



How much is the environment worth?

Catchment management decisions in NSW

by Jeff Bennett with Ian Close

How much is protecting an endangered species worth? How much should we spend to make sure that native bush stays in good condition? And how much are we willing to pay for healthier rivers in 20 years' time? These are some of the difficult questions catchment managers regularly face.

Some people might argue that environmental assets are priceless and that it is wrong to put a price on saving a species, or protecting a forest or waterway. They believe putting a price on them only subjects them to greater development pressures.

In reality, decisions are continually being made that weigh up environmental protection and development. Putting a value on environmental resources doesn't make any decision outcome any more or less likely. It merely makes the decision process transparent.

The Catchment Management Authorities

There are 13 catchment management authorities (CMAs) in NSW, set up by the state government in 2004. The CMAs work



Lachlan catchment

in partnership with farmers, Aboriginal communities, local groups, local government, industry and state government agencies to develop and implement natural resource management (NRM) programs for their catchments.

CMAs receive funding from both Commonwealth and state governments to spend on natural resource improvements in their catchments. Each CMA decides how to spend its funds to meet government priorities.



Wollondilly River in the Hawkesbury-Nepean catchment

Making the most of public funds

A major issue for every CMA is how to allocate its limited share of public funds for its own large wish-list of NRM projects. It's not just a matter of predicting the environmental improvements that will flow from the project. It also involves assessing the values placed on those environmental improvements by people both in the catchment and those living outside.

While the costs of NRM projects are relatively easy to identify, the prospective benefits are not. Because most of the benefits are environmental outcomes they are complex to quantify and compare.

If the ultimate goal of the NRM projects is to achieve the best value for the public's

money from the community's perspective, this will inevitably involve trading off outcomes. So how should the decisions be made to achieve this goal?

Choice modelling

One of the methods increasingly being used to help in environmental decision making is choice modelling. Respondents to a choice-modelling survey are given sets of hypothetical choices which are used to assess a community's willingness to pay for environmental benefits. Unlike other willingness-to-pay methods, where respondents are asked directly what they would be willing to pay for a particular



environmental outcome, choice modelling draws out the information indirectly through a process of observing trade-offs made by the respondents across a sequence of choices.

Choice modelling is based on the idea that any good – or in the catchment management



Regent honeyeater

case, environmental or social asset – can be broken down to a number of ‘attributes’. NRM outcomes can be described in terms of number of native species, the length of healthy waterways, and the number of people employed in agriculture.

Each of these attributes can take on different levels. Respondents are asked to choose between a number of options, or baskets, containing environmental and socio-economic attributes at different levels. The basket in each option will have a particular cost expressed, for example, as an annual household payment in the form of increased taxes, rates and prices over five years.

By choosing a particular basket of goods at a particular cost over the other baskets, respondents indirectly reveal the value they give each of the attributes. Choice modelling allows us to assess trade-offs between environmental and non-environmental goods – for example, a trade-off between employment on one hand and, on the other,

The catchments

Location and extent:

- **Namoi.** Extends from the Great Divide in the east to the Barwon River at Walgett in the west, linking the cities of Tamworth, Manilla, Gunnedah and Narrabri. The river flows 350 kilometres from the south-east to north-west, much of it through the rich black soils of the Liverpool Plains. It covers some 42 000 square kilometres.
- **Lachlan.** Rises near Goulburn and flows west for more than 600 kilometres. The catchment includes the centres of Cowra, Forbes, Parkes, Condoblin and West Wyalong, and terminates in the Great Cumbung Swamp near Oxley. The Lachlan notionally flows into the Murrumbidgee River but is connected only when both rivers are in flood. At 84 700 square kilometres, the catchment is the largest of the three. It is unique in the Murray Darling Basin in the way it terminates in wetlands and diverging creeks.
- **Hawkesbury-Nepean.** Extends from Goulburn in the south to Lithgow in the west and Cessnock in the north. The catchment drains into the ocean at Broken Bay and provides most of the drinking water for Sydney and surrounding regions – 70 per cent of the NSW population. It covers 22 000 square kilometres and is home to a million people.

Land use:

- **Agricultural.** Some 90 per cent of the Namoi and Lachlan is agricultural – mostly grazing. Only about a third of the Hawkesbury-Nepean is agricultural and a fifth is urban.
- **Parks and reserves.** Varies from four to five per cent in the two western catchments to 50 per cent in the Hawkesbury-Nepean.
- **Native vegetation.** Covers about 30 to 40 per cent of the Namoi and Lachlan with only around a fifth of it in good condition. The Hawkesbury-Nepean on the other hand is more than two-thirds native vegetation with around half in good condition.

Drinking water, fishing and swimming:

Only about 20 per cent of the rivers and streams in the Namoi, 15 per cent in the Hawkesbury-Nepean and 10 per cent in the Lachlan are good enough for drinking, fishing and swimming.

Threatened species and ecological communities:

There are more than 300 threatened species and ecological communities in the Hawkesbury-Nepean, with more than 100 in each of the Namoi and Lachlan.

Environmental issues:

All three catchments face similar environmental problems including declining biodiversity, loss of native vegetation, erosion, weeds and reduced water quality. The Hawkesbury-Nepean also has issues relating to urban expansion, while the Namoi is faced with peri-urbanisation in the top end of the catchment around Tamworth, and proposed mining and gas developments on the Liverpool Plains.



an increase in the area of good-condition native forest and length of healthy waterway. These trade-off values are the strength of choice modelling over other willingness-to-pay models.

Choice modelling gives us four important pieces of information:

- the attributes that are significant determinants of the values that people place on the environmental and socio-economic assets;
- the implied ranking of these attributes between different groups of survey respondents;
- the value of changing more than one of the attributes at once (for example, if a project results in a particular increase in the total kilometres of healthy streams

but a reduction in the number of people employed in agriculture); and

- by extension, the total economic value of a change in a good or environmental asset caused by an NRM investment.

The choice-modelling studies

The Namoi, Lachlan and Hawkesbury-Nepean CMAs were chosen in 2008 for a willingness-to-pay study using choice modelling.

The survey

Study respondents in separate sub-samples from each of the three catchments were asked questions about their willingness to pay for benefits in a particular catchment (not necessarily their own). As an 'urban

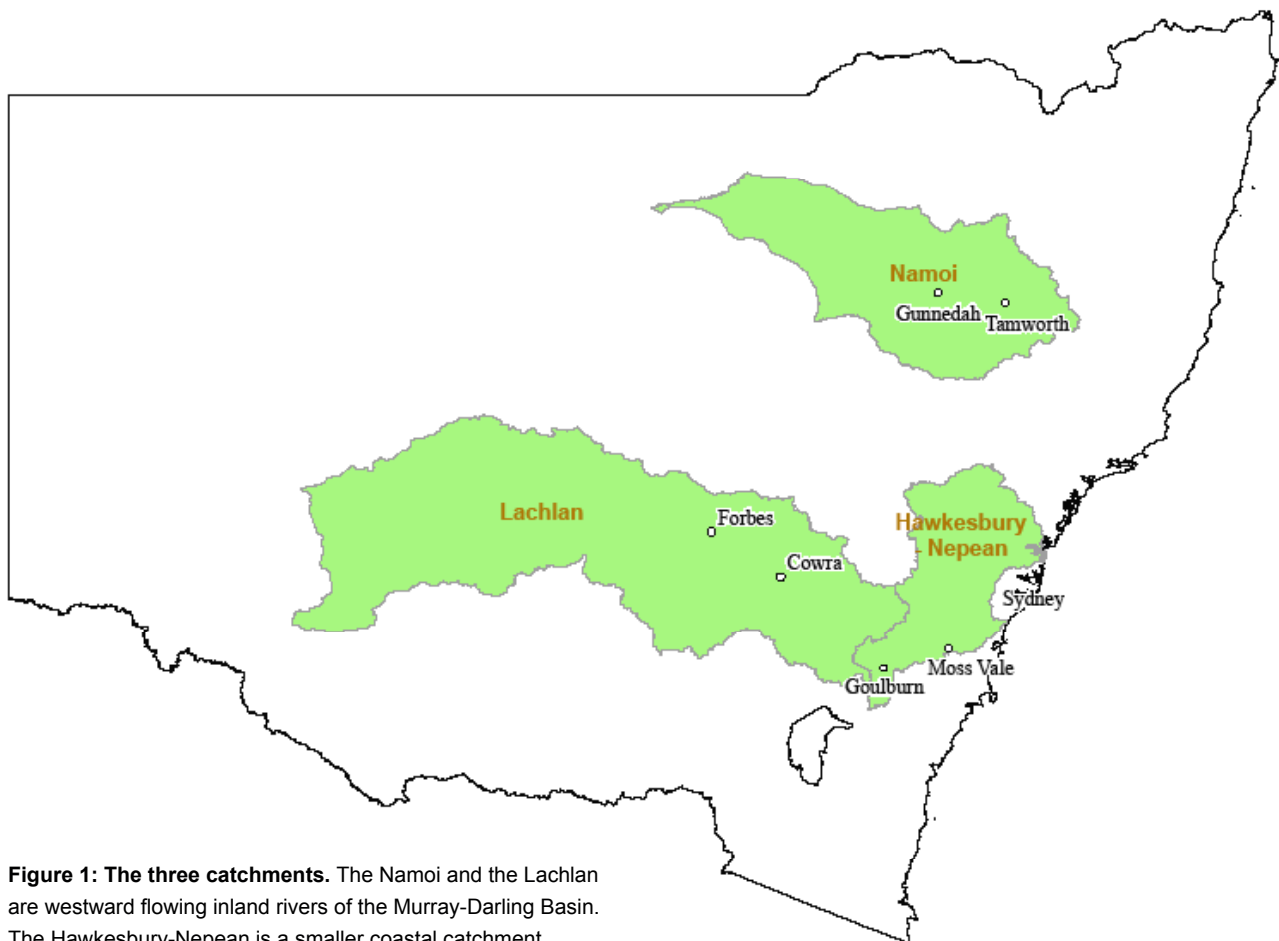


Figure 1: The three catchments. The Namoi and the Lachlan are westward flowing inland rivers of the Murray-Darling Basin. The Hawkesbury-Nepean is a smaller coastal catchment.



Questionnaire about:	Number of Hawkesbury-Nepean respondents (from Goulburn and Moss Vale)	Number of Namoi respondents (from Tamworth and Gunnedah)	Number of Lachlan respondents (from Cowra and Parkes)	Number of Sydney respondents	TOTAL respondents
Hawkesbury-Nepean	284	296	–	278	858
Namoi	–	268	284	255	807
Lachlan	275	–	314	275	864

Table 1: Design of the nine survey respondent sub-samples. The sample groups were discrete. For example, the Namoi respondents questioned about the Hawkesbury-Nepean catchment were a separate group to those questioned about the Namoi catchment.

control', Sydney residents were also surveyed in separate sub-samples about one of the three catchments.

Running the study in three catchments had the advantage that the results could be tested for 'location effect'. Questions about each catchment were given to three groups – a set of local respondents, a set of respondents from one of the other catchments, and a set from Sydney.

While the sampling was carried out through a randomised drop-off/pick-up approach, it was geographically stratified to ensure that the respondents were representative of the relevant population in terms of their age, gender, education attainment, income, household size, and association with environmental organisations and agricultural industries.

The results provide useful information for policy makers on the extent to which preferences are local, regional or more widespread, and whether investment funding might come from local, state or national sources.

As indicated in Table 1, about 800 to 860 people were surveyed about each catchment. The respondents were split more or less equally between people living in the catchment being surveyed, people in another catchment and people from Sydney. They were each given five scenarios and asked to choose between three options in each scenario. Each of the three options was a basket of attributes for the catchment providing a different level of:

- square kilometres of good-condition native vegetation in 20 years' time;
- numbers of native species in 20 years' time
- kilometres of healthy waterways in 20 years' time;
- numbers of people working in agriculture in 20 years' time; and
- an annual household cost to be paid for five years to achieve the above levels of attributes.



Gang-gang cockatoo

These attributes, their wording, the time frames and the structure of the questions were carefully developed in focus groups.

The 'people working in agriculture' attribute was considered important because feedback from the focus groups suggested people wanted to know the social effects of protecting more species or improving more waterways.



Namoi catchment

The five-year time period for the additional household cost was considered a plausible timeframe – enough to make a difference but not a permanent tax.

First option

In each question the first option was always a ‘no-new-action’ and ‘no-cost’ option. The level of attributes for this option was determined in consultation with policy makers and scientists in the CMA being surveyed. For the Namoi, for example, this represented 1800 square kilometres of good-condition native forest, 2100 native species, 1900 kilometres of healthy rivers and 5000 people working in agriculture.

Note that the no-new-action option is not

the same as the current condition as no action can lead to environmental (and employment) decline. In most cases, the no-new-action option resulted in a decline in numbers of native species, length of healthy waterways and numbers of people in agricultural employment (but no change in area of good-condition native vegetation).

Second and third options

The attribute levels for the second and third options in each scenario were also developed carefully with specialists from the relevant CMA and were then systematically mixed. One option, for the Lachlan for example, included for a cost of \$200 a year:



‘Consider each of the following three options for managing natural resources in the Hawkesbury-Nepean catchment. Which one would you choose?’		Area of native vegetation in good condition (km ²)	Number of native species	Kilometres of healthy waterways (km)	Number of people working in agriculture
		Condition now			
		10 500	3000	630	8000
OPTIONS		Condition in 20 years			
	My household payment over 5 years				
A – no new actions	\$0	10 500	2970	600	7000
B	\$200	12 000	2980	750	7200
C	\$300	11 000	2980	700	7200

Table 2: A question developed for one of the Hawkesbury-Nepean surveys showing the sort of choices faced by respondents. Each of the three sub-samples of respondents questioned about this catchment (see Table 1) were given different questionnaires with a different mix of options. This systematic mixing of a large number of options provides much of the statistical strength behind the choice modelling methodology.

- a 90 per cent increase in the area of good-condition native vegetation compared to the current condition;
- a loss of 10 native species (down 0.5 per cent);
- a 50 per cent increase in length of healthy waterways; and
- a 7 per cent decline in agricultural employment.

Another option for the Lachlan, for \$50 a year, had:

- a doubling of native vegetation;
- no change in numbers of native species;
- a 36 per cent increase in healthy waterways; and
- a 7 per cent drop in agricultural employment.

Difficult choices

Because the amount of information to be considered by the respondent is high for this type of survey, each respondent was only asked about one catchment. They were given a poster showing a map of the catchment that explained the land uses and the general NRM background and issues. Respondents were each given only a relatively small number

of questions and choices. Respondents were placed in the difficult position of having to make choices between differing levels of benefits for different social and financial costs.

This deliberate trading off of desirable and undesirable outcomes is the core of choice modelling.

Survey results

The nine sub-samples of surveyed respondents were analysed separately.

Namoi catchment

The **Namoi** respondents were more likely to choose NRM options that increased the level of native species and healthy waterways within their own catchment. They were not concerned about the impact of the loss of agricultural jobs in the catchment.

The **Lachlan** respondents were concerned about the decline of good-quality native vegetation in the Namoi catchment but not about the other attributes.

The **Sydney** respondents preferred NRM options that increased the level of native vegetation and native species in the Namoi.



Location of respondents	Area of native vegetation in good condition (km ²)	Number of native species	Kilometres of healthy waterways (km)	Number of people working in agriculture
Values for Namoi				
Namoi	ns	\$2.50	\$0.11	ns
Lachlan	\$0.02	ns	ns	ns
Sydney	\$0.02	\$2.43	ns	ns
Values for Lachlan				
Lachlan	\$0.01	\$4.51	\$0.83	\$0.27
Hawkesbury-Nepean	ns	\$7.45	\$1.29	ns
Sydney	\$0.02	\$8.11	ns	ns
Values for Hawkesbury-Nepean				
Hawkesbury-Nepean	ns	\$6.97	\$0.90	ns
Namoi	ns	\$4.97	\$0.84	ns
Sydney	\$0.06	\$5.25	\$1.10	ns

Table 3: Willingness-to-pay values for the different catchments. (ns = value was not statistically significant)

Lachlan catchment

The **Lachlan** respondents were more likely to choose NRM options that increased the level of native species and healthy waterways. They were also concerned about the extent of quality native vegetation. They were the only sub-sample concerned about the impact of the loss of agricultural jobs in the region.

The **Hawkesbury-Nepean** respondents were concerned about native species and healthy rivers in the Lachlan catchment.

The **Sydney** respondents preferred NRM options that increased the level of native vegetation and native species in the Lachlan.

Hawkesbury-Nepean catchment

The **Hawkesbury-Nepean** respondents were more likely to choose NRM options that increased the level of native species and healthy waterways. They were not concerned about the decline in native vegetation (possibly because their catchment is well-endowed with native forest) or the impact of the loss of agricultural jobs.

The **Namoi** respondents were concerned

about the decline of native species and healthy waterways in the Hawkesbury-Nepean catchment but not the other attributes.

The **Sydney** respondents preferred NRM options that increased the level of native vegetation, native species and healthy waterways.

Willingness to pay

As one of the attributes used in the survey was cost, it is possible to analyse the respondents' willingness to pay (the 'implicit price') for each attribute (see Table 3).

The table shows the attributes that were statistically significant at the five per cent level. Attribute values that were not significant were ignored.

The willingness-to-pay values for the Namoi catchment, for example, show how the table can be interpreted. Those living in the Namoi catchment were willing to pay for both maintaining/increasing the numbers of native species and kilometres of healthy waterways. This is expressed as \$2.50 per respondent for each additional native species and 11 cents per respondent for each



Lachlan catchment

additional kilometre of healthy river.

To extrapolate from these figures, Namoi residents are willing to pay \$12.50 (spread over five years) to save one threatened native species multiplied by the number of households in the catchment and the response rate of around 30 per cent, and discounted for time.

This provides a present value for each threatened native species re-introduced to the region to residents in the Namoi catchment. The significant value also ascribed by Sydney residents to native species in the Namoi can likewise be extrapolated to provide a wider community value to protecting native plants and animals in the catchment.

A similar exercise can be carried out

in relation to increasing the length of healthy waterways in the Namoi. Ten kilometres of river (for example) x 11 cents a year for five years = \$5.50 x the number of households in the catchment discounted for time and the response rate of around 30 per cent.

Since respondents outside the Namoi catchment did not value healthy waterways to a significant level, no extrapolation can be done beyond the regional level for this attribute.

Native vegetation

Five of the nine respondent sub-samples gave a significant value to saving and restoring native vegetation. Only one of the three groups surveyed about their own catchment (Lachlan



respondents) valued the native vegetation in their own catchment.

The amount that Namoi and Hawkesbury-Nepean respondents were willing to pay for maintaining/increasing good-condition native vegetation in their own catchments was not statistically significant.

The three Sydney respondent groups valued the native vegetation of all three catchments.

Possibly these results represent the phenomenon of valuing what you don't have, and not valuing what is on your doorstep.

Native species

All the respondent samples bar one – Lachlan respondents in relation to the Namoi – expressed a willingness to pay to protect threatened native species.

The significant values from the respondents outside each catchment suggest a widespread community connection with protecting threatened native species anywhere in the state and not just in one's own area. The values here can be used to extrapolate a wider community willingness to pay.

Respondents in all three catchments were willing to pay to save native species in the Hawkesbury-Nepean catchment.

Healthy waterways

Six of the nine respondent groups saw significant value in improving the condition of rivers and streams. Residents of each catchment gave significance to this attribute in their own catchment.

All respondent groups surveyed about the Hawkesbury-Nepean catchment valued an increase in healthy waterways in that catchment – perhaps recognising the unique position of the Hawkesbury-Nepean in supplying water to more than two-thirds of the state's population.

Both Hawkesbury-Nepean and Lachlan respondents put a greater value on healthy rivers and streams in the Lachlan catchment than people from Sydney.

Agricultural employment

This was the least significant attribute in terms of willingness to pay among all respondent groups. The only respondents willing to pay to reduce job losses in agriculture were those from the Lachlan in relation to their own catchment.



Hawkesbury-Nepean catchment

Measuring community value

Choice modelling provides each CMA with a present value for each of the statistically significant attributes in that catchment. The CMA can say with some statistical validity that this is the value placed by the community on that particular attribute.

If the cost of carrying out the improvements needed to achieve the particular attribute level is less than the value the community places on that level of attribute, the CMA can claim it is a good investment.

The process also allows CMAs to evaluate past projects – whether there was, for example, a net benefit in fencing a particular



area of remnant native forest or revegetating a particular length of riverbank.

Like the values given to the attributes by local respondents, the significant values from the respondents in other areas can be



Peel River in the Namoi catchment

used to extrapolate a community willingness to pay to add to the value provided for locals. This can be important in arguing for regional, state or national funding for catchment programs.

Choice modelling allows CMAs to measure community attachment to values both within the catchment and further afield. Knowledge of these willingness to pay values can only improve the way a CMA chooses projects and sets priorities.

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