to $9704 million. Improvement in the state of the Coorong (from poor to good) was expected to occur only for the 4000 GL/year reallocation. Sensitivity analyses were done, including using alternative value estimates (Van Bueren and Bennett 2004) and a meta-analysis (Rolfe and Brouwer 2011).

Overnight visitor numbers were respectively estimated to increase for different scenarios of returning annual environmental flows to the Murray–Darling Basin: 113 452 for 3000 GL/year, 133 463 for 3500 GL/year and 153 212 for 4000 GL/year. These changes in visitation were combined with value estimate of $585 per overnight trip to derive the aggregate change in recreation value. Other estimates were derived for changes in costs associated with salinity, flooding and dredging. As a result, it was possible to estimate the

Table 18.5. Increases in non-use and use values and decreases in irrigated agricultural economic values (NA = not available), for three scenarios of water returned to the environment, evaluated in the cost–benefit analysis for the Murray–Darling Basin Plan (Centre for International Economics 2011).

Economic value	Cost ($x million) of environmental flow scenarios			
		3000 GL	3500 GL	4000 GL
Non-use values	Values for changes in fish population and waterbird breeding	$3750	$4760	$5430
	Values for the Coorong	NA	NA	$4274
Use values	Recreation	$490	$562	$649
	Salinity	$91	$87	$84
	Cost of flooding	$2	$2	$2
	Cost of dredging	$13	$14	$14
Irrigated agriculture[a]	Lower estimate	$924	$1107	$1309
	Higher estimate	$4491	$5789	$7329

[a] Lower cost estimates resulted from assuming and elasticity of demand of -0.5 for water (i.e. more elastic, so reduced water availability had less effect on water prices) and there was no baseline growth in the real price of water. High cost estimates resulted from assuming that there was an elasticity of demand for water of -0.05 (i.e. more inelastic demand, so reduced water availability had an increased effect on water prices) and that the baseline real price of water grew by at ~8%/year.

increase in non-use and use values and decreases in economic value from irrigated agriculture, resulting from the redirection of water from irrigated agriculture to the environment of 3000–4000 GL/year (Table 18.5). The Australian Government agreed to return 2750 GL/year to the environment under the Murray–Darling Basin Plan, although this figure is recommended to be further reduced by 70 GL/year in the Darling River catchments (Murray–Darling Basin Authority 2016).

A 3000 GL/year increase in environmental flows substantially increased use and non-use values (over $3300 million), which exceeded the lower estimate for costs to irrigated agriculture (Table 18.5). Even when high costs to irrigation were used, use and non-use values were only $145 million less (Table 18.5). Similar results held for a 3500 GL/year reallocation, with an increased cost to irrigation, using the high estimate (Table 18.5). For the 4000 GL/year increase in environmental flows, including values from improvement of the Coorong and Lower Lakes, the use and non-use values substantially exceeded both the lower and higher irrigation cost estimates, by $9.1 billion and $3.1 billion respectively (Table 18.5).

This evaluation excluded various non-use values associated with improved environmental quality, including changes in vegetation, waterbirds and other organisms. It also excluded other use values. For example, the evaluation did not include the value of grazing to the livestock industry, resulting from increased flooding (Chapter 11). For example, 15 years of flooding added $6.8 million in gross profit to three grazing properties on the Paroo River (Arche Consulting 2010). There were also insufficient data to apply this more widely across the entire river basin.

Given considerable challenges in identifying the full range of environmental benefits for cost–benefit analysis of the Murray–Darling Basin Plan, CSIRO and researchers from several universities evaluated changes in ecosystem service values of the Murray–Darling Basin, with different scenarios of increased environmental flows for the Murray–Darling

Basin Plan (Prosser *et al.* 2012). This involved consideration of the return of 2800 GL/year of environmental water, less reallocation than previously modelled but close to the final provision in the Murray–Darling Basin Plan (2750 GL/year). They identified a wide range of ecosystem services benefiting from increased environmental flows (Table 18.6). Carbon sequestration was one of the large-valued ecosystem services (Table 18.6). Other values of erosion prevention and household salinity were smaller. There were also substantial changes to amenity value, with property prices near Barmah–Millewa Forest, the Lower Darling river system, the Mid-Murrumbidgee River Wetlands and Lake Alexandrina increasing overall by $353 million, due to increased river flows. Increased values for tourism were identified, with more flows along the River Murray adding $161 million/year (Table 18.6) to the present value of $490–649 million, previously calculated (Centre for International Economics 2011).

Substantial use values were either excluded or underestimated in the first cost–benefit analysis of the Murray–Darling Basin Plan (Centre for International Economics 2011), compared to the subsequent estimates (Prosser *et al.* 2012), which included values for carbon sequestration, changes in property prices and recreation (Table 18.6).

Neither study aggregated the individual value estimates produced across the Murray–Darling Basin. Using Prosser *et al.* 2012, this would have produced an estimated

Table 18.6. Estimates of economic value of ecosystem services in the Murray–Darling Basin in response to improved flows in the rivers with 2800 GL/year of water reallocated from irrigated agriculture to the environment (Prosser *et al.* 2012).

Ecosystem service	Estimated value ($x million)	Description[a]
Carbon sequestration	126–1041	Present value
Erosion prevention	23.8	Present value
Reduced household costs from salinity	3.1	Annual
Reduced agricultural costs from salinity	29	Annual
Recreation benefits from reduced blackwater events	5–10	Annual
Reduction in acid sulphate soil	9.2	Annual
Reduction in costs of dredging the Murray Mouth	3.6	Annual
Increased property prices	311 (Coorong, Lower Lakes and Murray Mouth) 15.5 (Lower Darling river system) 1.3 (Barmah–Millewa Forest)	Present value
Tourism on the River Murray	161	Annual
Non-use values[b]	$7.7 billion (return of 2800 GL/year, including the Coorong) $3.4 billion (return of 2800 GL/year, excluding the Coorong) $3.9 billion scenario 3 (return of 2800 GL/year, with values for the Coorong adjusted by ecosystem state)	Present value

[a] 'Present value' refers to the current value of the future stream of benefits. 'Annual value' refers to the value of the benefits that will occur each year.
[b] Increased value from native vegetation, native fish populations and frequency of waterbird breeding, and improved quality of the Coorong.

total economic value of $6.2–11.5 billion, with the increased 2800 GL of environmental water each year. This contrasts with the aggregate value of $4.4 billion (Centre for International Economics 2011), estimated for return of 3000 GL of environmental water each year. The increased valuation relates to increased knowledge of the considerably increased economic benefits from improving or maintaining environmental quality, through water reallocations.

Implications for the Lake Eyre Basin

There are challenges in valuing river and wetland health in the Lake Eyre Basin, with no previous environmental valuation studies. There is also no policy need to improve degraded wetlands and rivers, such as in the Murray–Darling Basin. But the principles remain the same. It is critical to understand the real economic values to the community of use and non-use environmental values, such as those identified in the Murray–Darling Basin (Table 18.6). Relatively few people live within the Lake Eyre Basin and so there are limited direct or indirect use economic values, except for grazing (see Chapters 10 and 11) and tourism (Chapter 13). However, the Lake Eyre Basin is a unique and iconic system and so there are likely to be significant non-use values. Some understanding of the potential economic values can be gained through benefit-transfer from the Murray–Darling Basin. For a free-flowing river system such as in the Lake Eyre Basin, the decision will primarily be whether to allocate water resources from the environment, such as irrigation or mining (see Chapter 22), and should be made using a cost–benefit analysis.

There is high economic value from irrigation in the nearby Condamine ($457 million/year) and Border Rivers ($245 million/year) in the Queensland (Nguyen *et al.* 2012) part of the Murray–Darling Basin. This gross value cannot simply equal the value of irrigation. It does not take account of the change in the productivity of the land from use of irrigation, nor does it take into account environmental costs. It also does not adequately measure the downstream impact on other economic uses of water (see Chapters 14 and 15) and neither does it adequately include the costs of building and maintaining large public infrastructure, such as dams or the costs of regulating and managing the river for irrigation. These are all government subsidies for irrigation. Currently, the economic value of irrigation is low from the Lake Eyre Basin rivers because of the relatively small amounts of active irrigation and absence of a large dam.

The development of mining projects, including coal mines and coal seam gas (CSG) projects, could also affect the connectivity of wetlands and river flows (see Chapter 22), with other associated environmental costs, impacting on river health (see Chapter 19). Using Computable General Equilibrium (CGE) modelling, gross regional product was predicted to increase by about $470 million/year with the development of the CSG industry in north-west New South Wales (Williams *et al.* 2012) – an estimate which did not include environmental costs.

Given the current understanding of the environmental values and costs of the Murray–Darling Basin development, environmental costs from development of the Lake Eyre Basin rivers will also be substantial. Use values, such as grazing, are substantial but remain largely unquantified, while non-use values are likely to be considerable given its iconic status (see Chapter 7). There are also considerable recreation values, given the amount of tourism and the distances people are willing to travel (see Chapter 13). The costs to the environment will not be just the cost to Lake Eyre, but also the cost in the decline in river health in its unique rivers: Cooper Creek, and the Diamantina and Georgina Rivers. There are also likely to be impacts on cultural values, both Aboriginal (see Chapters 8 and 9) and European. Consequently, development of either irrigation or mining resources in the Lake Eyre Basin will probably come with considerable costs that need to be adequately accounted for, not just the economic values of outputs.

Conclusion

I have outlined the nature of economic values for the environment and how they can be estimated. Economic value estimates for improved river health have been estimated for the Murray–Darling Basin, where they are related to improved flows in a highly regulated river system. Apart from this, it has many similar environmental values to the Lake Eyre Basin, providing a useful comparison. The estimation of the benefits of returning water to the Murray–Darling Basin have shown there are considerable economic values for the environment of the Murray–Darling Basin, which would probably be similar for the Lake Eyre Basin. Non-use values dominated in the Murray–Darling Basin, but there were also substantial economic values resulting from ecosystems services, also known as direct and indirect use values. Given the relatively marginal value of intensive agriculture in the Lake Eyre Basin, and the lack of a major dam, the additional economic value from establishing irrigated agriculture would be unlikely to exceed the economic costs. Similarly, the economic value of additional coal or CSG mining developments, particularly given the downward trajectory of coal prices and gas prices, is unlikely to exceed the economic costs from reduced environmental quality where it affects the rivers of the Lake Eyre Basin.

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