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Location differences in communities' preferences for environmental improvements in selected NSW catchments: A Choice Modelling approach

Kasia Mazur and Jeff Bennett

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About the authors

Kasia Mazur is a PhD student in the Crawford School of Economics and Government at the Australian National University and an economist at the Australian Bureau of Agricultural and Resource Economics (ABARE)
Jeff Bennett is a Professor at the Crawford School of Economics and Government at the Australian National University

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Crawford School of Economics and Government
THE AUSTRALIAN NATIONAL UNIVERSITY

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Abstract

A choice modelling (CM) study was conducted to elicit household willingness to pay (WTP) for improvements in environmental quality in three NSW catchments (Lachlan, Namoi and Hawkesbury-Nepean). This report presents results of research designed to investigate variations in WTP across different communities including local residents, distant/urban and distant/rural residents. Nine split samples were established to test for 'location effect'. The analysis involved both conditional logit and random-parameters logit models. The non-market values obtained from this study are suitable for use by the Catchment Management Authorities (CMAs) to guide natural resource management (NRM) investment processes.

Key words: Choice modelling, Location effects, Non-market valuation, Catchment planning, Environment

1. Introduction

Choice modelling (CM) is a non-market valuation technique that is increasingly being used in policy decision making processes (Champ et al., 2003, Bateman et al., 2003). The aggregated non-market values held by individuals estimated using CM are used in cost benefit analysis (CBA) enabling decision makers to compare a more complete set of benefits and costs for different resource allocations (Bennett and Blamey, 2001). CM is based on the analysis of sampled individual preferences (Bateman et al., 2006). Therefore, to estimate aggregated values it is necessary to identify the extent of the market and to account for any variations in individual values across the market that may affect the total value of the good (Bateman et al., 2006).

Bateman et al., (2006) discusses the challenges associated with determining the appropriate extent of the market. The approaches include using economic or political jurisdictions. However, preferences across and within these jurisdictions can differ depending on variations in the types of communities, the socio-economic characteristics of the population and on the location or distance of peoples' residences in relation to the site of interest (Morrison and Bergland, 2006). The effects of these features therefore require identification as a precursor to the aggregation process.

Location or distance effects on non-market value estimates have been widely investigated in non-market valuation studies (Hanley et al., 2003, Pate and Loomis, 1997a, Bateman and Langford, 1997, Pate and Loomis, 1997b, Giovanni, 2007, Van Bueren and Bennett, 2004). In this study, CM was used to estimate the non-market values of NSW communities for improvements in environmental quality in selected catchments. The main methodological focus was to investigate the relationship between willingness to pay (WTP) and the relative location of different communities (local/rural, distant/rural and distant/urban) from the catchments under considerations.

The term 'location effect' as used in this report, refers to any potential impact of different relative locations of the respondent on WTP. The 'location effect' shares many common properties with the 'distance effect' but does not refer to any specific measurable distance of the respondent from the area being investigated. This study investigates non-market goods that are spread over large areas. Therefore an exact distance of the respondent from the good was difficult to measure. The differences in WTP between proximate and distant beneficiaries of the environmental goods and other sources of heterogeneity in preferences within these communities were also analysed.

Based on the results of this study we argue that a superior approach to obtaining useful aggregated values for environmental improvements involves estimating any variation in WTP between different communities together with an analysis of the impact of respondent socio-economic characteristics on values held. This approach provides readily-transferable monetary estimates of environmental values that can be applied in CBA.

This report is constructed as follows. Section 2 describes the theoretical basis of the CM technique. Section 3 presents a short literature review of distance and location effects. Section 4 describes the study design and sets out three research hypotheses. Section 5 details the case study catchments. Section 6 sets out the questionnaire design procedure. Section 7 describes the survey logistics. The sample characteristics are set out in section 8. Section 9 provides an analysis of the results to test the hypothesis. The last section (10) presents some concluding comments.

2. *Theoretical basis of Choice Modelling*

CM is a survey based non-market valuation technique used to estimate the values associated with the impacts of changes across different attributes that describe the outcomes of different policy options (Bennett and Blamey, 2001). Unlike other non-market valuation methods, CM can estimate, cost effectively, values associated with a wide range of environmental attributes and policy options (Bennett and Blamey, 2001). It also has the capacity to avoid many of the biases faced by other stated preference (SP) techniques and has advantages in benefit transfer applications (Bennett, 2006, Morrison et al., 2002, Morrison and Bergland, 2006). CM is increasingly being used in environmental valuation studies internationally (Horne et al., 2005, Xu et al., 2007, Wang et al., 2007, Boxall et al., 1996, Adamowicz et al., 1998, Hanley et al., 1998) and in Australia (e.g. Bennett et al., 1997, Rolfe et al., 1997, Rolfe et al., 2004, Bennett et al., 2001, Blamey et al., 2000, Blamey et al., 1999b, Windle and Rolfe, 2005).

In a CM questionnaire, respondents are presented with a number of alternative resource allocations and asked to indicate their most preferred options (Rolfe et al., 2004). A baseline alternative representing the *status quo* situation is included in each choice set and so choices are made between a *status quo* scenario and a series of different proposed alternatives (Rolfe et al., 2004). Each choice option is presented in terms of a common set of attributes with different levels between the options (Blamey et al., 2000).

The theoretical base of CM evolved from Thunstone's (1927) random utility model (RUM) (Bennett and Blamey 2001). The RUM is based on the researcher being able to observe only part of respondents' utilities. The unobserved component is taken to be randomly distributed. Therefore the utility U_{an}, derived by the respondent *n* from the choice of an alternative *a* can be describe as:

$$U_{an} = V_{an} + \varepsilon_{an} \qquad \textbf{(1)}$$

where V_{an} is the deterministic observable component of utility and ε_{an} is the stochastic, unobserved component of utility associated with option *a* and consumer *n.* The observed component (V_{an}) is a function *u* of the attributes Z_a and of individual characteristics S_n (Rolfe et al., 2000).

$$U_{an} = u\,(Z_a, S_n) + \varepsilon_{an} \qquad \textbf{(2)}$$

While utility can never be exactly determined, it can be concluded that the probability of choosing a particular option *a* from choice set C_n, by the respondent *n* is greater if that option has a higher level of the deterministic and stochastic components than other options (e.g *j*) in the same choice set. This is expressed as:

$${}^{a}|_{Cn} = P[(V_{an} + \varepsilon_{an}) > (V_{jn} + \varepsilon_{jn})] \qquad \textbf{(3)}$$

for j options in a choice set C_n , $a \neq j$

Therefore, the probability of choosing alternative a increases proportionally with the difference in observed utility. Because the distribution of the random component is not known, assumptions have to be made about this distribution. The standard assumption is that the ε term is an independently and identically distributed (IID) Gumbel random variable, which leads to the familiar binary, conditional (CL) or multinomial logit (MNL) models (McFadden, 1974). The irrelevance of independent alternatives (IIA) assumption is derived from the IID. According to the IIA assumption, the inclusion of an irrelevant alternative in a choice set has no impact on the probability of the selection of a particular alternative by the respondent. This means that the random error component of utility has the same variance and is uncorrelated between alternatives (Carson et al., 1994).

The two most common models in choice modelling analysis are CL and MNL. The CL model provides the probability of an individual n choosing alternative a as a function of attributes that describe each alternative:

$$P_{an} = \frac{\exp\left(x_{an}\beta\right)}{\sum_j \exp\left(x_{jn}\beta\right)} \qquad \textbf{\textit{(4)}}$$

where x_{an} is a vector of attributes a and individuals n

The MNL gives the probability of an individual n choosing the alternative a as a function of individual characteristic (Haab and McConnell, 2003):

$$P_{an} = \frac{\exp\left(x_n\beta_a\right)}{\sum_j \exp\left(x_n\beta_j\right)} \qquad \textbf{\textit{(5)}}$$

By combining the MNL and CL formulations, a General Multinomial Logit Model can be obtained. In this model both the attributes that describe each alternative and the individual characteristics are included as independent variables. Therefore the probability of an individual *n* choosing the alternative is expressed as:

$$P_{an} = \frac{\exp\left(x_{an}\beta + x_n\beta_a\right)}{\Sigma_j \exp\left(x_{jn}\beta + x_n\beta_j\right)} \tag{6}$$

Therefore a utility function for choice models takes the form:

$$V_{an} = \beta_a + \sum{}_k \beta_k Z_{ka} + \sum{}_p \theta_p S_{pn} + \sum{}_{kp} \varphi_{kp} Z_{ka} S_{pn} + \sum{}_{pa} \psi_{pa} \beta_a S_{pn} \tag{7}$$

Where:

β_a is the alternative specific constant for *A-1* of the *a= 1,……, A* choice options;

β_k is a matrix of *k =1, …., K* attributes that relate to choice options, Z_{ka};

φ_p is a matrix of *p=1,….,P* characteristics that relate to individual respondents, S_{pn};

φ_{kp} is a matrix of possible relationships of choice option attributes with the characteristics of the individuals, $Z_{ka}S_{pn}$; and

ψ_{pa} is a vector of possible interactions between individual characteristics and choice option intercepts (Louviere, 2001).

The utility function estimated for each alternative contains the effects of attributes, an alternative specific constant (ASC) and the individual respondent characteristics that are interacted with the attributes or the ASC (Blamey et al., 2001). The ASCs capture the influence of any variation in choices that cannot be explained by the attributes or the socio-economic characteristics (Bennett and Adamowicz, 2001, Rolfe et al., 2000).

If the IIA condition is not met, a different assumption regarding the stochastic term needs to be made, necessitating the use of alternative models including random parameter logit (RPL).

RPL relaxes the IIA assumption and accounts for observed and unobserved preference heterogeneity across respondents. In the RPL model, it is assumed that the random vector β_n varies among respondents. The utility function is described as:

$$U_{an} = \beta_n X_{a\,n} + \varepsilon_{an} = \beta X_{an} + ð_n X_{an} + \varepsilon_{an} \quad \textbf{(8)}$$

where β_n is the sum of the population mean β and individual deviation from the mean $ð_n$. Therefore the stochastic part of utility $ð_n X_{an} + \varepsilon_{an}$ is correlated among alternatives (Alpizar et al., 2001). This relaxes the IIA "despite the presence of the IID assumption for the random components ε_{an} of the alternatives" (Louviere et al., 2000). This means that the RPL model separates IIA from IID and allows cross-correlation amongst alternatives in the estimated models (Hensher and Reyes, 2000).

The researcher does not know the individual's preferences, and so it is assumed that individual preferences vary across the population with density $f(\beta / \theta *)$, where $\theta *$ are the parameters of this distribution (representing the mean and standard deviation of preferences) (Train, 1998). Hence the probability that the individual *n* chooses the alternative *a* can be expressed as the integral of the conditional probability (equation 4) over all possible values of β weighted by the density of β (Train, 1998). The probability of individual choices is given by:

$$P_{an} = \int \left(\frac{\exp(\beta_n \; x_{an})}{\sum_j \exp(\beta_n \; x_{jn})} \right) f(\beta / \theta^*) \, d\beta \quad \textbf{(9)}$$

3. Location/distance effect

The importance of accounting for the location/distance effect has been highlighted in the non-market valuation literature (Sutherland and Walsh, 1985, Bateman et al., 1999, Jiang et al., 2005, Giovanni, 2007). The main advantage of location/distance tests is that it provides information about the substitution possibilities (Sutherland and Walsh, 1985) and it is important for further benefit transfer (Bateman et al., 1999, Jiang et al., 2005). Giovanni (2007) claims that distance tests provide valuable information for policy makers in regards to whether investment funding should come from local, state or federal governments. Sutherland and Walsh (1985) and Pate and

Loomis (1997b), argue that the omission of a location/distance test produces biased parameters especially when the sample is geographically limited.

The location/distance effect depends on the type of good involved, the use and non-use values ratio for each attribute, the availability of information, the number of substitute goods and experience with the good (Stouffer, 1940). For example, Clawson and Knetsch (1966) argue that if the good is iconic or scarce, the WTP may be the same across different distances from that good. However, in some instances people who live close to an environmental amenity such as a national park may value the good less than people who live further away (Espey and Owusu-Edusei, 2001, Imber et al., 1991). Distance also influences the availability of information and consequently peoples' preferences (Beckmann, 1999). For example, Heberlein et al., (2005) argue that people who know more about a good tend to value this good more than people who know less. A relationship between distance and knowledge was also found by Pate and Loomis (1997). Bateman et al., (2006), however, argues that average values should decline with increasing distance from that site as the number of users (who hold higher values than non-users) declines with the distance. In general, it is assumed that WTP for used goods declines with distance (Hanley et al., 2003).

Southerland and Walsh (1985) and Hanley (2003) have shown a negative relationship between WTP and distance. Some other studies (Espey and Owusu-Edusei, 2001, Imber et al., 1991, Do and Bennett, 2007) have shown a positive relationship between WTP and distance but Pate and Loomis, (1997) and Loomis, (1996) , and Ece Ozdemiroglua et al., (2004) did not show any impact. Morrison and Bennett (2004), Hanley et. al (2003), Rolfe and Bennett (2000) and van Buren and Bennett (2004) also showed differences in preferences between those living within a study area and beyond.

The impact of location/distance on the WTP for improvements in environmental quality can also depend on the type of population tested (e.g. urban or rural) and socio-economic and attitudinal factors. The importance of accounting for different community types and their locations has been tested in a previous study by Rolfe and Bennett (2000). That study found significant differences in values held by people living in different community types (rural and urban) within Queensland.

4. Hypothesis and study design

This study tests for variations in environmental benefit estimates across different communities including local/rural, distant/urban (Sydney) and distant/rural residents. The values for each environmental attribute for each catchment were compared between different community locations. Based on the review of literature presented in the pervious section, hypotheses were formulated for testing the location effect:

HA: *The local/rural (WTP^{LR}) versus distant/rural (WTP^{DR}) community test.*

The null hypothesis:

HA_0: $WTP^{LR} = WTP^{DR}$

The alternative hypothesis:

HA_1: $WTP^{LR} \neq WTP^{DR}$

The null hypothesis (HA_0) implies that WTP for improvements in environmental quality are not significantly different between the local/rural (WTP^{LR}) and distant/rural (WTP^{DR}) communities. The alternative hypothesis (HA_1) states that these two communities hold different WTP for improvement in environmental quality. Our prior expectation is that the HA_1 will not be rejected.

HB: *The local/rural (WTP^{LR}) versus distant/urban (WTP^{DU}) community test.*

The null hypothesis:

HB_0: $WTP^{LR} = WTP^{DU}$

The alternative hypothesis:

HB_1: $WTP^{LR} \neq WTP^{DU}$

The null hypothesis (HB_0) implies that WTP for improvements in environmental quality are the same for local/rural (WTP^{LR}) and distant/urban (WTP^{DU}) communities.

The alternative hypothesis (HB_1) states that the WTP for these improvements differs between these two communities. Our prior expectation is that the HB_1 will not be rejected.

HC: *The distant/rural (WTP^{LR}) versus distant/urban (WTP^{DU}) community test.*

The null hypothesis:

HC_0: $WTP^{DR} = WTP^{DU}$

The alternative hypothesis:

HC_1: $WTP^{DR} \neq WTP^{DU}$

The null hypothesis (HC_0) implies that WTP for increased environmental benefits is the same for distance/rural (WTP^{LR}) and distant/urban (WTP^{DU}) communities. The alternative hypothesis (HC_1) states that these two communities hold different values for improvements in environmental quality. Our prior expectation is that the HC_1 will not be rejected.

In order to perform the above tests, four subsets of the NSW population (household in Sydney, Lachlan, Namoi and Hawkesbury-Nepean) were selected as the basis for estimating NSW population values for improvements in environmental quality in three NSW catchments (Lachlan, Namoi and Hawkesbury-Nepean). A split sample approach was employed to test for the effect of different communities' locations on value estimates. Nine split samples were created to make a comparison between local/rural, distant/rural and distant/urban communities' attitudes and preferences (see Table 1).

Table 1. Research design and the study sub-samples

Sub-sample location / Catchments	Hawkesbury - Nepean (Goulbourn, Moss Vale)	Namoi (Tamworth, Gunnedah)	Lachlan (Cowra, Parkes)	Sydney
Hawkesbury-Nepean	Local – rural (HN/HN)	Distant – rural (HN/Namoi)		Distant – urban (HN/Sydney)
Namoi		Local – rural (Namoi/Namoi)	Distant – rural (Namoi/Lachlan)	Distant – urban (Namoi/Sydney)
Lachlan	Distant – rural (Lachlan/HN)		Local – rural (Lachlan/Lachlan)	Distant – urban (Lachlan/Sydney)

Note: In the brackets (the catchment that the questionnaire was focusing on/location of the respondent where the questionnaire was distributed).

People in the three catchments, in separate sub-samples, were asked about their NRM preferences in their catchment and in the other catchments in NSW. In order to make a comparison with distant/urban communities' attitudes towards improvement in environmental quality in rural areas, sub-samples of Sydney residents were asked about their preferences for resource allocation in all three selected catchments. Each respondent from each area received only one version of the questionnaire (Namoi, Lachlan or Hawkesbury-Nepean) asking about NRM management in one of these three catchments.

5. Case studies

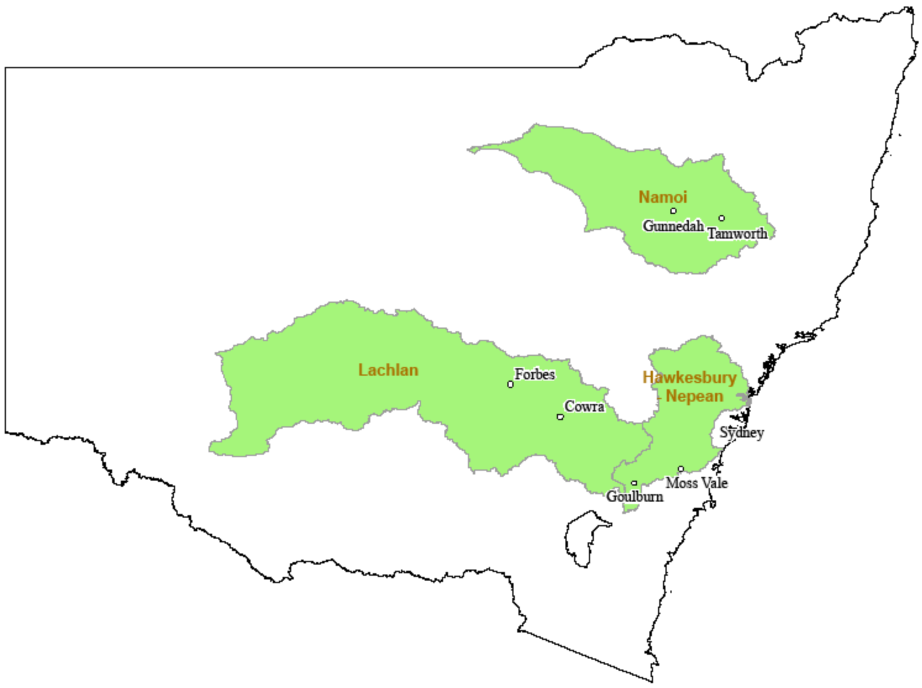
The three selected catchments represent a wide variety of NSW catchment characteristics and their NRM issues.

The Hawkesbury-Nepean, Namoi and Lachlan (see Figure 1) catchments differ in land use, size and population. In terms of land use there are some similarities between the Namoi and Lachlan catchments. Both catchments are mostly devoted to agriculture (about 90 percent of the land) with a majority of area used for grazing. Native vegetation in both locations covers between 30 to 40 percent of the catchment area and national parks occupy less than five percent. Both catchments have similar populations of about 100,000 people. The Lachlan catchment (84,700 km^2) is the largest of the three. It has twice the area of the Namoi (42,000 km^2) and almost four times the area of the Hawkesbury Nepean catchment (22,000 km^2). The Hawkesbury Nepean catchment has the greatest population (one million people). Over 50 percent of the area of that catchment is National Park, only 30 percent of the area is used for agriculture and about 20 percent is urbanised.

Despite the many differences between these catchments there are also similarities in terms of the environmental issues faced. These include declining biodiversity, loss of native vegetation and reduced water quality. Across the total area of the three case studies, the area of native vegetation in good quality has declined by about 87 percent since pre-European settlement. The greatest area of native vegetation of good quality is in the Hawkesbury-Nepean catchment (50 percent of the total) but only five and seven percent respectively of the total area of Namoi and Lachlan catchments has native vegetation in good condition. Over 200 native species across the three catchments are endangered. Water quality has declined in 85 percent of the total waterways in the catchments. Currently about 20 percent of the waterways in Namoi's catchment, 15 percent of the Hawkesbury-Nepean's and 10 percent of the Lachlan's are of good enough quality for drinking, swimming and fishing.

NRM actions such as planting more trees, protecting existing vegetation, fencing and revegetating river banks and wetlands, pest and weed control are just some of the actions that can improve environmental quality in the catchments. More information about each catchment's characteristics is included in Mazur and Bennett (2009).

Figure 1. Case study catchments areas.



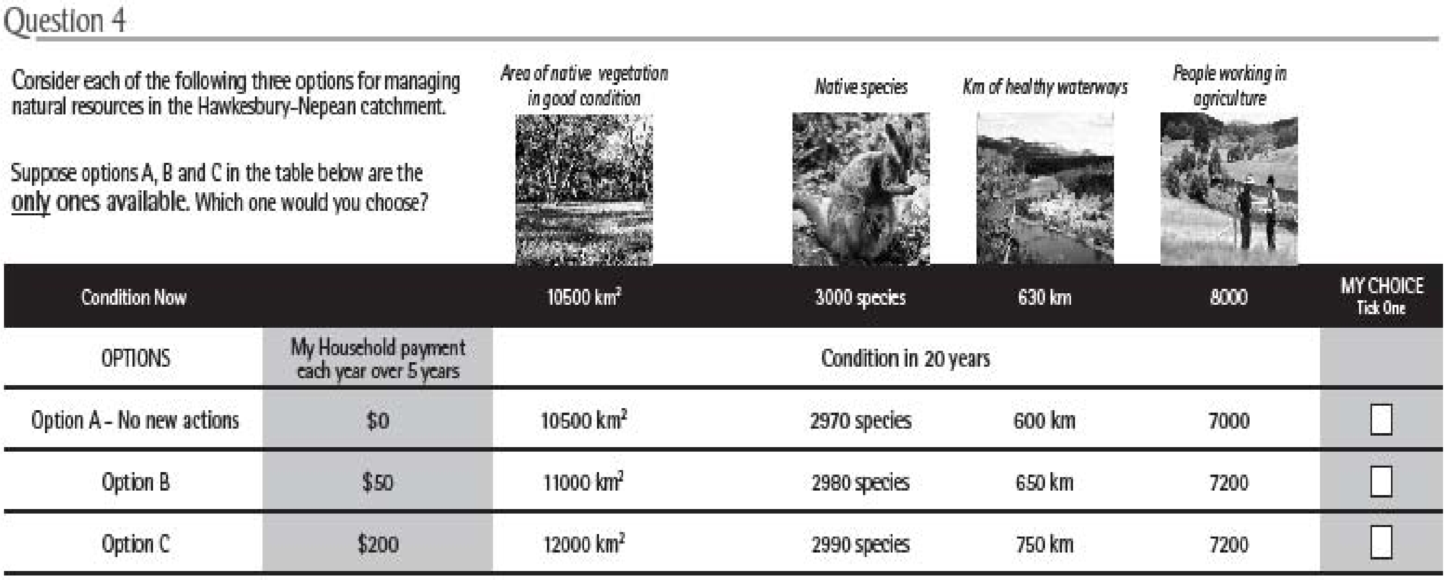
6. Questionnaire development

The attributes used in the CM questionnaire, their current and potential future levels were determined through consultations with policy makers and NRM specialists. Further consultations and verifications of a draft questionnaire were undertaken during eight focus group discussions.

Three attributes that describe the main environmental benefits derived from NRM actions in the three catchments were selected: area of native vegetation in good condition (NV), kilometres of healthy waterways (HW), and number of native species (NS). One additional attribute - people working in agriculture (PA) - was chosen to capture the social consequences of changes in NRM actions. The fifth attribute was a monetary cost. The annual payment to be made by respondents from new NRM actions was specified to continue for five years. The payment vehicle was described as a mixture of increased taxes, council rates, prices and recreational charges. Three different levels of each attribute were determined and used in an experimental design to structure the choice set used in the questionnaires.

The levels of each attribute across the predicted range were used in an orthogonal design that produced 25 alternative NRM options. These alternatives were randomly blocked into five different versions, each with five choice sets for the three different versions of the questionnaire (Namoi, Lachlan and Hawkesbury–Nepean). This resulted in 15 different versions of the questionnaire. Two change options and a *status quo* option were included in each choice set (see Figure 2).

Figure 2. Example of a choice set for the Hawkesbury-Nepean catchment


Question 4

Consider each of the following three options for managing natural resources in the Hawkesbury-Nepean catchment.

Suppose options A, B and C in the table below are the **only ones available.** Which one would you choose?

		Area of native vegetation in good condition	Native species	Km of healthy waterways	People working in agriculture	
Condition Now		10500 km²	3000 species	630 km	8000	MY CHOICE Tick One
OPTIONS	My Household payment each year over 5 years	Condition in 20 years				
Option A - No new actions	$0	10500 km²	2970 species	600 km	7000	☐
Option B	$50	11000 km²	2980 species	650 km	7200	☐
Option C	$200	12000 km²	2990 species	750 km	7200	☐

7. Survey Logistics

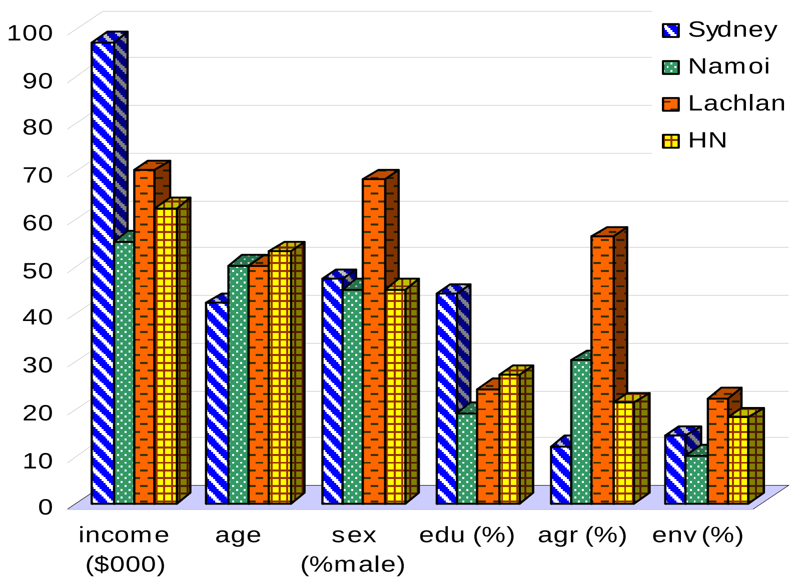
A drop-off/pick-up approach for the distribution of the questionnaire was used. In total, 2,529 responses which account for 12,645 choices observations from nine sub-samples were obtained. Out of 12,645 choice sets about three percent were not answered. About 24 percent of respondents chose the *status quo* option in each choice set.

In order to test for location effects, an appropriate spatial distribution of the population was chosen to avoid a potential self selection bias. This involved ensuring an equal number of responses from different locations. This is important because in previous studies (Bateman and Langford, 1997, Hanley et al., 2003), random sampling yielded more responses from areas closer to the goods investigated. Questionnaires were distributed in two main towns in each case study catchment and in Sydney. Geographically stratified random sampling was applied to choose the households to ensure a representation of the NSW population in terms of gender, age, income etc.

8. Sample characteristics

The socio-economic characteristics of the sub-samples are presented in Figure 3.

Figure 3. Descriptive statistics of the sub-samples from each case study and Sydney.



Note: income- \$000 household annual income, edu – represents respondents with tertiary degree and above, agr- represents association with agricultural industry of the respondents and their close family, env- represents association with environmental organisations of the respondents and their close family.

A comparison of the socio-economic characteristics of the sub-samples with ABS (2006) Census data was undertaken. The χ^2 test was used to compare the distribution of age, income and education level between the sub-samples against the Census data.

Significant differences[1] in the age distribution between the sub-samples and the population data was observed in Parkes (χ^2 =38.13), Moss Vale (χ^2 =30.32) , Cowra (χ^2 =26.59) and Goulburn (χ^2 =23.12). For the Sydney (χ^2 =5.33), Gunnedah (χ^2 =13.92) and Tamworth (χ^2 =12.92) sub-samples the distribution of age was not significantly different from the ABS census data.

No significant differences in household size between the samples and the ABS census data were found. However, the proportion of people with a tertiary degree is higher in the sub-samples than recorded by the ABS census. Only the education level recorded in Parkes (χ^2 = 2.0)[2] was not significantly different from the ABS census data. For the other sub-samples there are significant differences between the average population and the sample's education level.

The income ranges presented in the questionnaire were consistent with ABS household ranges presented in the 2006 Census. Significant differences[3] between the sub-samples and Census income were recorded in Cowra (χ^2=102.28), Gunnedah (χ^2=41.68), Goulburn (χ^2=24.29), and Sydney (χ^2=23.86). No significant differences in the distribution of income were found between the Census and the Moss Vale (χ^2=16.85), Parkes (χ^2=14.91), and Tamworth (χ^2=6.90) sub-samples.

A comparison of the socio-economic characteristics of each of the sub-samples within the same area was undertaken. The χ^2 test was also used to compare the average age, income and education level, number of children, association with environmental organizations and agricultural industry. No significant differences (at 99% confidence) in any of these socio-economic characteristics between the sub-samples were found.

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[1] The critical χ^2 = 24.99 at the 0.05 level
[2] The critical χ^2 = 3.84 at 0.05 level
[3] The critical χ^2 = 22.36 at 0.05 level

9. Results

9.1 The models

The data obtained from the CM survey were analysed using conditional logit (CL) and random parameter logit (RPL) models. Limdep (version 4.0) software was used to compute the choice models.

The first choice models used in this analysis were CL models with attributes only as explanatory variables and the alternative specific constant. The equations for these models are:

$$U(A)=\beta_1 costs+\beta_2 NV+\beta_3 NS+\beta_4 HW+\beta_5 PA \qquad \textbf{(10)}$$
$$U(B)=ASC+\beta_1 costs+\beta_2 NV+\beta_3 NS+\beta_4 HW+\beta_5 PA$$
$$U(C)=ASC+\beta_1 costs+\beta_2 NV+\beta_3 NS+\beta_4 HW+\beta_5 PA$$

where:
A - *Status quo* option
B and C - change options
β - estimated coefficients
ASC - alternative specific constant
Attributes:
NV - km^2 of native vegetation in good condition
NS - number of native species
HW - km of healthy waterways
PA - number of people working in agriculture

The *status quo* level was treated as the constant base for each attribute. Therefore the differences in choice probabilities between the *status quo* and a specific option with different attribute levels were expressed in the estimated model parameters. All parameters used in the models are generic.

In order to account for preference heterogeneity, CL models with socio-economic and attitudinal variables ('full model') were estimated. Socio-economic characteristics such as age, education, income, gender, number of children, association with agricultural industry and association with environmental organisation were included in the CL full models by interacting them with the ASC.

The results from the choice models for each sample are presented in Tables 3, 4 and 5. The results indicate a good overall model performance. For the sub-samples, a better model fit (higher pseudo-R^2) was obtained by accounting for preference heterogeneity. The pseudo R^2 for most of the CL full models were around 10 percent level which is acceptable for this type of data (Louviere et al., 2000). The values of the χ^2 statistics for the CL full models show that important gains in model fit were obtained by accounting for the heterogeneity in preferences.

The ASC (coded as 1 for the change options) was negative and significant for most of the sub-samples. This implies that respondents systematically prefer the *status quo* option over the change options. The insignificant ASC for the Namoi/Namoi[4] (questionnaire type/respondent location) sub- sample suggests that there is no systematic favouring by respondents of the *status quo*. The highest proportion (about 30 percent) of respondents choosing the *status quo* option was obtained from the two distant/rural sub-samples (Lachlan/HN[5] and Namoi/Lachlan[6]). The lowest preference towards the *status quo* option was from all local/rural sub-samples (HN/HN[7], Namoi/Namoi and Lachlan/Lachlan[8]).

The results show that for all the split samples, the signs of the model parameters are in accordance with *a priori* expectations. All the environmental attribute parameter coefficients have positive signs values which mean that those NRM scenarios which result in higher levels of any single attribute are preferred. The cost coefficient was

[4] Namoi/Namoi means that the respondents from the Namoi catchment were asked about their own catchment.
[5] Lachlan/HN means that the respondents from the Hawkesbury-Nepean catchment were asked about the Lachlan catchment.
[6] Namoi/Lachlan means that the respondents from the Lachlan catchment were asked about the Namoi catchment.
[7] HN/HN means that the respondents from the Hawkesbury-Nepean catchment were asked about their own catchment.
[8] Lachlan/Lachlan means that the respondents from the Lachlan catchment were asked about their own catchment.

negative and significant for all the models. The significance of the attributes varies between sub-samples locations and community types (see Tables 3, 4 and 5).

Lachlan catchment

In the Lachlan sub-sample all the attributes were significant implying that the local Lachlan respondents want to have more of each of these four attributes in their own catchment. In the Sydney sub-sample all the environmental attributes (NS, HW and NV) were significant but PA was insignificant. This means that Sydney respondents were more likely to choose the change option if it provides more of the environmental improvements in the Lachlan catchment but were unconcerned by impacts on people working in agriculture. In the HN sub-sample, NS and HW were significant at the five percent level, PA was significant at the 10 percent and the NV attribute was not significant. This implies that the Hawkesbury-Nepean respondents were not willing to pay to restore NV in the Lachlan catchment.

The respondents with higher levels of income and who were associated with environmental organisations from the local community of the Lachlan catchment and higher income from distant/urban communities of Sydney prefer NRM scenarios that provide higher levels of environmental goods. Respondents in the distant/rural community (Hawkesbury-Nepean) did not show any strong relationship between these two socio-economic characteristics and their preferences towards improvement in environmental quality. Association with the agricultural industry also indicated a higher probability of choosing new NRM actions in the Lachlan catchment by the local community of Lachlan and Sydney catchment respondents.

Namoi catchment

In the Namoi sub-sample, all the attributes except PA were significant, implying that the Namoi respondents are more likely to choose the change option if it provides more environmental benefits in their own catchment. They are not, however, concerned about the social impacts such as loss of jobs in agriculture. In the Sydney sub-sample, NS and NV were significant implying that Sydney respondents prefer those management options that provide more of these two attributes in the Namoi catchment. Sydney respondents were not concerned about a decline in HW and PA in the Namoi catchment. In the Lachlan sub-samples, only the NV attribute was significant and the other attributes were insignificant implying that Lachlan respondents are only concerned by the decline of area of good quality native vegetation in the Namoi catchment.

The significant coefficients for the socio-economic attributes indicated that the respondents with higher levels of income and who were associated with environmental organisations for all the three communities' locations are likely to prefer NRM scenarios that provide higher levels of environmental goods in the Lachlan catchment. Association with agricultural industry also indicated a higher probability of choosing new NRM actions in the Sydney and local Namoi sub-samples.

Hawkesbury-Nepean catchment

In the HN sub-sample the NS and HW attributes were significant at the five percent level and the PA attribute was significant at the ten percent level. NV was insignificant. This implies that the local community of the Hawkesbury-Nepean catchment prefers those NRM scenarios that provide more of NS, HW and PA but is not concerned about NV. In the Namoi sub-sample, NS and HW were significant but the other attributes were insignificant implying that Namoi respondents prefer more of these attributes in the Hawkesbury-Nepean catchment but they are unconcerned about NV and PA. In the Sydney sub-sample all the environmental attributes were significant but the social attribute was insignificant.

The significant coefficients for the socio-economic attributes indicate that Sydney respondents who were associated with environmental organisations are likely to prefer NRM scenarios that provide higher levels of environmental goods. However, Namoi respondents associated with environmental organisation are less likely to choose a change option for the environmental improvement in the Hawkesbury-Nepean catchment. People with higher income from the local area (Hawkesbury-Nepean), distant/urban (Sydney) and distant/rural (Namoi) are more likely to choose the change option. Association with agricultural industry also indicated a higher probability of choosing new NRM actions for Sydney respondents.

Hausman test

A Hausman test showed that there was a breach of the IIA assumption in all of the CL models (attributes only) except the HN/Sydney sub-sample. However, the CL full models resulted in violation of the IIA at the five percent level of significance only for the Namoi/HN sub-sample. To address the violation of the IIA, RPL models were estimated for the Namoi/HN data. Simulations were undertaken in order to determine the appropriate distribution for the random variables. Triangular distributions were used for the final models. The cost attribute coefficient was treated as a fixed parameter whilst other coefficients were allowed to vary. Estimates for the RPL models were derived using 1000 random draws. The attributes that consistently showed an insignificant standard deviation were treated as non-random and the model was re-estimated. In order to identify the sources of both the random and conditional heterogeneity, interactions of the random parameters with respondent-specific socio-economic and attitudinal characteristics were also used. For this particular sub-sample, the NV parameter was treated as random. The mean effect on the random parameter was insignificant but the standard deviation was significant (see table 5). The interactions of the random parameter with socio-economic characteristics resulted in a significant positive coefficient for income indicating that people with higher income prefer more NV. Also, the age and environmental coefficients were significant and negative indicating that older people and people associated with environmental organisations prefer less NV.

Table 2. Variables used in the Choice Models

ASC	alternative specific constant
NV	km^2 of native vegetation in good condition
NS	number of native species
HW	km of healthy waterways
PA	number of people working in agriculture
COST	cost of choice alternative ($ pa per household over 5 years)
ASCAGE	respondent age x ASC
ASCEDU	respondent education status (1=with tertiary degree) x ASC
ASCINCOME	respondent household income ($000) x ASC
ASCGENDER	respondent gender (1= female) x ASC
ASCCHILDERN	respondent children (1= with children) x ASC
ASCENV	respondent association with environmental organisation (1=associated) x ASC
ASCAGR	respondent association with agricultural industry (1=associated) x ASC

Table 3. Results of CL models for the Lachlan catchment

	Local/rural		**Distant/urban**		**Distant/rural**	
	Lachlan/Lachlan		**Lachlan/Sydney**		**Lachlan/HN**	
	Survey conducted in Lachlan		Survey conducted in Sydney		Survey conducted in HN$^{\Delta}$	
	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions
ASC	-.7531***	-2.6241***	-.2145	-4.1152***	-.9228***	-4.5051***
	(.3232)	(.6236)	(.3599)	(.8008)	(.3297)	(.7712)
COST	-.0052***	-.0055***	-.0059***	-.0060***	-.0044***	-.0049***
	(.0004)	(.0005)	(.0004)	(.0006)	(.0004)	(.0005)
NV	.5801D-04**	.6906D-04**	.4482D-04	.0001***	.2163D-04	.451829D-04
	(.3125D-04)	(.3452D-04)	(.3459D-04)	(.4510D-04)	(.3309D-04)	.3908D-04
NS	0.0208**	.0244**	.0254**	.0480***	.0350***	.0362***
	(.0098)	(.0110)	(.0011)	(.0142)	(.0103)	(.0123)
HW	.0038***	.0046***	.0028***	.0021**	.0057***	.0063***
	(.0008)	(.0009)	(.0008)	(.0011)	(.0008)	(.0010)
PA	.0016***	.0015***	-.0005	-.0006	.0008	.0011*.
	(.0005)	(.0005)	(.0005)	(.0007)	(.0005)	0006
ASCAGE		-.0014		.0140**		.0008
		(.0045)		(.0065)		(.0057)
ASCEDU		.0494		.1282***		.2764***
		(.0324)		(.0402)		(.0448)
ASCINCOME		.0128***		.0141***		.0012
		(.0019)		(.0021)		(.0021)
ASCGENDER		.2879**		.5813***		-.1996
		(.1505)		(.1768)		(.1779)
ASCCHILDREN		.0551		-.2210		-.8383***
		(.1950)		(.2202)		(.2860)
ASCENV		.4363***		-.1295		-.0670
		(.1826)		(.2718)		(.2329)
ASCAGR		.3211**		.6610*		.0591
		(.1423)		(.3706)		(.2113)
Pseudo R2	0.05118	0.09258	0.06602	0.12458	0.05672	0.10400
Log likelihood	-1577.946	-1215.845	-1366.542	-753.7176	-1348.963	-921.3986
D.F.O	6	13	6	13	6	13
Chi^2(critical Chi^2	170.24600	248.09800	193.18200	214.51280	162.2200	213.9068
in brackets)	(9.4877)	(16.9190)	(9.4877)	(16.9190)	(9.4877)	(16.9190)
Observations	1534	1247	1342	786	1331	966

Table 4. Results of CL models for the Namoi catchment

Sub-samples	**Local/rural**		**Distant/urban**		**Distant/rural**	
	Namoi/Namoi		**Namoi/Sydney**		**Namoi/Lachlan**	
	Survey conducted in Namoi		Survey conducted in Sydney		Survey conducted in Lachlan	
	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions
ASC	-.0003	.7449	.3552	-3.1315***	-.2048	-2.917***
	(.2666)	(.6281)	(.2687)	(.7019)	(.2414)	(.5924)
COST	-.0051***	-.0054***	-.0068***	-.0065***	-.0047***	-.0050***
	(0004)	(.0005)	(.0004)	(.0006)	(.0004)	(.0005)
NV	.5530D-04	.6305D-04*	.9140D-04***	.0001***	.8310D-04***	.8512D-04**
	(.349D-04)	(.392D-04)	(.364D-04)	(.464D-04)	(.35D-04)	(.3939D-04)
NS	.0121**	.0133**	.0125**	0156**	.0072	.0087
	(.0054)	(.0061)	(.0058)	(.0073)	(.0053)	(.0060)
HW	.0005***	.0006***	.8099D-	.772D-04	.0001	.0002
	(.0002)	(.0002)	04(.0001)	(.0002)	(.0001)	(.0002)
PA	.0009**	.0008	.0005(.0006)	.0012*	.0009*	.0009
	(.0005)	(.0006)		(.0007)	(.0005)	(.0006)
ASCAGE		-.0056		.0107*		.0054
		(.0048)		(.0060)		(.0047)
ASCEDU		-.0683*		.1446***		.1098***
		(.0375)		(.0407)		(.0333)
ASCINCOME		.010***		.0047***		.0112***
		(.002)		(.0017)		(.0019)
ASCGENDER		-.2233		-.1680		.6282***
		(.1562)		(.1725)		(.1600)
ASCCHILDREN		-.1348		.0897		.1297
		(.2116)		(.1972)		(.1911)
ASCENV		1.0290***		1.0137***		.4676***
		(.3170)		(.2698)		(.1713)
ASCAGR		.8962***		1.5529***		-.1192
		(.1869)		(.4240)		(.1426)
Pseudo R2	0.05262	0.09119	0.09044	0.13422	0.03941	0.08675
Log likelihood	-1307.570	-984.9534	-1239.520	-731.0136	-1460.606	-1090.818
D.F.O	6	13	6	13	6	13
Chi^2(critical Chi^2	145.2460 (9.4877)	197.6532	246.5000	226.64760	119.852	207.242
in brackets)		(16.9190)	(9.4877)	(16.9190)	(9.4877)	(16.9190)
Observations	1263	999	1245	769	1408	1099

Notes: Significance levels indicated by: * 0.1, **0.05, ***0.01, standard errors in brackets $^{\Delta}$ Hawkesbury-Nepean

Table 5. Results of CL and RP models for the Hawkesbury-Nepean catchment

	Local/rural **HN/HN** Survey conducted in HN $^{\Delta}$		**Distant/urban** **HN/Sydney** Survey conducted in Sydney		**Distant/rural** **HN/Namoi** Survey conducted in Namoi			
	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions	CL Attributes only	CL with interactions	RP	RP with interactions
ASC	-.1986 (.2424)	-3.8937*** (.6445)	-.4672** (.2456)	-3.955*** (.7050)	-.5550** (.2454)	-.4269 (.5140)	-.2570 (.3114)	.0222 (.3448)
COST	-.0045*** (.0004)	-.0047*** (.0005)	-.0053*** (.0004)	-.0052*** (.0005)	-.0042*** (.0004)	-.0045*** (.0005)	-.0049 (.0006)	-.0053*** (.0006)
NV random parameter	.6190D-04 (.0004)	.0001 (.0001)	.0003*** (.0001)	.0003*** (.0001)	.3623D-04 (.0001)	.4990D-04 (.0001)	***-.0002*** ***(.0002)***	***-.0003*** ***(.0006)***
NS	.0283*** (.0052)	.0325*** (.0061)	.0198*** (.0054)	.0269*** (.0067)	.0192*** (.0053)	.0219*** (.0059)	.0238*** (.0062)	.0260*** (.0069)
HW	.0033*** (.0010)	.0042*** (.0012)	.0045*** (.0010)	.0057*** (.0013)	.0037*** (.0010)	.0038*** (.0011)	.0046*** (.0012)	.0046*** (.0014)
PA	.0006 (.0005)	.0011* (.0006)	.0008 (.0005)	.0009 (.0007)	.0008 (.0005)	.0004 (.0006)	.0006 (.0006)	.0002 (.0007)
ASCAGE/NVAGE		.0223*** (.0049)		.0189*** (.0061)		-.0123** (.0042)		-.0001** (.5341D-04)
ASCEDU/NVEDU		.1257*** (.0368)		.0777* (.0418)		.0388 (.0297)		.3480D-04 (.3613D-04)
ASCINCOME/NVINCOME		.0085*** (.0023)		.0119*** (.0018)		.005*** (.002)		.6046D-05*** (.2502D-05)
ASCGENDER/NVGENDER		.5930*** (.1508)		.5283*** (.1701)		-.3368*** (.1353)		-.0003* (.0002)
ASCCHILDREN/NVCHILDREN		-.2922 (.2016)		-.1987 (.1990)		.1368 (.1129)		.5191D-04 (.0001)
ASCENV/NVENV		.3475 (.2174)		.5477*** (.2320)		-.5319** (.2393)		-.0049* (.0003)
ASCAGR/NVAGR		-.0238 (.2077)		.4834** (.2529)		-.0411 (.1424)		-.0001 (.5341D-04)
Standard deviation NV							.0012*** (.0004)	.0012*** (.0004)
Pseudo R2	0.0469	0.0886	0.06347	0.12079	0.03982	0.06059	.0549	.0648
D.F.O	6	13	6	13	6	13	7	14
Log likelihood	-1423.711	-1000.866	-1394.734	-847.1601	-1464.555	-1154.783	-1461.927	-1157.925
Chi^2(critical Chi^2 in brackets)	139.9880 (9.4877)	194.6540 (16.9290)	189.04400 (9.4877)	232.78460 (16.9190)	121.468 (9.4877)	148.958 (16.9190)	169.8374 (14.6071)	160.4211 (33.9234)
Observations	1365	1004	1360	879	1408	1127	1408	1127

Notes: Significance levels indicated by: * 0.1, **0.05, ***0.01, standard errors in brackets $^{\Delta}$ Hawkesbury-Nepean

9.2 The implicit prices

Given that one of the attributes presented was cost, respondents' WTP for changes in each attribute level were estimated as implicit price (IP) estimates. The marginal value of a change in a single attribute was calculated by dividing the β coefficient of the attributes (NV, NS, HW, and PA) by the β coefficient of the costs parameter and multiplied by *-1*.

$$\mathrm{IP}=-1\left(\frac{\beta_{\mathrm{attribute}}}{\beta_{\mathrm{money}}}\right) \qquad \textbf{\textit{(13)}}$$

In most cases, the full CL models were used to calculate WTP but in one case, the RPL model gave a better fit and was used for the calculations. The 95 percent confidence intervals (CI) for the implicit prices (IP) for the CL models and for the non-random parameters for RPL models were calculated using a bootstrapping procedure (Krinsky and Robb, 1986). Using this procedure, a vector of 1000 sets of parameters for each attribute was drawn from the covariance matrix for each sub-sample. IPs for random parameters were estimated using unconditional parameter distributions and conditional means methods. A Poe et al. (1994) test was used to compare the IPs derived from the CL and RPL models. No significant differences were found.

9.2.1 Attribute Values for the Lachlan, Namoi and Hawkesbury-Nepean catchments

Lachlan catchment

The IPs for improvements in the Lachlan catchment attributes are presented in Table 6 for three different communities: the local/rural community (Lachlan respondents), the distant/rural community (Hawkesbury-Nepean respondents) and the distant/urban community (Sydney respondents).

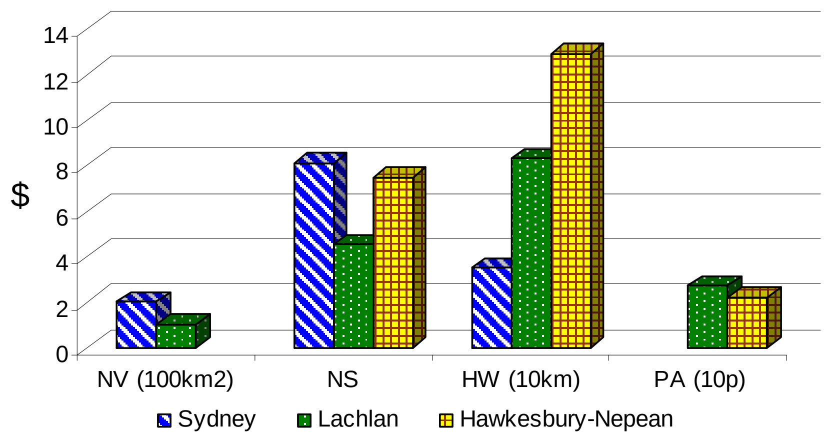
Table 6. Attribute Values for the Lachlan catchment

Attributes / Respondent Location (sub-sample)	**NV** Ares of native vegetation in good quality (km^2)	**NS** Number of native species (species)	**HW** Kilometres of healthy waterways (km)	**PA** Number of people working in agriculture (person)
Sydney (distant/urban)	\$0.02** (0 ~ 0.03)	\$8.11*** (3.36 ~ 12.85)	\$0.35* (-0.02 ~ 0.73)	-\$0.10 (-0.34 ~ 0.14)
Lachlan (local/rural)	\$0.01** (0 ~ 0.03)	\$4.51** (0.52 ~ 8.50)	\$0.83*** (0.49 ~ 1.18)	\$0.27*** (0.08 ~ 0.47)
HN (distant/rural)	\$0.01 (-0.01 ~ 0.03)	\$7.45*** (2.43 ~ 12.46)	\$1.29*** (0.83 ~ 1.75)	\$0.22* (-0.02 ~ 0.47)

Notes: IPs calculated from the CL full model, significance levels indicated by: * 0.1, **0.05, ***0.01, 95% CI in brackets calculated using bootstrapping (Krinsky and Robb, 1986).

The results show that local Lachlan respondents are willing to pay for more of each of the attributes (NV, NS, HW and PA) in their own catchment. The distant/rural community (Hawkesbury-Nepean) also had positive and significant values for the improvement in NS, HW and PA in the Lachlan catchment. However, the value for NV improvement was not statistically significant, implying that the Hawkesbury-Nepean residents are not willing to pay for the improvement in NV in the Lachlan catchment. The distant/urban respondents from Sydney have positive values for improvements in all the environmental attributes (NV, NS and HW) in the Lachlan catchment. Unlike in the rural communities (Lachlan and Hawkesbury-Nepean) the value for PA was insignificant for the distant/urban community implying that Sydney respondents are not interested in paying to maintain employment in agriculture in the Lachlan catchment. The significant IPs for all four attributes obtained from the three different locations are presented in Figure 4.

Figure 4. Attribute Values for the Lachlan catchment.



Namoi catchment

The IPs for improvements in the Namoi catchment attributes are presented in Table 7 for three different communities including the local/rural community (Namoi respondents), the distant/rural community (Lachlan respondents) and the distant/urban community (Sydney respondents).

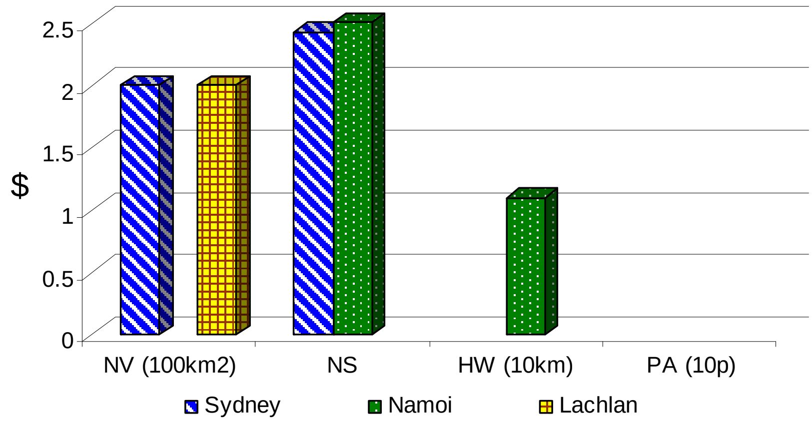
Table 7. Attribute Values for the Namoi catchment

Attributes / Respondent location (sub-sample)	**NV** Ares of native vegetation in good quality (km^2)	**NS** Number of native species (species)	**HW** Kilometres of healthy waterways (km)	**PA** Number of people working in agriculture (person)
Sydney (distant/urban)	\$0.02*** (0.01 ~ 0.04)	\$2.43** (0.23 ~ 4.64)	\$0.01 (-0.5 ~ 0.07)	\$0.19* (-0.03 ~ 0.41)
Namoi (local/rural)	\$0.01 (0.00 ~ 0.03)	\$2.50** (0.24 ~ 4.75)	\$0.11*** (0.05 ~ 0.18)	\$0.15 (-0.07 ~ 0.37)
Lachlan (distant/rural)	\$0.02** (0.00 ~ 0.03)	\$1.79 (-0.61 ~ 4.18)	\$0.04 (-0.03 ~ 0.11)	\$0.18 (-0.06 ~ 0.42)

Notes: IPs calculated from the CL full model, significance levels indicated by: * 0.1, **0.05, ***0.01, 95% CI in brackets calculated using bootstrapping (Krinsky and Robb, 1986).

Local respondents of the Namoi catchment are willing to pay for the improvement in NS and HW in their own catchment. However, the values for the improvement in NV and PA were insignificant in the local/rural sub-sample. The distant/rural community (Lachlan) was willing to pay for the improvement in NV in the Namoi catchment. The WTP for other attributes in this sub-sample were insignificant. The Sydney respondents expressed their interest in paying for higher amounts of NV and NS in the Namoi catchment. However, their values of PA and HW were insignificant. These results show that only the local residents of Namoi catchment wanted to pay for the improvement in the HW in the Namoi catchment. The two distant communities (Lachlan and Sydney) are willing to pay for the improvement in NV in the Namoi catchment whereas the local respondents' value for this environmental attribute was insignificant. The significant IPs for all four attributes obtained from the three different locations are presented in Figure 5.

Figure 5. Attribute Values for the Namoi catchment.



Hawkesbury-Nepean catchment

The IPs for attribute improvements in the Hawkesbury-Nepean catchment are presented in Table 8 for three different communities including the local/rural community (Hawkesbury-Nepean respondents), the distant/rural community (Namoi respondents) and the distant/urban community (Sydney respondents).

Table 8. Attribute Values for the Hawkesbury-Nepean catchment

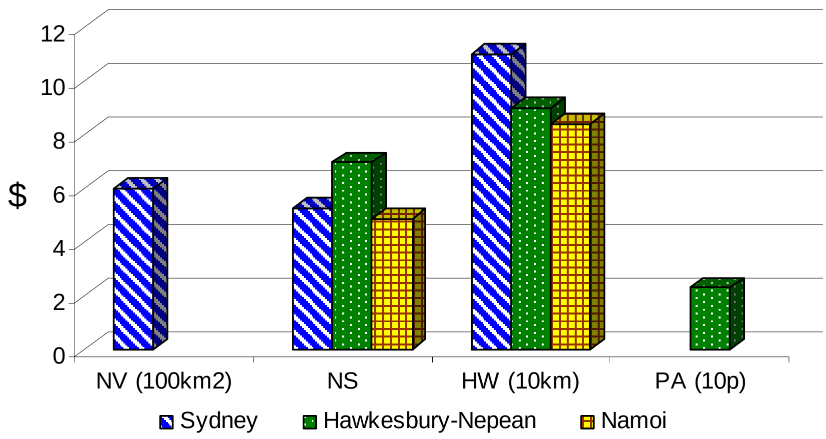
Attributes / Respondent location (sub-sample)	**NV** Ares of native vegetation in good quality (km^2)	**NS** Number of native species (species)	**HW** Kilometres of healthy waterways (km)	**PA** Number of people working in agriculture (person)
Sydney (distant/urban)	\$0.06** (0.01 ~ 0.11)	\$5.25*** (2.61 ~ 7.90)	\$1.10*** (0.56 ~ 1.64)	\$0.17 (-0.08 ~ 0.42)
HN (local/rural)	\$0.03 (-0.02 ~ 0.08)	\$6.97*** (4.21 ~ 9.74)	\$0.90*** (0.37 ~ 1.42)	\$0.23* (-0.02 ~ 0.48)
Namoi (distant/rural)	\$0.01 (-0.04 ~ 0.06) -\$0.07$_{RPL}$	\$4.97*** (2.26 ~ 7.68) \$4.85***$_{RPL}$	\$0.84*** (0.30 ~ 1.38) \$0.87***$_{RPL}$	\$0.09 (-0.17 ~ 0. 35) \$0.04$_{RPL}$

Notes: IPs calculated from the CL full model, significance levels indicated by: * 0.1, **0.05, ***0.01, 95% CI in brackets calculated using bootstrapping (Krinsky and Robb, 1986).

The local respondents of the Hawkesbury-Nepean catchment were interested in paying for the improvement in all attributes except NV in their own catchment. Namoi respondents however were only willing to pay for improvements in NS and

HW. Sydney respondents expressed their WTP for the improvement across all attributes except PA. These results show that only the local community is willing to pay for PA. Unlike the Sydney community, both rural communities were not interested in paying for the improvement in NV in the Hawkesbury-Nepean catchment. The significant IPs for all four attributes obtained from three different locations: Sydney (distant/urban), the Namoi catchment (distant/rural) and the Hawkesbury-Nepean catchment (local/rural) are presented in Figure 6.

Figure 6. Attribute Values for the Hawkesbury-Nepean catchment.



9.3 Hypothesis testing

In order to perform the hypotheses tests for the location effect it is necessary to identify whether the differences between the estimated IPs of the attributes across the different sub-samples are statistically significant. The Poe et al. (1994) test was used to compare IPs between different sub-samples. The Krinsky and Robb (1981) bootstrapping procedure was used to simulate the distribution of each IP by using a 1000 of random draws. Using these random draws, the distributions of IP differences between sub-samples pairs were compared. This process was repeated 100 times for each pair of IP in order to generate the average proportion of differences where the differences are greater than zero.

9.3.1 Hypothesis test for HA: The local/rural (WTP^{LR}) versus distant/rural (WTP^{DR}) communities test.

This test involved a comparison of the IPs (for each attribute from each catchment) between different rural communities' locations.

The results of these comparisons showed that at the five percent significance level there are no significant differences in any of the attributes' IPs for each catchment in all three tests for local/rural *versus* distant/rural communities. Therefore the null hypothesis HA_0 is not rejected and the alternative hypothesis HA_1 is rejected.

9.3.2 Hypothesis test for HB: The local/rural (WTP^{LR}) versus distant/urban (WTP^{DU}) community test.

A comparison of the IPs (for each attribute from each catchment) between the local/rural and distant/urban community for each location was conducted to test whether HB_0 that implies that there are no significant differences in values between local/rural (Lachlan respondents) and distant/urban (Sydney respondents) communities could be rejected and the alternative hypothesis HB_1 that implies that there are significant differences between these two communities could be accepted.

Lachlan catchment attributes

The Poe et al. (1994) test showed no significant differences in IPs for Lachlan's NS and NV between Lachlan respondents and Sydney respondents. However, significant differences in IPs for the improvement in the Lachlan's HW and PA attributes were found between Lachlan and Sydney communities' values. For example, Sydney respondents' value for the HW in Lachlan catchment (Lachlan/Sydney sub-sample) was not significantly different from zero but for the respondents from the local catchment (Lachlan/Lachlan sub-sample) the value estimate was $0.83 and significantly different from zero. Also significant differences in WTP for PA were found between the local Lachlan catchment and Sydney sub-sample. For example, Lachlan residents' WTP for an increase in one person working in agriculture in their own catchment was $0.27 and significant whereas the WTP for Sydney respondents was not significant. Hence, for the Lachlan HW and PA values the null hypothesis HB_0 is rejected and the alternative hypothesis HB_1 is accepted. For the NV and NS values, the HB_0 hypothesis could not be rejected.

Namoi catchment attributes

No significant differences in IPs for Namoi NS, NV and PA between Namoi respondents values and Sydney respondents values were found. A significant difference in values for the HW attributes was found between the Namoi and Sydney communities. The local Namoi community (Namoi/Namoi) WTP for this attribute was ($0.11) significantly different from zero and the value held by Sydney respondents was insignificant (see Figure 4).

Therefore, HB_0 is partially rejected as there are significant differences between the local/rural and the distant/urban communities' values for only the improvement in HW in the Namoi catchment but not for other attributes.

Hawkesbury-Nepean catchment attributes

The Poe et al. (1994) test showed no significant differences in IPs for all the Hawkesbury-Nepean' attributes (NV, NS, HW and PA) between local/rural and distant/urban communities. This implies that the null hypothesis HB_0 could not be rejected and the alternative hypothesis HB_1 is rejected.

Conclusion for the HB test

The Poe et al. (1994) test showed no significant differences in IPs for NS and NV in all three tests between local/rural versus distant/urban communities. However, some significant differences in IPs for the HW and PA attributes between distant/rural and distant/urban communities were found for the Namoi and Lachlan improvements. No significant differences in IPs for each of the attributes were found for the Hawkesbury-Nepean catchment.

Hence, the null hypothesis HB_0 that implies that there are no significant differences in values between local/rural and distant/urban communities is partially rejected.

9.3.3 Hypothesis test for HC: The distant/rural (WTP^{LR}) versus distant/urban (WTP^{DU}) community test.

This test involves a comparison of the IPs (for each attribute from each catchment) between two distant communities (rural and urban).

Lachlan catchment attributes

Significant differences for the improvement in the Lachlan' HW and PA attributes were found (see figure 4). The results showed that in Sydney the value for the improvement in one kilometre of HW in the Lachlan was not significantly different from zero but respondents from the Hawkesbury-Nepean catchment value this good at $1.29. Also the IP for PA was not significant for Sydney respondents whereas the Hawkesbury-Nepean respondents valued this attribute at $0.22 (significantly different from zero). The IPs for NS and NV were not significantly different between Hawkesbury-Nepean and Sydney respondents. The null hypothesis HC_0 is partially rejected for improvements in the Lachlan catchment.

Namoi catchment attributes

The IPs for all the attributes for the Namoi catchment do not differ significantly between Lachlan respondents and Sydney respondents. Therefore, the null hypothesis HC_0 is accepted and the alternative hypothesis HC_1 is rejected.

Hawkesbury-Nepean catchment attributes

The IPs for all the attributes for the Hawkesbury-Nepean catchment do not differ significantly between Namoi respondents and Sydney respondents. Therefore, the null hypothesis HC_0 is accepted. The alternative hypothesis HC_1 is rejected.

Conclusion for the HC test

Only differences in values for the improvements in Lachlan catchment natural resources were found between two distant communities (rural and urban). The IPs for all the attributes from the Namoi and the Hawkesbury-Nepean catchments did not differ significantly between two distant communities (rural and urban).

Therefore the null hypothesis HC_0 that implies that there are no significant differences in WTP between distant/urban communities and distant/rural communities is partially rejected.

Table 9. Attribute value estimates

Quest.	Attributes / Respondent location (sub-sample)	**NV** Ares of native vegetation in good quality (km^2)	**NS** Number of native species (species)	**HW** Kilometres of healthy waterways (km)	**PA** Number of people working in agriculture (person)
Namoi	**Sydney** (distant/urban)	**$0.02**	**$2.43**	----	**$0.19**
	Namoi (local/rural)	----	**$2.5**	**$0.11**	----
	Lachlan (distant/rural)	**$0.02**	----	----	----
Lachlan	**Sydney** (distant/urban)	**$0.02**	**$8.11**	**$0.35**	----
	Lachlan (local/rural)	**$0.01**	**$4.51**	**$0.83**	**$0.27**
	HN (distant/rural)	----	**$7.45**	**$1.29**	**$0.22**
HN	**Sydney** (distant/urban)	**$0.06**	**$5.25**	**$1.10**	----
	HN (local/rural)	----	**$6.97**	**$0.90**	**$0.23**
	Namoi (distant/rural)	----	**$4.97**	**$0.84**	----

Notes: ---- indicates that values were not significant.

10. Conclusion

The location test undertaken in this study allows for an assessment of the aggregated NSW community's values for non-market attributes in selected NSW catchments.

This study showed that there are some significant differences in value estimates between rural and urban communities for the Namoi and Lachlan catchments attributes. Significant differences exist in the PA and HW attributes values. Moreover, the concern about HW in the Namoi catchment was only significant for local rural community.

Moreover, the impact of socio-economic characteristics on choices was identified to be of different significance for the three communities' locations. For example, the respondents from local/rural, distant/rural and distant/urban communities who were associated with environmental organisations were more likely to choose the change option for the Namoi and Lachlan catchments. However, respondents from both rural communities (local and distant) who are associated with environmental organisation did not show any significant preferences toward a change option for the Hawkesbury-Nepean catchment. Also the local/rural and distant/urban respondents associated with the agriculture industry but not distant/rural respondents showed a preference toward change options of NRM in all three catchments.

The significant differences in preferences between different communities' locations and the different impact of the socio-economic characteristics in different communities' locations shown in this study suggests that an appropriate aggregation of the values for environmental improvements should be made on the basis of preference heterogeneity.

By using this approach the estimated values from this study will allow for an appropriate aggregation of environmental values to obtain catchments population and whole NSW population values. The design of this study took into account not only the variations in different communities' preferences and socio-economic characteristics of different communities on value estimates but also the differences between NRM catchment characteristics. These results showed that the differences in environmental conditions could also have an impact on value estimates. Factors such as the scarcity of the good and the scale of the improvement could potentially influence people's choices. Further analysis of these factors could be used in benefit transfer of these values to similar studies in different NSW catchments.

The aggregated non-market values that can be obtained from this study will be suitable to be used in CBA by CMAs to determine those actions and areas of potential investments that can generate the greatest net benefits to society.

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