



How much is the environment worth?

Catchment management decisions in the Hawkesbury-Nepean

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 (CMA)

There are 13 catchment management authorities (CMAs) in NSW, set up by the state

government in 2004. The CMAs work 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.

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 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 observed 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 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 relative 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, 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 case studies

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

The Hawkesbury-Nepean

Aaron Smith is a catchment coordinator with the Hawkesbury-Nepean Catchment Management Authority. He grew up in the Central Tablelands, has an agricultural science background and has worked for the CMA since its inception. He manages projects in the



Warragamba area of the catchment.

'In setting priorities under our catchment action plan, we saw the choice-modelling survey as a different approach', says Smith. 'Something that would fill a gap in our socio-economic data. One of our key partners is the community, and how we engage with the community is important. So we saw this survey as an opportunity to obtain information and feedback from the community on how they value natural resources in the Hawkesbury Nepean Catchment.'

The survey

Study respondents in two catchments, the Hawkesbury-Nepean and Namoi, were asked questions about their willingness to pay for benefits in the Hawkesbury-Nepean. Running the study in two catchments had the advantage that it could be tested for 'location effect'. As an 'urban control', Sydney residents were also surveyed.

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.

A total of 858 people were surveyed about the Hawkesbury-Nepean catchment. The respondents were split more or less equally between people in the Hawkesbury-Nepean, Namoi and Sydney areas. 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;
- numbers of native species;
- kilometres of healthy waterways;

The Hawkesbury-Nepean River catchment

Location:

The catchment is in eastern NSW and extends from Goulburn in the south, Lithgow in the west and Cessnock in the north. It 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. About one million people live in the catchment.

Extent:

The catchment covers 22 000 square kilometres and includes the Hawkesbury, Nepean, Wollondilly, Wingecarribee, Natai, Coxs and Colo rivers.

Land use:

- **Industry and agriculture** – about 30 per cent of the catchment is used for grazing and horticulture but it also supports forestry, commercial estuarine trawling, oyster farming, coal mining and power generation.
- **Urban** (20 per cent of the catchment).
- **Parks and reserves** (50 per cent of the catchment) – includes the bulk of the Greater Blue Mountain World Heritage Area.
- **Native vegetation** (covers about two-thirds of the catchment) – half of the native vegetation is in good condition.

Drinking water, fishing and swimming:

About 630 kilometres of the rivers and streams in the catchment are good enough for drinking, fishing and swimming.

Threatened species and ecological communities:

More than 300 threatened species and ecological communities including:

- the brush-tailed rock-wallaby, southern brown bandicoot, gang-gang cockatoo, swift parrot, regent honeyeater, painted snipe, trout cod and booroolong frog;
- woodland and forest communities such as Cumberland Plain woodland, Agnes Banks woodland, blue gum high forest; and
- a wide range of shrubs and herbs such as *Epacris hamiltonii*, river swamp wallaby grass and the small snake orchid.

Environmental issues:

- urban expansion;
- soil erosion;
- weeds;
- salinity and soil acidity;
- loss of native vegetation; and
- reduced biodiversity.



- numbers of people working in agriculture; and
- an annual household cost to achieve the above levels of attributes.

These attributes, their wording 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. The five-year time period for the additional household cost was considered a plausible timeframe.

First option

In each question the first option was always a 'no-new-action' and 'no-cost' option. The levels of attributes for this option were determined in consultation with policy makers and scientists in the CMA. For Hawkesbury-Nepean, this represented 10 500 square kilometres of good-condition native forest, 2970 native species, 600 kilometres of healthy rivers and 7000 people working in agriculture. Note that the no-new-action option is not necessarily the same as the current condition as no action can lead to environmental (and employment) decline.

Second and third options

The attribute levels for the second and third options in each scenario were also developed carefully with specialists from the CMA and were then systematically mixed. One option, for example, included for a cost of \$200 a year, a 14 per cent increase in the area of good-condition native vegetation, compared to the current condition, a loss of 20 native species, a 19 per cent increase in length of healthy waterways, but an 8 per cent decline in agricultural employment.

Another option, for \$50 a year, had a 10 per

cent increase in native vegetation, a loss of 10 native species, a 19 per cent increase in healthy waterways and an 11 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 is only given a relatively small number of questions and choices. Respondents are placed in the difficult position of having to make choices between differing levels of benefits for different social and financial costs.

This deliberate weighing up of desirable and undesirable outcomes is the core of choice modelling. Systematic mixing of the options and a large number of respondents provides a sound methodology and statistically significant trends.

'One of our key partners is the community, and how we engage with the community is important. So we saw this survey as a great opportunity.'

Aaron Smith, Catchment Coordinator,
Hawkesbury-Nepean
Catchment Management Authority.

Survey results

The three sub-samples of respondents surveyed about the Hawkesbury-Nepean catchment – residents of towns in the catchment, residents from the Namoi catchment and Sydney residents – were analysed separately.



Hawkesbury-Nepean respondents

Respondents from the Hawkesbury-Nepean 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 or the impact of the loss of agricultural jobs.

‘Perhaps it shows that we already have a lot of good-quality native vegetation’, says Aaron Smith. ‘Over half this catchment is in national parks’.

‘In terms of what came out [of the choice modelling survey] it’s useful to see the values community placed on native vegetation, native species, healthy waterways and people working in agriculture. The data from the survey can be analysed in a number of ways and provide valuable information to assist in prioritising and investing in natural resource activities across the catchment.’

Aaron Smith, Catchment Coordinator,
Hawkesbury-Nepean
Catchment Management Authority.

Namoi respondents

The Namoi respondents were concerned about the decline of native species and healthy waterways in the Hawkesbury-Nepean catchment but not the other attributes.

Sydney respondents

The Sydney respondents preferred NRM

options that increased the level of native vegetation, native species and healthy waterways.

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 (refer table below).

Willingness-to-pay values for the Hawkesbury-Nepean catchment

Location of respondents		
Hawkesbury-Nepean	Namoi	Sydney
Area of native vegetation in good condition (square km)		
ns	ns	\$0.06
Number of native species		
\$6.97	\$4.97	\$5.25
Kilometres of healthy waterways (km)		
\$0.90	\$0.84	\$1.10
Number of people working in agriculture		
ns	ns	ns

ns = value was not statistically significant

As can be seen from the table, those living in the catchment were willing to pay for both maintaining/increasing the numbers of native species and kilometres of healthy waterways. This is expressed as \$6.97 per respondent for each additional native species and 90 cents per respondent for each additional kilometre of healthy river.

To extrapolate from these figures – 10 kilometres of river (for example) x 90 cents a year for five years = \$45 x the number of households in the catchment discounted for time and the response rate of around 30 per cent.

Willingness to pay

Choice modelling has provided the CMA with a net present value that it can say with some statistical validity is the value placed by the community on returning to health each



100 kilometres of waterways in the catchment. If the cost of carrying out the improvements is less than the value the community places on them, the CMA can show it is a good investment.

The results provide useful information on the values the community placed on Hawkesbury Nepean Catchment.

Native vegetation and agricultural employment

Only Sydney residents considered native vegetation in the Hawkesbury-Nepean of sufficient importance to pay extra to protect it. This could be explained by the importance of the catchment for recreation. They were also willing to pay for improvements to the waterways as they are so important in Sydney's water supply.

None of the sub-samples of respondents considered agricultural employment of enough significance to pay extra to reduce job losses.

Native species

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

Like the values given to the attributes by local respondents, the significant values from the respondents in other areas can be used to extrapolate a community willingness to pay to add to the value provided by locals. This can be important in arguing for regional, state or national funding for catchment programs.

References

Mazur, K., Bennett, J., *Choice Modelling in the Development of Natural Resource Management Strategies in NSW*, Environmental Economics Research Hub Research Reports No. 1, (2008) Crawford

School of Economics and Government, The Australian National University.

Mazur, K., Bennett, J., *Using Focus Groups to Design a Choice Modelling Questionnaire for Estimating Natural Resource Management Benefits in NSW*, Environmental Economics Research Hub Research Reports No. 2, (2008) Crawford School of Economics and Government, The Australian National University.

Mazur, K., Bennett, J., *A Choice Modelling Survey of Community Attitudes to Improvements in Environmental Quality in NSW Catchments*, Environmental Economics Research Hub Research Report No.13, (2009) Crawford School of Economics and Government, The Australian National University.

Mazur, K., Bennett, J., *Location Differences in Communities' Preferences for Environmental Improvements in Selected NSW Catchments: A Choice Modelling Approach*, Environmental Economics Research Hub Research Report No. 21, (2009) Crawford School of Economics and Government, The Australian National University.

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