# Risk & Sustainable Management Group

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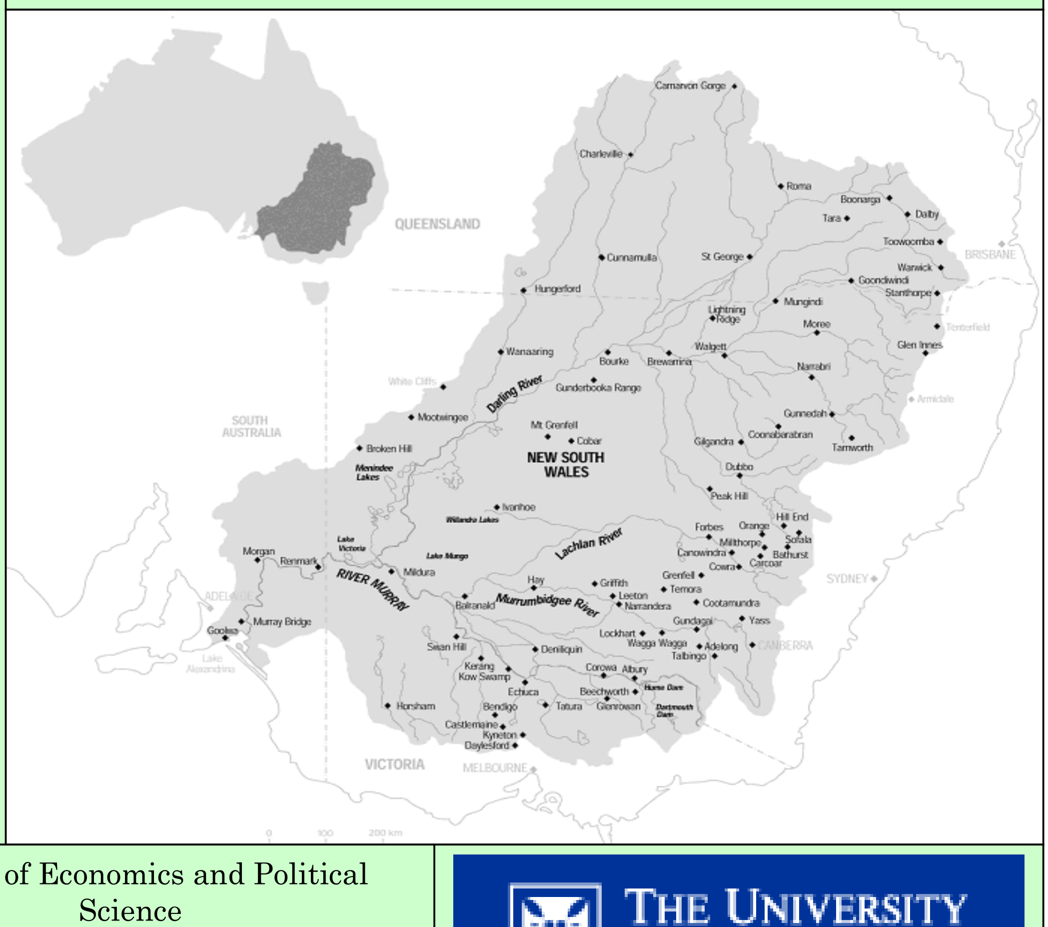
### WILLINGNESS TO PAY AND WILLINGNESS TO ACCEPT FOR CHANGES IN NATIVE VEGETATION COVER.


**Nanni Concu**



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# WILLINGNESS TO PAY AND WILLINGNESS TO ACCEPT FOR CHANGES IN NATIVE VEGETATION COVER.

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**Abstract**
In this paper we experiment with an original format of a Choice Modelling questionnaire developed to capture preferences from respondents with different property right frame of references. The format includes both WTP and WTA choice alternatives for native vegetation management. It is well documented in the literature that WTP and WTA differ considerably when the property right frame of reference changes. Accounting for different property right regimes is important because it greatly improve policy assessment. It would indeed possible to determine the direction of change from the current policy. Would it be optimal to tighten a standard or loosen it?

## Introduction

This paper addresses two issues. First, we investigate the willingness-to-pay (WTP)/willingness-to-accept (WTA) disparity using the Choice Modelling (CM) technique. Second, we use the same Choice Modelling application to test the efficiency of native vegetation protection measures the state of Queensland (Aus) introduced in 2004.

Theory and experiments have been widely used to analyse the disparity between WTP and WTA. The gap is often interpreted as an "endowment effect" where the initial endowment affects the rate of exchange between goods. Prospect theory states that endowment effects and loss aversion—people commonly value losses much more than commensurate gains—describe a fundamental feature of human preferences (Tversky and Kahnemann 1991). The neoclassical model of decision making, on the contrary, assumes that preferences do not depend on the current assets and that the initial entitlement does not change the final allocation. The WTP/WTA disparity is then taken as evidence that individuals do not have Hicksian preferences. Many experimenters have observed significant differences between WTA and WTP measures (see Horowitz and McConnell 2002); many others have not (see Plott and Zeiler 2005). Hence, the observed disparity could be the result of weak methods for preference elicitations. That is, in some experimental settings individuals may not reveal their true preferences.

The existence and interpretations of the WTP/WTA disparity have important implications for the design and implementation of environmental policies. WTA and WTP imply different property right regimes. If the two measures diverge, environmental policies could be substantially altered by the assignment of property rights. For instance, assume the public's WTP for native vegetation conservation is half the WTA compensations for loss of native plants. Also assume developers would willingly buy or sell land at the prevailing market prices. The amount of native vegetation protected when rights are assigned to developers and had to be purchased by the public would be less than the amount protected if the developers had to purchase rights from the public (Horowitz and McConnell 2003).

The Queensland's native vegetation legislation assumes the first property right regime. The 2004 Vegetation Act Amendment Bill (Queensland Department of Natural Resource and Water) phased out broad scale land-clearing by 2006. It aims to protect Queensland's biodiversity and addresses salinity, soil degradation and water quality problems. The Bill provides $150 million in financial assistance that will take primarily two forms. First, the Government can buy landholders out if their business if not longer viable after the introduction of the new legislation. The Government will pay the value of the land determined on the basis of the development potential prior to the legislative change. Second, incentives for protection of native vegetation are assigned through tenders for funds. This process is expected to deliver biodiversity and landscape outcomes and to provide income to landholders. Overall, for the intervention to produce an efficient outcome, the amount paid by the government should be less than the value of biodiversity services generate by new land uses. It is plausible that some members of the public have different views on the correct property right regimes. In order to assess the efficient of a policy, it is then necessary to check how benefits from development compare to conservation and biodiversity benefits estimated under the two property right regimes. Indeed, if WTP and WTA differ substantially, a policy may pass the efficient test under one regime but not the other. Of course, if WTA and WTP do not differ, the way benefits are estimated is not relevant.

We design a CM study to address the issue of the hypothetical disparity of WTP and WTA for changes in land use and native vegetation conservation. In environmental valuation studies, the common practice is that monetary attribute of the policy under valuation is either framed as WTP or WTA. That is, the monetary attribute changes in one direction only with reference to the status quo. The reason is to avoid "endowment effects". However, evaluating an environmental change under either the WTP or the WTA framework makes impossible to capture preferences based on different property right frames of reference. Farmers may protest to policies requiring them both to pay for environmental conservation through taxes and to give up agricultural land to native vegetation. On the other hand, some section of the public may abhor the idea of gaining monetary benefits in order to loose environmental services. As a result, the evaluation exercises may leave out the preferences of important policy's stakeholders. Our CM application divides the sample in two groups. One group receives a CM questionnaire proposing policies that are both more and less expensive than the current native vegetation policy. That is, the contribution to the policies could be negative or positive –respondents would pay more or less in taxes than what they are actually paying. The second group receives a standard CM questionnaire in which the same policies are framed in terms of WTP. Respondents in this group are asked to pay no less than their current contribution to environmental conservation policies. One would expect that the two different treatments produce different results. In what direction? A symptom of endowment effects would be that when respondents face a policy proposal that entails compensation for an environmental change, they would require larger monetary payments than in case the policy asks respondents to pay. By splitting the sample in two, the respondents receiving the WTP questionnaire format would work as a control group.

This study is the first application of the CM technique to investigate the WTA/WTP disparity. Several Contingent Valuation (CV) studies and experiments have tackled the problem. CM has an advantage over CV. It asks respondents to repeat the choice task several times. Plott and Zeiler (2005) show that practicing to choose help respondents to discover preferences and then reduce the WTP/WTA gap.

The paper is organised as follow. In section 1 we briefly review of the literature on 'endowment effects". Section 2 contains a description of the Choice Modelling technique. In section 3 we illustrate the institutional framework, the study area, and the design of the study. Section 4 illustrates the sampling and survey administration. Results and discussions are reported in section 5. In section 6 we conclude.

**1. Endowment effects in Stated Preference methods.**

Stated preference (SP) techniques such as Contingent Valuation (CV) and Choice Modelling (CM) are the only available methods for the estimation of 'passive use' or 'non-use values'. These techniques are based on the creation of hypothetical markets for the exchange of public goods. The transactions in hypothetical markets generate a set of data which is then used to estimate the benefits of environmental changes. SP techniques are often regarded with scepticism because they are troubled with anomalies–i.e. systematic inconsistencies between the theory used to organise the data collection and interpretation, and the pattern of individuals' responses. The disparity between WTP and WTA is on of these anomalies. While the Hicksian theory does not imply WTP=WTA (Hanemann 1991), Sudgen (2006) argues that the difference should be small. For an individual with Hicksian preferences, if the WTP is only a small fraction of income–as is expected for environmental goods– the gap between WTP and WTA should be in the order of few percentage points (Sudgen 1999, p.159). Horowitz and McConnell (2002) review 45 WTP/WTA studies–for a total of 201 experiments–and find that WTA is about seven times higher than WTP. Theory and estimates are clearly at odds.

In order to improve the reliability of elicitation methods, hypothetical data have been enriched with observations obtained from revealed preference methods. This approach combines observations from real but surrogate markets and hypothetical markets. Adamowicz et al. (1994) pioneered this approach in the field of environmental valuation. They found sufficient evidence to claim that revealed and SP data contain a similar preference structure. They also cannot reject the hypothesis that the underlying variance of the two datasets is different. In other words, while the parameter point estimates are not statistically different, stated preference estimates have larger variance.

Controlled, theory-driven experiments in laboratory settings have also been designed to assess the magnitude of the hypothetical bias. Experiments are typically set up as direct revelation mechanisms in which individuals have a dominant strategy to reveal their true valuation of the good. In SP methods, individual responses to valuation questions do not entail a real economic commitment or real economic consequences. On the contrary, in experimental valuation, the revelation mechanism entails a real economic commitment, or consequence, or both. In three simple Dichotomous Choice (DC)–or take-it-or-leave-it–experiments, Cumming et al. (1995) found that the hypothetical DC experiments did not generate the same responses as the real DC experiments. List and Gallet (2001) reviewed 29 field and laboratory studies. They found that, on average, respondents overstated their preference by a factor of 3 in hypothetical settings. In Balistreri et al. (2001), DC and Open-Ended (OE) question formats were used to estimate WTP for insurance against an environmental hazard with known probability. WTP estimates were then compared with auction values. Hypothetical values systematically overestimated auction values. The OE format had a bias smaller than the DC format. Also Veisten and Navrud (2006) compared hypothetical DC and Open-Ended (OE) hypothetical experiments to Actual Payment (AP) for the provision of an environmental good. Respondents facing DC and AP questions stated lower willingness to pay than respondents confronted with just DC question or OE and AP questions. The gap between stated and actual WTP was lower when respondents face mechanisms that induce truth telling.

In their seminal paper, Plott and Zeiler (2005) developed alternative strategies to investigate anomalies in SP. They designed a set of controls to reduce or eliminate "subject misconceptions"–that can loosely define as "confusion"–under the assumption that it is a source of the WTP/WTA disparity. The first control was the use of an incentive compatible mechanism to induce subjects to reveal their true preference for private goods. By telling the truth, subjects increase the probability of gaining the maximum amount possible. Training was the second control strategy. It provides subjects with a basic understanding of the elicitation mechanism. Many incentive-compatible mechanisms are indeed unfamiliar to subjects, even if the task may appear to be a simple buying or selling task. The third control was a set of practice rounds to allow subject to experience the instrument while gaining familiarity with its properties. In particular, Plott and Zeiler (2005) used paid practice rounds so that subjects were immediately exposed to the consequences of their decisions. And finally, the experiments assured anonymity. If decisions are not made anonymously, subjects may be concerned with how others view their bids. The main finding of Plott and Zeiler's experiments is that no WTP/WTA disparity is observed. Their primary conclusion is that the observed WTP/WTA gaps do not reflect a fundamental feature of human preferences.

The CM method is a repeated exercise in which respondents are asked to choose policy alternatives grouped in six to ten choice sets. The method provides a straightforward way to test if repetition helps to correct stated preference anomalies. Swait and Adamowicz (2001) showed indeed that the variance of estimated utility parameters decreases as respondents familiarise with the choice tasks. But would repetition be enough also to actually eliminate anomalies?[1]

**2. The Choice Modelling application.**

The Choice Modelling (CM) technique has been increasingly applied in environmental valuation (Adamowicz 2004). It is a technique belonging to Conjoint Analysis, a set of experimental tools designed in the early 1960s by mathematical psychologists (McFadden 1986, Mackenzie 1993). CM combines Lancaster's approach to consumer theory with Random Utility Theory (Louviere et al. 2000). Individuals are assumed to choose the alternative that yields the highest utility. Each alternative's utility is represented by a utility function $U_i$ that contains an observable (deterministic) element $V_i$ and a stochastic element $\varepsilon_i$:

$$U_i = V_i + \varepsilon_i \qquad (2)$$

The alternative's characteristics–or attributes–enter the deterministic element of the

[1] The experimental conditions in a CM application are clearly very different from laboratory experiments. Hardly anything definitive could be inferred from any result.

utility function. An individual will choose alternative $i$ if $U_i > U_j$ for all $i \neq j$. Since the stochastic elements are not observed, the analyst can only describe the probability of choosing $i$ as:

$$\Pr[i \quad is \quad chosen] = \Pr[(V_i + \varepsilon_i) > (V_j + \varepsilon_j)] \qquad \forall j \in C \tag{3}$$

where $C$ is the set of all possible alternatives. Probabilities of choice can be computed from (3) once the distribution of the error terms is specified. The deterministic component is usually specified a linear, additive function of the choice attributes (Louviere et al. 2000):

$$V_i = \Sigma_i \, \beta_{ik} \, X_{ik} \tag{4}$$

where $\beta_{ik}$ is a parameter vector conditional on a matrix of $k$ alternative's attributes. In a CM experiment, subjects are presented with several alternatives usually partitioned in choice sets of two or three. What researchers observe in this experimental setting is a series of yes/no answers that indicate which alternative provide the maximum utility. $\beta_{ik}$ is estimated as the set of parameters that maximise the utility of the chosen alternatives.

The alternatives presented to the subjects are selected from the universe of possible alternatives by a mechanism called design of experiment (Louviere et al. 2000). Consultation with experts, focus group and pilot studies are usually set up with the purposes of identifying the attributes and their levels. Variables that are expected to affect the utility of any alternative but that do not vary across alternatives, such as socio-economic characteristics and distance, have to be interacted with choice specific attributes. The great advantage of the CM technique is the possibility of breaking down the observable element of utility function into explanatory variables that can strategically varied by the researcher. It allows estimating marginal values for each single attribute that enter $V_i$, testing its significance and evaluating the welfare impacts of policies as different bundles of attributes.

## 3. Institutional framework for native vegetation management.

The Queensland's Vegetation Management Amendment Bill 2004 is a package of measures to phase out broadacre land clearing, and to protect "of concern" remnant vegetation. Land clearing contributes to species extinction, salinity, declining water quality, land degradation, damage to coastal marine zones, and greenhouse gases emissions. The Bill commits Au$150 million to assist landholders who are significantly affected by the legislation.

Queensland is the state with the largest remaining forest cover in Australia but until recently accounted for the greatest annual rate of clearing. Until 1999 there was no regulatory framework and the cattle industry took advantage of new, more resistant cattle breeds and pasture varieties to expand production in areas previously left undeveloped. Sheep and cattle farming enjoyed favourable terms of trade and high commodity prices in the 1970s and 80s, and farmers responded by clearing more land for production. During the 1990s, decline of commodity prices pushed small farmers to further clearing to remain viable (Australian Commodity Statistics 2004). Most of the land clearing occurred in central-eastern and south-eastern Queensland. The institutional environment changes in 1999 with the approval of the Vegetation Management Act (VMA), successively emended in 2004 to phase out broad acre tree clearing by 2006. The underlying concern of this legislation is that too much land has been taken away from forests, woodlands and native grasslands.

The current policy is a mixture of a simple command-and-control strategy and some incentive measures. A command-and-control strategy implies fixing the upper or lower limit for resource use. The VMA establishes that the admissible rate of land cleared should go to zero by 2006. In other word, the land allocated to native vegetation in 2006 is the upper limit of the resource use. At the same time, the legislation provides financial assistance to establish native vegetation. Every year, then, the quantity of land available for development is reduced by the amount of revegetated land. Authorities are working under the assumptions that the marginal benefits of land reclaimed from development are larger than marginal costs.

The CM application aim to elicit public's preferences over changes of the VMA. The standard fixed by the VMA could be more stringent—for instance, reclaiming land from agriculture or forestry to native vegetation in order to combat greenhouse gas emissions. It could be also relaxed to expand agriculture so that farmers can exploit favourable market conditions or favourable seasons. Relaxing the standard may be seen as unfeasible or undesirable. However, as it has been proposed, impacts of climate change on farm profitability could be mitigated by allowing more flexibility in land allocation and opening up high rainfall areas in North Queensland to agriculture. This would require overruling the VMA. Eliciting people's preferences over relaxing or tightening the VMA requires attention for property right regimes. There is a risk of respondents rejecting policy scenarios because of inappropriate regime framing.

*3.1 The study area.*

The study area is the Maranoa-Balonne catchment on the Queensland-New South Wales border, around 500 km west of Brisbane (Figure 1). For the 15 years from mid-1988 to mid-2003, the average clearing rate for the Maranoa-Balonne catchment (NRM) Region was 60,000 ha/year (Queensland Department of Natural Resources and Water, 2005). This equates to 0.9% of the region area cleared per year. This also represents 13% of the average Queensland clearing rate for the 15 year period. The Maranoa-Balonne NRM Region covers 3.7% of the State land area. The trend for the 15 years strongly reflects the average state trend, with a significant increase in clearing rates since 2001. Since 1997, clearing of remnant vegetation has made up 60% of total clearing in the region.

The catchment supports a population of around 20,000, with the majority living in the main centres of Roma, Miles and St George. The region includes the Carnarvon ranges in the north, and the headwaters of the Darling River system. The Maranoa-Balonne catchment is part of the Mulga Lands bioregion. It consists of undulating plains and low hills supporting a range of acacia and eucalypt woodlands, shrublands and grasslands. The main land uses within the region are grazing, cropping and irrigation. Grazing accounts for more than 300,000 ha. Wheat and barley crops account for the greatest area of cropping with 375,000 ha of wheat on average grown annually. Irrigation within the Maranoa-Balonne catchment accounts for 78,000 ha, of which cotton is the most economically important crop, accounting for $300 million per annum. The area of native vegetation is around 5,700,000 ha but it is reputed to be mainly in moderately poor conditions (Walker and Dowling, 2006).

*3.2 Design of the CM study.*

Designing the CM survey required focus groups and a review of the existing literature. We organised three focus groups. 16 post graduate students with background in natural resource economics took part in the first focus group. It run for 1 hour and 30 minutes. The group was divided by gender in 9 female and 7 male students. Half of the participants were international students. The goals of the session were described as follow:

- *general goal*: provide information for the design of a Choice Modelling experiment on native vegetation management
- *goals specific to the session*: understand what are the most relevant **indicators** policy-makers could act on to address the consequences of tree clearing—loss of habitats, loss of topsoil, acidification and deterioration of soil structure, salinity, and greenhouse gas emissions.

The session was organised in two parts. The first part was a questionnaire in which participants were asked to rank 25 indicators of water, land, biodiversity, social and economic conditions. Ranking was done through a 5-point Likert scale –from very important to unimportant. The set of indicators correspond to the one developed for the Land and Water Audit on catchment conditions (Commonwealth of Australia, Land and Water Resource Audit, 2001). The facilitator illustrated the meaning of each indicator referring to the Malonne-Baranoa catchment in the Queensland Murray Darling Basin. Participants were reminded to assess indicators according three criteria:

- How well the indicator reflects a valued element of the environment, the economy or society;
- If actions to improve the indicators are possible or desirable;
- How relevant the indicator is for policy and management needs.

Participants had 15 minutes to fill the questionnaire. The rationale behind this task was to provide technical information on native vegetation, stimulate participants to ponder the different aspects of vegetation management, and encourage interaction.

The second part of the session was an open discussion prompted by two questions. The facilitator asked firstly if participants thought the set of indicators excluded some important measures of social, economic or ecological conditions. After a brief discussion, the group stated that they would have liked more information on:

- Social conditions. Participants indicated that a relative measure of job losses in the catchment would provide more information than an absolute number. They asked for the number of jobs in agriculture and the population density.
- Area of intensive agriculture; the group wanted more information on the extent and type of Genetically Modified crops. This interested was manly driven by two international students, but the group at the end agreed GM crops is an important issue.

At the end of the session participants indicated the five most important indicators of catchment conditions. Participants discussed the relative importance of the indicators and reached a consensus on which indicators are **less** important:

- Rivers in salt hazard
- Rivers in acid hazard
- Soil acidification
- Agriculture on steep slopes
- Employment (as absolute number)
- Hillslope erosion
- Household waste
- Feral Animal Density
- Road density
- Weed Density

The group debated for some time on the **most** important indicators. At the end, the list of most was quite long. Six indicators emerged as most important, but closely followed by other eight. The most important six indicators were:

- Soil degradation.
- Current Salinity levels in soil.
- Intensive Agriculture Area
- Higher education qualification
- Native vegetation fragmentation
- Protected Areas

This set can be grouped in: a) indicators of land conditions (soil degradation and current salinity levels); b) indicators of biodiversity conditions (protected areas, native vegetation fragmentation and intensive agriculture area); c) social conditions (higher education qualification).

The second focus group was composed by 11 undergraduate students with a background in economics of natural resources. Participants were 6 male and 5 female students. No international student took part to this session. The goals of the second focus group were:

- Testing if a policy scenario described by indicators suggested in the previous focus groups was meaningful to participants;
- Understand what elements are important for policy implementations (time frame, payment vehicle, agencies involved);

The session was divided in two parts. The first part introduced participants to the tasks of a focus group, the structure of the session and topic under discussion. Participants were encouraged to interact and exchange opinions. They were also reminded that participation was voluntary. In the second part, participants were asked to discuss few topics related to native vegetation policies. The facilitator prompted the discussion proposing two policy scenarios defined using the indicators suggested by the first focus group. The rational behind this question was to put participants in a position of choice, where they could reveal what information and indicators were important in taking a decision about the policy.

Participants stated they needed more information on the effects of the policy in two areas: a) the impact on agriculture, either expressed in terms of *income* or in terms of *job*; and b) The impact on biodiversity, possibly with a list of the species affected by the policy. The session moved on to the discussion of payment methods. Four methods were proposed–changes in the water bill, changes in the food bill, changes in land rates, and an environmental levy via a tax increase or decrease. At the end of the discussion, the group supported using the environmental levy. They were concerned that other methods would penalise low income citizens. Participants also discussed the maximum amount they reputed plausible for an environmental levy. There was a general agreement that any amount above $30 would have been perceived as excessive. We take this as the maximum level of our monetary attribute.

In the next step in the Choice Modelling design, we contrasted the information gathered with the focus groups with the relevant literature on native vegetation in Australia. Table 1 summarizes the most recently published Stated Preference studies on native vegetation management in Australia. Blamey *et al.* (2000), Mallawaarachchi *et al*. (2001), Bennett *et al.* (2001), Mallawaarachchi *et al*. (2005) and Hatton-McDonald and Morrison (2005) applied the CM technique to address issues of land use conflicts between agriculture and native vegetation. With the exception of Blamey *et al.* (2001) and Bennett *et al.* (2001), these studies use a native vegetation attribute expressed in terms of the extent of the native vegetation cover. The biodiversity attributes and the socio-economic indicators differ across studies.

Table 2 lists the set of attributes selected for the CM survey. Attribute levels in bold indicate the level of the current policy. **Land and biodiversity indicators** are a set of three attributes describing the land cover in the catchment. Distinguishing between biotopes—and providing relevant information—is meant to help respondents to understand the impact of land use changes on species and landscape. As reported above, the second focus group suggested the facilitator to provide more information on the species affected by the policies. The classification of land cover corresponds to the Bureau of Rural Science Integrated Vegetation database (Bureau of Rural Science, http://data.brs.gov.au/mapserv/intveg/nht.php). This database provides also the most update land cover data for the area under study. The policy impact on rural communities is summarised by the **socio-economic indicator** “Job in the agricultural sector”. The first focus group indicated that the absolute number of jobs is not informative, and suggested the use of a percentage changes. We decided to give respondents both the absolute numbers and the change for each attribute.

Table 1. Stated Preference studies on native vegetation in Australia.

| *Author(s)* | *Vegetation Attribute(s)* | *Levels* | *Other biodiversity indicators* | *Levels* | *Social/economic attributes* | *Levels* | *Monetary attribute* | *Levels* |
|---|---|---|---|---|---|---|---|---|
| Blamey *et al.*(2000) | Loss in area of unique ecosystems (%) | **40%**, 15%, 22%, 28%, 35% | • Number of endangered species lost to region<br>• Reduction in population size of non-threatened species (%) | 4, 8, 12, 16, **18**<br>30%, 45%, 60%,75%, **80%**, | • Job lost in region<br>• Income lost to region ($ million) | **0**, 10, 15 20,30, 40<br>**0**, 5, 10, 15 | Levy on income tax | **$0** $20 $60 $100 $140 |
| Mallawaarachchi *et al*. (2001) | • Wetlands (ha)<br>• Tea-tree woodlands (ha) | **700**, 250<br>**12000,** 15000, 30000 | | | Income in region in 2005 ($ million) | $50, $100, **$400** | Annual levy on land rates | **$0**, $50, $100 |
| Bennett *et al.*(2001a, 2001b) | a) Wetlands (km$^2$) | **1000**, 1250 1650 | • Waterbirds breeding,<br>• Endangered and protected species present | **Every 4 years**, 3, 1<br>**12**, 15, 25 | Irrigation related employment | 4400, 4350, ? | Water rates (one-off increase) | **$0,** $20, $50 |
| | b) Loss in area of unique ecosystems (%) | 15%, 22%, 28%, 35%, **40%** | • Number of endangered species lost to region<br>• Reduction in population size of non-threatened species (%) | 4,8,12,16, **18**<br>30%, 45%, 60%,75%, **80%** | • Job lost in region<br>• Income lost to region ($ million) | **0**, 10, 15 20, 30, 40<br>**0**, 5, 10, 15 | Levy on income tax | **$0** $20 $60 $100 $140 |
| Morrison and Bennett (2004) | Healthy riverside vegetation and wetlands (%) | | Native fish<br>Waterbirds and other fauna | **15 species**, 18, 21, 25<br>**30% of river,** 40%, 60%, 80% | Recreational uses | **picnic/boating** to swimming (4 lev) | Levy on water rates (one-off) | **$0** $50 $100 $200 |
| Van Bueren and Bennett (2004) | Area of farmland repaired and bush protected (ha), | | Number of species protected from extinction | | 1)Net loss of people from country town each year, 3) Length of waterway restored for fishing and swimming (km) | | Annual household levy | |

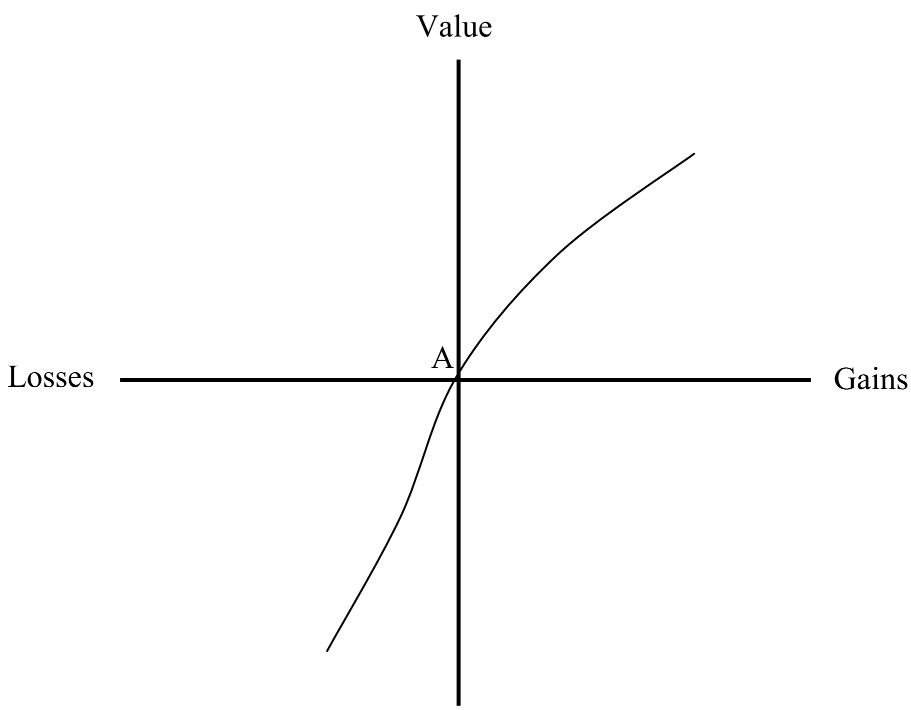
| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Mallawaarachchi *et al*. (2005) | Rare or unique vegetation (ha) | **15000,** 17000, 20000, 23000, 26000 | | | Area of sugar cane (ha),<br><br>Urban area (ha) | 12000, 15000, 18000, **19000**, 22000<br>**5000**, 10000, 15000, 20000 | Changes in land rates | **$0** $50, $100, $200 |
| McDonald-Hatton and Morrison (2005) | 1) Scrublands (ha),<br><br>2) Grassy woodlands (ha)<br><br>3) Wetlands (ha) | **66000,** 73000, 80000, 90000<br>**46000**, 51000, 56000, 63000<br>**73000**, 81000, 88000, 99000 | | | | | Levy per year per 5 year | **$0** $10, $20, $40, $60 $80, $100 |
| Rolfe and Windle | 1) Healthy vegetation left in floodplains (%),<br>2) Waterways in good health (km) | | Unallocated water | | Protection of Aboriginal cultural sites | | Environmental levy for 20 years | |

Table 2. Attributes and levels.

<table>
<tr><th colspan="4">Land/biodiversity indicators</th><th colspan="4">Socio/economic indicators</th></tr>
<tr><td>Attribute</td><td>Levels (ha)</td><td></td><td></td><td>Attribute</td><td>Levels</td><td></td><td></td></tr>
<tr><td>Area of native forest and woodlands</td><td>2,300,000<br>2,200,000<br>2,100,000<br>2,000,000<br>1,900,000</td><td>+200,000<br>+100,000<br>-<br>-100,000<br>-200,000</td><td>+10%<br>+ 5%<br><br>-10%<br>-5%</td><td>Jobs in the agricultural sector</td><td>2600<br>2300<br>2000<br>1700<br>1400</td><td>+600<br>+300<br><br>-300<br>-600</td><td>+30%<br>+15%<br><br>-15%<br>-30%</td></tr>
<tr><td>Area of native shrublands and heathlands</td><td>380,000<br>350,000<br>320,000<br>290,000<br>260,000</td><td>+60,000<br>+30,000<br><br>-30,000<br>-60,000</td><td>+20%<br>+10%<br><br>-20%<br>-10%</td><td colspan="4">HP:<br>Average farm size in the catchment=1500 ha<br>Average job per farm = 4 / 5 (less than 5)</td></tr>
<tr><td>Area of native grassland and minimally modified pasture</td><td>3,600,000<br>3,450,000<br>3,300,000<br>3,150,000<br>3,000,000</td><td>+300,000<br>+150,000<br><br>-150,000<br>-300,000</td><td>+10%<br>+5%<br><br>-5%<br>-10%</td><td colspan="4">Monetary cost and levels</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Attribute</td><td colspan="2">Treatment 1</td><td>Treatment 2</td></tr>
<tr><td></td><td></td><td></td><td></td><td>Environmental levy per year per 5 year (per household)</td><td colspan="2">$30<br>$20<br>$10<br>$5<br>$0</td><td>$30<br>$25<br>$20<br>$15<br>$10</td></tr>
</table>

Under the current legislation, Queensland taxpayers are already contributing to native vegetation conservation. The VMA provides $150 million in 5 years in incentives and compensation for farmers to adapt to the VMA regime (NRW, http://www.nrw.qld.gov.au/vegetation/financial/index.html). Queensland's 15 Natural Resource Management (NRM) Regions received $146.6 million in the past three years (2004 to 2006) to protect and restore the state's water quality, World Heritage Areas, biodiversity hotspots, RAMSAR sites, cultural values and agriculture (Commonwealth of Australia, Ministry for Agriculture, Fisheries and Forestry). Overall the average QLD taxpayer pays around $6.00 for the vegetation management in the Maranoa-Balonne catchment per year.  This means that the average household pay for the environment around $13.00 per year. We round it to $10.00, considering that not all the money from NHT and NAP goes to native vegetation programs. This is the second fixed point of our monetary attribute.

We designed two questionnaire formats using the attribute and levels from table 2. The first format or treatment proposes policies for vegetation management in which all attributes –including the monetary attribute– can change above and below the status quo. This is likely to expose us to endowment effects, if they are a feature of respondents' preferences. The hypothesis under scrutiny is that, in case of endowment effects, the decreases in income tax–or environmental levy–have distinguishable effects on choices. That is, in order to accept an environmental change people would expect a compensation larger than the amount they would pay to make without the environmental change. Take Tversky and Kahneman (1991) illustration of the loss aversion problem (figure 1).




In the proximity of the reference point A we expect the impact of correspondent gains and losses to have different impacts on utility. That is, the monetary amount that can compensate forgoing a gain would not be enough to compensate incurring a loss. Respondents should then be less sensitive to payments than to small compensations.

The two fixed points (levels of the status quo and the maximum amount) of the monetary attribute forced us to choose the levels and steps reported in table 2. The first questionnaire format accommodates for respondents whose preferences are based on different views of the rights on native vegetation and biodiversity.  The second treatment proposes policies under the traditional WTP format. Each respondent is asked to contribute to the policies by paying an environmental levy through income taxes, no matter what their personal property right frame of reference is. Also in this case, the status quo level and the maximum amount dictate the intermediate levels of the monetary attribute. We used a Hyper Graeco-Latin (HGL) square to combine attributes and levels in the final choice sets. Latin squares create choice sets that have the same properties has fractional factorial designs. They provide balanced and orthogonal designs (Cox and Reid, 2000).  Figure 2 gives an example of the two formats of the final choice sets. Notice that under the treatment 1, respondents compare policy options that may require an increase or a decrease in the environmental levy. Under treatment 2 respondents compare options that involve an environmental levy at least as large as the current tax contribution for vegetation management.

**4. Sampling and survey administration.**

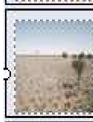
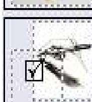
The questionnaire was administered by mail in July and August 2007. Participants were randomly selected from three geographical areas: within the Maranoa-Balonne catchment, from the Border Rivers catchment, and from Brisbane's metropolitan area

Fig. 2. Examples of Choice Sets.

**Treatment 1**

| | Table 2 | Current Policy | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
|  | *Forests and woodlands (ha)* | 2.1m ha | 2.2m ha<br>+100,000 ha | 1.9m ha<br>-200,000 ha |
|  | *Shrublands and heathlands (ha)* | 320,000 ha | 260,000 ha<br>-60,000 ha | 290,000 ha<br>-30,000 ha |
|  | *Grasslands and minimally modified pasture (ha)* | 3.3m ha | 3.45m ha<br>+150,000 ha | 3.15 ha<br>-150,000 ha |
|  | *Jobs in the agricultural sector* | 2,000 | 1,700<br>-300 | 1,700<br>-300 |
|  | *Environmental Levy per year for 5 years ($)* | $10.00 | $30.00 | $ 5.00 |
|  | Please tick your preferred option | ☐ | ☐ | ☐ |

**Treatment 2**

| | Table 4 | Current Policy | Alternative 1 | Alternative 2 |
|---|---|---|---|---|
|  | *Forests and woodlands (ha)* | 2.1m ha | 2.2m ha<br>+100,000 ha | 2.3m ha<br>+200,000 ha |
|  | *Shrublands and heathlands (ha)* | 320,000 ha | 320,000 ha<br>– | 260,000 ha<br>-60,000 ha |
|  | *Grasslands and minimally modified pasture (ha)* | 3.3m ha | 3.0m ha<br>-300,000 ha | 3.6m ha<br>+300,000 ha |
|  | *Jobs in the agricultural sector* | 2,000 | 2,300<br>+300 | 2,300<br>+300 |
|  | *Environmental Levy per year for 5 years ($)* | $10.00 | $25.00 | $10.00 |
|  | Please tick your preferred option | ☐ | ☐ | ☐ |

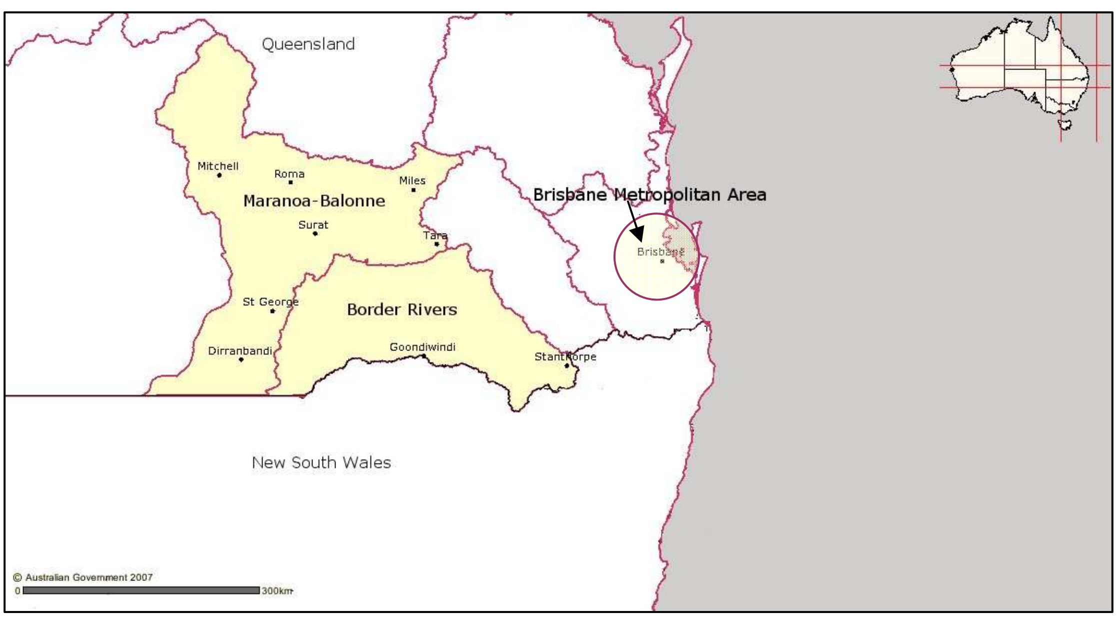
(see table 3 and figure 3). Over 1,000 respondents were sampled from each area, with a slight larger number for the Brisbane metro area to correct for outdated addresses. Each questionnaire was accompanied by an introductory letter. A small monetary prize was offered to incentive participation. After few weeks, a reminder letter was sent.

Table 3. Sampling frame and response rates.

| *Area* | Population | Sample Size | | Returned | | Response Rate (%) |
|---|---|---|---|---|---|---|
| | | | *Treatment 1* | *Treatment 2* | *Total* | |
| Maranoa-Balonne | 20,200 | 1,278 | 33 | 35 | 68 | 5.3 |
| Border Rivers | 22,300 | 1,210 | 54 | 48 | 102 | 8.4 |
| Brisbane | 1,500,000 | 1,364 | 57 | 60 | 117 | 8.6 |
| *Total* | | 3,852 | 144 | 143 | 287 | 7.4 |

We received back 287 questionnaires. Overall the response rate is less than 10%. This is a very low response rate, well below the 20-25% that is common in this type of work. This low response rate cannot be imputed to neither of the treatments. It is clear, though, that neither the reminder letter nor the monetary incentive had any effect on participation.

Figure 3. Map of the study area




**5. Results and discussion.**

We use a Multinomial Logit model to a preliminary data analysis. Multinomial Logit (ML) models are unsophisticated yet powerful models that assume the errors in eq. (3) are identically and independently distributed (i.i.d.) with a type I extreme distribution (Louviere et. al, 2000).

In table 4 we report the estimation results of the ML model. We use the ML both on all observations and on respondents that were subjected to the two treatments. Each choice alternative in the choice sets is coded to create a set of Alternative Specific Constant (ASCs).

Table 4. Results of the Multinomial Logit model.

| | *All Observations* | *Treatment 1 (WTP)* | *Treatment 2 (WTP/WTA)* | *T tests* | | |
|---|---|---|---|---|---|---|
| | *Coeff. (a)* | *Coeff. (b)* | *Coeff. (c)* | *(a)-(b)* | *(b)-(c)* | *(a)-(c)* |
| ASC1 | -0.30767*** | -0.49458*** | -0.19043** | 1.55 | -2.29 | -1.10 |
| | *0.000* | *0.000* | *0.024* | | | |
| ASC2 | -0.51353*** | -0.67708*** | -0.34760*** | 1.45 | -2.58 | -1.53 |
| | *0.000* | *0.000* | *0.000* | | | |
| FOREST | 3.80997*** | 3.91907*** | 3.57750*** | -0.20 | 0.54 | 0.43 |
| | *0.000* | *0.000* | *0.000* | | | |
| SHRUB | 0.00566*** | 0.00712*** | 0.00432*** | -0.85 | 1.44 | 0.82 |
| | *0.000* | *0.000* | *0.001* | | | |
| GRASS | 0.67294*** | 0.71618*** | 0.51189** | -0.14 | 0.58 | 0.54 |
| | *0.000* | *0.004* | *0.032* | | | |
| JOBS | 0.00100*** | 0.00099*** | 0.00089*** | 0.08 | 0.42 | 0.57 |
| | *0.000* | *0.000* | *0.000* | | | |
| COST | -0.01080*** | -0.00600 | -0.01957** | -0.82 | 1.48 | 0.98 |
| | *0.004* | *0.173* | *0.015* | | | |
| Cost*Income | 0.00001*** | 0.00001*** | 0.00000 | -0.16 | 0.60 | 0.52 |
| | *0.004* | *0.007* | *0.469* | | | |
| Obs | 1826 | 899 | 927 | | | |
| Log-Likelihood | -1836.43 | -885.53 | -943.32 | | | |
| Adj Rsq | 0.066 | 0.069 | 0.062 | | | |
| Correct Prediction (%) | 50.5 | 52.1 | 53.7 | | | |

P-values in italics. **** significant at 1%, ** significant at 5%, * significant at 10%*

The coefficients have the expected signs. The ASCs are negative and significant. It has been extensively reported that this result indicates a "status quo" bias (Adamowicz et al, 1994). Respondents prefer the current policy to any alternative. However, under treatment 2, the weights of the ASCs on the utility expression (eq. 4) are smaller. Indeed,

with COST level both above and below the current contribution (the Status Quo level), the ASCs become a little bit more attractive under treatment 2.
The three environmental attributes have significant and positive coefficients. Respondents prefer more native vegetation. Analogous consideration is valid for the JOB attribute. Its positive sign indicates that respondents would rather have more jobs in the agricultural sector. The COST coefficient gives the weight of the COST attribute in the utility expression in eq.(4). As expected, the negative coefficient indicates that the higher the cost of a policy, the less likely respondents would support it. This effect is mitigated by increasing income. The interaction term "Cost*Income" shows that respondents with higher income are less concerned about the cost of a policy option. Note that the COST coefficient is not significant for Treatment 1. Indeed, under this treatment the COST attribute has less variability than under treatment 2. The lack of a significant COST attribute in Treatment 1 is probably linked to the highly significant coefficients for the ASCs. Under Treatment 1, alternative 1 and 2 are less likely to be chosen when compared to Treatment 2. The only difference in the choice alternatives between the two treatments is in the COST attribute. The ASCs seem to capture part of the COST effects.

The difference in the COST attribute coefficients has important consequences on the implicit prices. Implicit prices are the ratio of two utility parameters. When one of the parameters is measured in monetary units, implicit prices are financial indicator of WTP or WTA, everything else being equal. In Table 5 we list the implicit prices for the environmental and social attributes.

Table 5. Implicit prices (in $)

| | *All Observations* | | | *Treatment 2 (WTA/WTP)* | | | |
|---|---|---|---|---|---|---|---|
| | Mean value | 95% Krinsky-Robb Confidence Intervals | | Mean value | 95% Krinsky-Robb Confidence Intervals | | T-TESTS |
| FOREST | 356.99 | 254.94 | 459.03 | 184.67 | 100.46 | 268.89 | 2.55 |
| SHRUB | 0.52 | 0.35 | 0.67 | 0.23 | 0.13 | 0.32 | 2.95 |
| GRASSLAND | 62.23 | 43.93 | 80.54 | 27.8 | 15.36 | 40.24 | 3.04 |
| JOBS | 0.09 | 0.07 | 0.12 | 0.05 | 0.03 | 0.07 | 2.86 |

Contrary to expectations, the implicit prices calculated using parameter estimates from all observations are larger than the corresponding implicit prices obtained from the

Treatment 2 sub-sample. The presence of COST levels above and below the current individual contribution increases the variability and then the weight the COST attribute in the utility function.

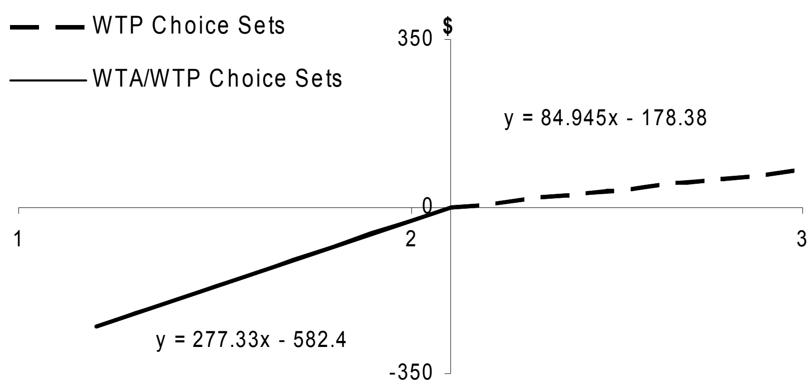
The analysis of the data from the Treatment 2 sub-sample offers further insights. We split this sub-sample by distinguishing the choice sets that contain WTA-type of alternatives from those that have only WTP alternatives. Results are listed in table 6.

Table 6. Results of the ML – WTP/WTA sub-sample

| | Coeff. | Std.Err. | t-ratio | P-value |
|---|---|---|---|---|
| ASC1 | -0.1208 | 0.0907 | -1.3312 | 0.1831 |
| ASC2 | -0.2901 | 0.0918 | -3.1588 | 0.0016 |
| FOREST | 3.4959 | 0.4376 | 7.9887 | 0.0000 |
| SHRUB | 0.0051 | 0.0014 | 3.6645 | 0.0002 |
| GRASS | 0.6330 | 0.2493 | 2.5385 | 0.0111 |
| JOBS | 0.0010 | 0.0002 | 5.9686 | 0.0000 |
| COST | -0.0412 | 0.0126 | -3.2594 | 0.0011 |
| CI | 0.0000 | 0.0000 | 0.7417 | 0.4582 |
| Choice Set=WTA | 0.0285 | 0.0129 | 2.2057 | 0.0274 |
| | | | | |
| Observations | | 927 | | |
| Log-Likelihood | | -940.863 | | |
| Adj Rsq | | 0.064 | | |
| Correct Prediction (%) | | 55.3 | | |

Note the coefficient of the dummy “Choice Set=WTA”. It is positive and statistically significant. When presented with WTA alternatives respondents assign less weight to the COST attribute. In other words, a decrease of the required contribution –a refund for the taxpayer–has less importance than a cost increase. To produce a welfare effect equal to that produced by a cost increase, the reduction in taxpayer’s contribution should be significantly larger. Respondents are behaving as predicted by Tversky and Kahneman (1991). In figure 4 we plot the welfare effects of increases and reduction of the FOREST attribute. There’s a clear kink in the welfare function. For increase of above the current level, the welfare function has a slope of $84.95–this is the implicit price for an increase in the attribute. When the attribute level falls below the current level, the welfare function has a slope of $277.33.

Figure 4. Welfare function for changes in the FOREST attribute.




Aggregating these implicit prices across the population of the two catchments and the Brisbane metropolitan area, we calculate the value per hectare of each vegetation type (table 7).

Table 7. Value per hectare of vegetation types (in $ per year) – Only respondents from Treatment 2

| | WTP Choice Sets | WTP/WTA Choice Sets |
|---|---|---|
| FOREST | 3033.74 | 9904.75 |
| SHRUBLANDS | 28.83 | 94.13 |
| GRASSLANDS | 349.54 | 1141.20 |

How do these figures compare with other estimates in the literature? Hatton-McDonald and Morris (2005) provide the following estimates for three vegetation types:

Table 8. Hatton-McDonald and Morrison (2005) estimates for three vegetation types (In $ per hectare per year for the whole State of South Australia)

| | Cov-het Model | MNP Model |
|---|---|---|
| Scrublands | 808 | 717 |
| Grassy Woodlands | 1164 | 1019 |
| Wetlands | 1909 | 1543 |

Even if the vegetation types are not directly comparable, it appears that the lower bounds of our estimates are comparable to those in Hatton-McDonald and Morrison (2005). One can reasonably assume that forests have the highest biodiversity, use and existence values. According to our model, forests have a value of around $3000 per hectare per year, while wetlands are worth around $2000 in Hatton-McDonald and Morrison (2005).

Figures for the implementations of the VMA are not available yet. According to the Queensland Department of Natural Resource and Water, however, the clearing rate of woody renmant vegetation in the Maranoa-Balonne catchment was around ha 13400. The large majority of this land cover was converted into pasture. Using our lowest ML estimates from the WTP/WTA treatment, the loss of ha13400 of woody renmant vegetation corresponds to a welfare reduction valued around $40m per year. Compared to this figure, the $150m in five years provided by the VMA for the whole Queensland appear to be insufficient. The welfare loss from tree clearing in the MB catchment sums to at least a third of the VMA provision.

## 6. Conclusion

In Queensland, the 2004 Vegetation Management Act sets the framework for managing native vegetation. The Act contains two important provisions: the phasing out of broad-acre land clearing and a package of financial measures to assist farmers adversely affected by the legislation. The first provision corresponds to fixing the amount of native vegetation cover. The second assume the welfare gains from the Act can compensate losses incurred by farmers.

We designed a CM application to capture welfare changes associated with both increases and decreases in native vegetation. We analyse the data from the CM questionnaire using the Multinomial Logit model. We first treat the observations as coming from the same population. We then split the sample distinguishing between respondents subject to the WTP-format-only and the WTP/WTA-format. Results indicate that the inclusion of WTA-type of alternatives in the choice sets produces the lowest welfare estimates for different native vegetation types. As expected, respondents that are offered a decrease in an environmental levy, and some other environmental changes, are less concerned about the moving away from the present policy. These respondents also behave as predicted by the "endowment effects". Respondents are worse off with a decrease in some environmental attributes and price than when they experience the corresponding price and environmental quantity increase.

Using conservative welfare estimates, we also found that the sampled population could benefit from further tightening of the Vegetation Management Act. The annual benefits from increasing forest cover in the sampled region are as large as a third of the financial resources available through the VMA for the whole state of Queensland.

These results are provisional and improvements are necessary. First, survey response rate was very low. The standard mechanisms used to stimulate participation didn't seem to work. A re-thinking of survey technique is probably necessary. Second, the WTA/WTP disparity issue is far from settled. While this paper confirms the "endowment effect", the presence of WTA alternatives in the choice sets offers greater variability in attribute levels, and produces lower welfare estimates. Further experiments with the mixed WTP/WTA formats would be extremely useful to investigate their actual impacts on the peoples' responses. On the econometric side, the ML is the simplest model. A straightforward improvement would be to account for respondents' heterogeneity with Nested Logit models.

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