Using Choice Modelling to establish the supply of riparian services and the potential for a water quality trading scheme in Central Queensland

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Abstract

The potential supply of water quality mitigation actions from diffuse sources is difficult to assess, although important for designing policies to encourage such actions. In this paper the design and results of a Choice Modelling(CM) valuation to assess the potential supply of rural mitigation actions from altered grazing management are reported. The valuation was focused on the supply of mitigating services (specified riparian management standards), the total cost of provision, and the extent to which these costs varied between landholders. CM has traditionally been applied to environmental valuation issues, but there is increasing use of the method to design agricultural markets. This study extends that application to markets for environmental actions.

Keywords: Choice Modelling, riparian management, market-based instruments

1. Introduction

Concern about the adverse environmental impacts of some land management practices on water quality in our river systems has resulted in both state and commonwealth funding for the National Action Plan for Salinity and Water Quality. In Queensland, these concerns are further exacerbated in the Great Barrier Reef (GBR) catchment area (Productivity Commission 2003; Science Panel 2003).

The government has used a mixture of regulatory and persuasive measures to try and reduced the impacts of land use activities on water quality. Considerable effort has been placed in voluntary schemes such as Landcare, but there is a widely held belief that voluntary measures alone will not be able to achieve the outcomes required to avoid the escalating costs of environmental damage. The Landcare style of changes in land management practices tend to involve both private benefits in terms of production gains

to the landholder as well as public benefits to society in terms of environmental gains, eg, weed control. However, the opportunity for further major gains in these areas appear limited.

The other key area of interest is land management changes that would bring public benefits, but involve a private cost to landholders. There has been a tendency in policy terms to view such tradeoffs as multi-party externality problems that are best solved through regulatory mechanisms. However, the externality paradigm is not always appropriate when there have been prior allocations of property rights, whether formal or informal (Anderson 2004). As well, regulatory intervention is not always very efficient, especially when there are potentially very large compliance, monitoring and enforcement costs.

In many of these areas, persuasive measures have been used to try and encourage landholders to "do the right thing", and reduce the environmental impact of their management actions. However, declining terms of trade in agriculture and adverse weather conditions have meant that many farmers cannot afford further production losses. There is a growing recognition that landholders might incur private costs by changing management practices to achieve environmental gains, and in order to achieve the desired environmental outcomes, landholders will need to be compensated for these incurred costs.

This recognition marks a shift in attitude to public and private property rights. If landholders are to be compensated for their private costs of making management changes, it implies they have some property rights over natural resource management. The implication of many regulatory interventions is that the public has the right not to be polluted. While regulation remains an important tool in some areas, it is not an appropriate or efficient mechanism to use for many natural resource issues. In areas where landholders hold property rights over land management issues, a more appropriate paradigm might be a form of negotiation over the balance between private and public outcomes.

A new range of policy tools, known as market-based instruments, are currently being developed to try and achieve environmental outcomes more efficiently and in the most cost effective way for society. The research outlined in this paper is being conducted as one of the pilot projects in the National Market-Based Instruments Pilots Program funded under the National Action Plan for Salinity and Water Quality. The main aim of the project is to examine the potential for quantity-based water quality outcomes in the Fitzroy Basin in central Queensland. These may be summarized as cap-and-trade mechanisms, offset trading and bubble schemes (O'Dea and Rolfe 2005). An overview of the environmental issues in the basin and opportunities for offset trading are outlined in Rolfe *et al.* 2004a.

The Fitzroy Basin is the second largest catchment in Australia and the largest of the catchments draining into the GBR. In terms of area, rangeland grazing is the principal land use and covers 87.5% of the basin area (Jones *et al*. 2000), with 94% of the area

used for agriculture (Furnas 2003). As it occupies such a large area in the basin, it is the land use which has the most impact on water quality. Sedimentation is the main environmental issue, with nitrogen and phosphorus loads also of concern.. Sediment comes from diffuse sources and in the Fitzroy River, with 63% of the sediment transport from hill slope erosion, 25% from gully erosion and13% is from stream bank erosion (NLWA 2003).

The focus of the research reported in this paper is on the minimization of diffuse source impacts from agriculture. A choice exists between two broad mechanisms for minimising water quality impacts from agriculture: riparian protection and improved ground cover. While improved ground cover would minimize most problems at the source, it is more difficult to implement as a policy option because of the heterogeneous landscape and difficulties in assessment and monitoring. The importance of riparian vegetation in improving water quality is outlined in Rolfe *et al.* 2004b, with riparian management selected as the primary mitigating strategy of focus in the project. While riparian buffers are essentially input controls designed to improve water quality rather than more desirable output measures, the lack of relevant scientific data and monitoring capability means that a focus on output measures (i.e. changed water quality off farms) is not practical. The establishment of riparian buffers has thus been selected as the appropriate mechanism for the study.

This paper focuses on the design of a Choice Modelling (CM) valuation exercise to determine the potential supply of riparian buffer rehabilitation by landholders in the Fitzroy Basin, in order to provide essential information to assist in the evaluation and design of a MBI to achieve water quality outcomes in the catchment. The technique has traditionally been applied to environmental valuation issues, but there is increasing use of CM to design agricultural markets (Lusk and Hudson 2004). This study extends that application to markets for environmental actions. It investigates landholders' preference heterogeneity in willingness-to-accept direct monetary incentives for the rehabilitation/restoration of riparian buffers. By predicting a supply function for riparian vegetation, the design of incentive structure can then be addressed. The demand for water quality improvements in the Fitzroy Basin has been assessed in a series of CM valuations (eg Rolfe *et al*. 2002; Rolfe and Bennet 2003; Windle and Rolfe 2002; 2004) and is synthesised in Rolfe *et al*. (2004b).

The design of a CM study is complex because of the number of relationships and factors that have to be modeled, and important because of the need to avoid biases and communicate choice tasks to respondents. In this paper, the main design issues and results of the CM valuation are reported. The remainder of this paper is set as follows. In the next section details are presented of the main design issues that distinguished this CM application (to examine management actions to provide environmental services) from the more standard application (to examine the values associated with environmental services). Details of the CM survey and the collection technique applied are presented in Section 3. The results are presented in the fourth section and discussed and summarized in the final section.

2. The Choice Modelling valuation – key design issues

Understanding the potential supply of riparian buffers by landholders is an important factor in modeling the application of different market based instruments. It might be possible, although difficult, to implement a minimum level of riparian buffer to be established, and then allow trade in the requirements between landholders. This would be a form of cap-and-trade mechanism. However the 'cap' would be difficult to implement given that it would be at odds with some landholder property rights over riparian management, especially for lower order streams.

A more realistic mechanism to introduce might be forms of offset trading, where landholders might supply intervention strategies to offset potential reductions from industry, urban or mining sources. To understand the potential for an offset market to operate, it is important to be able to model the supply of riparian buffers. The supply of riparian buffers might also be suited to government funded programs. In this situation, competitive tender mechanisms may be used to ensure efficient allocation of public funds. These are likely to hold some advantages over current systems of devolved grants used to achieve similar outcomes. Again, the estimation of a potential supply function for riparian buffers may be important to judge the likely takeup and gains available from this form of a market based incentive.

The research problem was to design an application of the CM technique to estimate the potential supply of riparian buffers. CM is typically used to estimate demands for a change in the provision of environmental factors, so this represented a very different application of the technique. There were four key design issues that needed to be addressed in the developing the CM exercise, which distinguish this CM application from the more common application to value non-market environmental goods. These are outlined in turn.

2.1 The policy context and implications

In a CM application a hypothetical market is created, but it must be framed in a realistic and believable policy context. One focus of the research project was on the use of a cap and trade policy mechanism, but this would have been an unrealistic policy context for agricultural producers. To impose the cap, a hypothetical regulation would need to be described to landholders, which would be unrealistic and likely to provoke an adverse reaction. Instead, the policy context was framed in terms of a competitive tender.

The competitive tender context framed the choice scenario in terms of the amount of money that landholders would be prepared to accept in order to provide a certain level of riparian buffer on their property. This was realistic as property rights were implicitly assigned to graziers and they would be paid for services provided. It was believable, as some landholders already received devolved grants to assist in the cost of fencing off riparian areas. It also provided the right incentives for graziers to participate in the survey.

One implication of using a competitive tender policy context was that a willingness-to-accept (WTA) format would need to be used. The disparity between willingness-to-pay (WTP) and WTA is well documented in the literature and substantial effort has been applied at both a theoretical and experimental level to explain the differences (Mitchell and Carson 1989, Hanemann 1991, Horowitz and McConnell 2002). Given the potential for strategic behaviour in a WTA payment format, consideration was given to the selection of choice attributes and the benefits of including at least one attribute described in qualitative terms.

The key issue with the WTP format is that respondents who were risk adverse or had little understanding of the tradeoffs may only respond to very high monetary incentives. To the extent that their response may be different in a real-world application where they had more time to consider and analyse their choices, the results of the CM exercise may understate the potential supply at various price levels.

2.2 Choice attributes

In a CM application, the choice scenario is described and presented to respondents in terms of different attributes. While many attributes seemed to be relevant to this case study, it was important to limit the number to four or five at the most so that tradeoffs were comprehensible to respondents. Initially consideration was given to a range of attributes that were explored in a focus group.

The potential attributes could be defined in two broad groups. The first were attributes that described the types of riparian buffers available. The types of attributes considered were:

- The potential width of a buffer zone,
- The stream order involved in a riparian buffer,
- The level of environmental service provided (i.e. the proportion of cattle exclusion),
- The length of the zone on each property (or the proportion of riparian length covered),
- The amount of fencing and water replacement that might be needed, and
- The level of landholder management required (i.e. weed control).

The second were attributes that defined the contract details. Here the key attributes that were considered included:

- The length of the contract period,
- The payment allocation over that period,
- The type of contracting body involved,
- The type of contract (i.e. a covenant over the land versus some form of contract),
- The type of monitoring and enforcement mechanism.

To reduce the number of attributes, the analysis was simplified in several ways. First, a number of key baseline conditions were set (outlined in Section 3 below) so that these did

not have to be presented as key attributes. Second, some additional information relevant to each choice made was collected in the survey. As well, other information was gathered by asking a separate question in the survey. Four attributes were finally used in the choice sets (see Table 2 in Section 3 below) which made the choice selection relatively straight forward. One attribute was described in qualitative terms and one attribute had a mixture of quantitative and qualitative levels.

2.3 Measurement issues

Table 1. Summary of measurement issues.

Issue	Considerations	Information to collect
River and Creek order	• Costs of riparian management vary with the size of the river. • There maybe more than one river and different river orders on a property.	• Focus on river order 3 and higher. • Focus on the highest river order on the property. • Identifying which river on the property is being considered was determined and agreed with the respondent beforehand.
Control and management of riparian land	• Give and take boundary agreements are common in Qld. Where boundaries run down the middle of a river, part of the river may be fenced into one property (give) and another part into into the adjoining property (take). • Rivers within a property will have two river bank riparian areas to manage	• Details of the length of river under the landholder control was separated into 3 categories. o River on the boundary edge o Give and take boundary o River within the property Landholders were asked in the survey to identify which of these applied to their situation.
Riparian areas covered by devolved grants	• Some landholders have already received devolved grants to assist with fencing costs.	• Landholders were asked to identify the river frontage areas that have been fenced under a devolved grant. These areas were to be excluded from the subsequent choice set questions..
Opportunity costs	• Buffer width will affect the opportunity cost, but will vary across locations because of different flood damage risk • Need to distinguish between opportunity cost and capital infrastructure costs so that bids could be compared.	• A separate question was used to establish the average width of river area under their control. • The capital costs associated with a WTA payment option were identified with a separate question on each choice set.

Using CM to provide information for assist in the design of an MBI meant that a variety of measurement issues needed to be addressed that would not arise in a CM environmental valuation. These are summarized in Table 1.

The amount of variability in the case study being considered made it very difficult to design appropriate choice sets. While the contract design issues and necessary management actions could largely be addressed by specifying set levels that applied to all the choice sets, the riparian buffer characteristics were more complicated to address. Some of the key issues that made it difficult to design choice sets that were applicable to all landholders were:

(a) Stream order: Stream order is important in predicting environmental benefits, but ranged from 1 (small watercourse) to 6 (major river) in the case study of interest. Most properties include more than one stream order, and it is unlikely that the opportunity costs are equivalent. This was addressed by asking for buffers on the highest stream order only, and identifying the stream order for each respondent.

(b) Buffer width: It was not practical to set a standard width for buffers because some floodplains are very wide compared to others, and many are already fenced at varying widths. This was addressed by setting only minimum widths for buffers, and not insisting that buffers be fenced.

(c) Cost structure: For some landholders, their willingness to accept would be determined not only by their opportunity costs, but by capital costs required as well. The latter would be involved when fencing was required for buffer zones, or when off-stream watering points were needed. Not all landholders would be affected, and the capital costs required might vary widely between landholders.

The problem caused by the capital cost component was that it would not be realistic to landholders to leave it out, but including it within the bid offers meant that it would be confounded with the production opportunity costs. This was addressed by asking respondents to nominate for each choice option selected the amount of waters and additional fencing required to implement the option. In the subsequent analysis, estimates of value for the capital cost components can thus be made and subtracted from the WTP amounts[1].

2.4 Sampling

Initially it was intended to collect information on both grazing and cropping enterprises to determine how the associated costs of the two may vary. However, this would have increased the complexity of the information presented to respondents, and it was decided to focus on cattle graziers, some of whom would have some cropping in their enterprise.

[1] A simple subtraction to give a net WTP amount may have raised experimental design problems, so it may have been better to introduce a new variable representing estimated capital costs.

Two separate areas were selected for comparison; one that had been targeted with devolved grants and one that had not. The purpose of this was to test whether familiarity with being paid to protect environmental areas helped to predispose respondents to supplying further areas of their property for this purpose. It was unlikely that landholders would have set aside all of their riparian areas under a devolved grants scheme. The CM survey would have targeted areas that would have involved an opportunity cost to landholders as well as capital costs.

3. The Choice Modelling survey

The CM scenario was framed in the context of landholders being paid for the provision of ecosystem services, and the following information was provided at the beginning of the survey.

> *We are interested in showing the State and Commonwealth governments that it is possible to negotiate with individual landholders to improve environmental conditions. We want to show that it will be more cost-effective for the government to focus in specific areas, and that it would be possible to negotiate varying levels of environmental improvement on a voluntary basis.*
>
> *We are suggesting a system where landholders could enter into contracts with a regional natural resource management body or government. In this system, landholders would receive annual payments to change their management practices for environmental outcomes, so that they are no worse off.*
>
> *T o demonstrate that there would be different amounts of interest and money required between landholders, we are focusing on what landholders think about managing vegetation buffer strips in their river frontage areas.*
>
> *The reason for focusing on vegetation along major waterways is to protect biodiversity and to reduce the amount of sediment entering major waterways. Sediment has potentially large impacts on the Great Barrier Reef area, but because there are many sources, it is difficult to impose any controls or regulation. We want to show that a system of incentives or voluntary contracts may be a better way of changing landholder actions.*
>
> *We are interested in the amount of payment you would need to manage your river frontage areas more conservatively.*

In a CM valuation exercise, the choice scenario is described in terms of different attributes. There are a range of attributes that are important components of riparian management and it was important that environmental outcomes (water quality improvements) could be achieved. Consequently, certain biophysical conditions or attributes were set as baseline conditions for any management options that attracted a rebate. These were outlined in the survey as follows:

The main requirements for the condition of this river frontage area is that:

(a) it should be a minimum of 50 metres from the top of the main bank

(b) it should be spelled for 40% of the year (can be spelled at several different times to make up the 40%), and

(c) there should be a minimum of 2000 kg/ha of grass biomass left by the end of the dry season (see photos on page 4 for examples).

Establishing these baseline conditions meant that other aspects of landholders preferences for incentive payments could then be explored in the choice sets. Four attributes were used to describe the choice scenario, two of which were 6 level attributes and two were 3 level attributes (Table 2).

Table 2. Attribute key used in survey questionnaire and levels applied

$	Payment received ($/km/year)	This represents the payment you would receive to meet the other option conditions.
	Attribute levels	*$100, $200, $300, $750, $1500, $2500**
	% of your river frontage covered	This refers to the length of river covered by an agreement. The management conditions outlined above will apply.
	Attribute levels	10%, 20%, 40%, 60%, 80%, 100%
	Length of agreement	This is the length of time that any agreement will last.
	Attribute levels	5 years; 10 years; perpetual
	Who you deal with	This refers to the type of organisation that will be the managing authority for any agreement. You will be given a choice between state and local governments and a registered community group.
	Attribute levels	State and local governments and community group

* An explanation of how the price levels were determined are outlined in Rolfe *et al*. 2004c

In a CM survey, respondents are presented with a series of choices or choice sets. In this survey there were six choice sets to complete. Each choice set had four options and respondents were required to select one option. The first option, which remained the same in each choice set, was the status quo or "do nothing" option. It was defined as their current management practices. Three other options were available, each described in terms of the same four attributes, but the levels varied in each option. The four option layout was chosen because it helped to minimize violations in modeling requirements[2],

[2] These are the IIA/IID conditions, which require that model parameters are proportionally unaffected if one of the alternatives is dropped from the analysis.

but came at a cost of making choice sets more complicated for respondents. An example choice set is provided in Figure 1.

Figure 1 Example choice set

Question 17a: Carefully consider each of the following options. Suppose these were the ONLY ones available, which would you choose?

Remember: The main requirements for the condition of this river frontage area is that:
(a) should be a **minimum of 50 metres** from the top of the main bank
(b) should be **spelled for 40% of the year** (can be spelled at several different times to make up the 40%), and
(c) there should be a **minimum of 2000 kg/ha grass biomass** left by the end of the dry season (see photos for examples)

Payment received $/km/year	% of your river frontage covered	Length of agreement	Who you deal with	I would choose
Option A				
$0	***Current***	***None***	***None***	☐
Option B				
$300	**10%**	**5 years**	**Local government**	☐
Option C				
$300	**20%**	**5 years**	**Community group**	☐
Option D				
$750	**10%**	**10 years**	**Local government**	☐

The experimental design[3] allowed for both main effects and first order interactions between the attributes to be estimated, and had an efficiency level of approximately 82%. There were six choice sets in each survey and six versions of the survey which meant that 36 different choice sets were completed in the survey.

Usually in a CM survey, respondents are simply asked to indicate their selection of a particular option in each choice set. However, in this study, once an option had been selected in the choice set, additional information was gathered on the fencing and water requirements associated with the option selected. This information was gathered so that the operating costs associated with the management option could be separated from the capital costs of providing extra fencing and water points.

In order to ensure the choice sets were clear and comprehensible icons were used and particular attention was paid to the layout. Colour was used to identify the status quo

[3] The experimental design was provided by Associate Professor Deborah Street from the University of Technology, Sydney.

option as compared to the choice sets, as well as to highlight that additional questions on fencing and water requirements needed to be completed for each choice set.

3.1 Survey collection details

One of the main concerns in survey collection is the response rate, particularly when landholders are the targeted participants.

There are four main factors that are likely to affect the response rate:

- the topic of the survey,
- how well the survey has been publicized,
- how difficult the survey is to complete, and
- how much effort is put into the survey distribution and collection.

A recent survey of sugarcane growers in central Queensland (with whom a low participation rate would be expected) achieved a response rate of 67% (Windle and Rolfe 2005). Although the survey was well tested at focus groups, it could not be considered easy to complete and included a relatively complicated Choice Modelling exercise with labeled choice sets. However, the topic of enterprise diversification was very relevant to canegrowers, which may have contributed to high participation rates. The survey collection technique involved an initial telephone call to establish landholders' willingness to participate in the survey which was well publicized and had industry support. The survey was then delivered directly to the respondent and collected from them at a prearranged time. This meant that respondents did not have to go to the effort of mailing the survey back, and knowing that someone was coming back to collect the survey meant that they that it was not so easy for them to ignore the survey or think it was too difficult to complete. The extra effort put into the collection had dividends in a higher response rates.

The vast size of the Fitzroy Basin, (143,000 sq kms) made the costs of applying the drop-off/pick-up collection technique prohibitive and a modified three-stage format was adopted. Two prior phone calls were made and then surveys were mailed out with a reply paid return envelope.

There was no list of contacts for graziers in the region and the first step was to try and identify possible participants. Two areas were targeted in the basin and all people listed with Telstra as "graziers" were contacted by phone and asked if they would be interested in completing a survey about paying graziers for improved management of river frontage areas. If agreeable they were informed that a follow-up phone call would be made and further information provided.

Of the 298 listed numbers, 157 (74%) were agreeable and 54 refused. Forty six could not be contacted and 41 were unqualified.

The second stage required identifying the exact property location of the potential participants on a database with exact information about the rivers/creeks and their river

order. Some properties might have more than one watercourse on the property, and names of rivers might vary. It was important that the respondent was clear about exactly which river or creek they were providing information about in the survey. In addition, for the survey information to be effective from an analytical perspective, it was important that the river order was known, because the costs associated with riparian management would vary according to river order. The information of the name of the creek and river order were agreed between the enumerator and the landholder over the phone and recorded on the survey before it was sent out. There were some difficulties in matching the properties from the first round calls with the database. In addition, not everyone had a creek or river of sufficient size as only river orders three and above were targeted.

The third stage was to mail out the surveys with a reply paid envelope for return. Only 60 graziers had been identified from the initial list and they were sent a survey in late 2004. A response rate of 33% was achieved with 20 surveys returned.

4. Survey results

The socio-economic characteristics of respondents are presented in Table 3. Generally, respondents were well experienced, and ran a family enterprise. While 75% did employ labour, the average was only two people (with part time labour counted as 0.5). Only 35% had some form of off-farm income, and for 71% of these, the proportion was less than 25% of household income. 65% had some level of debt, of which 62% had levels of less than 25% of the total asset value.

Table 3. Socio-economic characteristics of respondents

Respondent characteristics	
% male respondents	85%
Average age	53 years (range 36-67)
Average experience	34 years (range 10-60)
% with post year 12 education	45%
Average farm enterprise income (gross)	$250,000 - $500,000
% with dependent children	40%
Median number of family members working the property	2 (range 1-5)
% employing labour	75%
% with some off farm income	35%
% with some debt	65%
Property characteristics	
% freehold ownership	65%
Median property size (ha)	4378 (range 1110 - 137,500)
Median head of cattle	1110 (range 350 - 11,000)
Average stocking rate per ha	0.26 (range 0.08 - 0.51)
% cattle only enterprise	50%

Characteristics of the grazing enterprises are also presented in Table 2. The properties were relatively large, ranging from 1110 ha to 137,500 ha and average stocking rates were relatively low (0.26) which would be expected for the region. Half of the properties were cattle only enterprises and the other half had some cropping, but generally cropping comprised less than 15% of the property area.

The majority of respondents had a positive attitude to the profitability of their farm enterprise. 90% thought they were currently profitable and 75% thought they would be profitable in five years time. There was less optimism about property values, with 55% believing that values would increase in the next five years, while 45% thought they would stay much the same. Nobody thought they would decrease.

Respondents were mixed in their opinions about how they thought improving the condition of the natural environment on their property would affect the property value. As many thought it would decrease the value as thought it would increase, but half did not know, or thought it would have no effect. While there was not a strong perception that increasing the environment values would translate into an increase in property values, there was a perception that they were managing their properties in an environmentally responsible manner. Most respondents (75%) believed they balanced production and environmental benefits in their property management decisions.

The focus of attention in the survey was on maintaining a minimum grass biomass in riparian areas. A 2000kg/ha biomass was the baseline condition required (see Section 3), which was set at an above "duty of care" level. Respondents were asked what percentage of their river frontage area they estimated would have this biomass at the end of the dry season. The median percentage in a normal year was 90%; ranging from 10% to 100%. 35% believed they maintained this level of biomass 100% of the time. The median for the last couple of (drought) years was 60%, and ranged from 0% to 100%.

There was a range of river orders represented in the survey sample, with half being an order 4 or 6. The river order 6, the largest in the Fitzroy Basin, was the Dawson River. Half the properties already had all or part of their river frontage area already fenced and 25% had already received a grant to help with fencing costs. Apart from two properties; one with 80 kms and one with 25kms of waterway within their property, the average length was 6.4 kms or 5.6 kms that was not already fenced. The average width of river that would could be fenced off and managed separately was for most respondents under 250 metres (50% with 100 metres or less and 40% with 101-250 metres).

4.1 Choice Modelling results

The main result of the CM exercises was that there were too few surveys collected and too few choice sets completed for the choice data to be analysed. Seventy five per cent of respondents chose the status quo option and did not complete a choice set. Furthermore, out of a possible 120 choice sets (six pages of choices and 20 surveys) 87% selected the status quo option.

The strong preference for the status quo could have been because respondents were not interested in the incentive payments or because they found the choice sets too difficult. Both options were explored further in the survey.

Anecdotal evidence would suggest that there is considerable resentment towards the government by graziers in central Queensland over new tree clearing legislation. The *Vegetation Management and Other Legislation Amendment Act 2004* ensures broad scale tree clearing of remnant vegetation is phased out by 2006. An earlier moratorium and disputes over the classification of some areas as remnant vegetation as opposed to regrowth has generated much anger in the region over a number of years. Many graziers with freehold leases are concerned about the erosion of their private property rights and are suspicious of government initiatives. Some of the respondents may have viewed riparian buffers as another issue where landholder property rights could be eroded further.

In the survey, before being asked to complete the choice sets, respondents were asked if they were interested in being paid by the government to provide environmental benefits (eg making a buffer strip along their waterway). There was a mixture of responses, and broadly, 45% were not interested; 35% were interested and 20% were unsure. 30% specifically identified themselves as "not interested in dealing with the government".

However, it would appear that it is not distrust for the government that primarily motivated landholders to opt for the status quo or "no change" option. After the choice sets had been completed, a follow-up question probed the reasons behind those who always selected the status quo option. Respondents were asked to select from the following options:

- I already manage my property in an environmentally responsible way. I do not need to be paid extra for this.
- I think it is wrong to pay people to manage their property in an environmentally responsible way.
- I do not trust the government to agree to such an arrangement.
- I do not trust that I would receive any rebate.
- The payments offered were not attractive enough.
- Some other reason (please specify).

Eighty five percent of relevant respondents selected the first option "I already manage my property in an environmentally responsible way. I do not need to be paid extra for this." and only two selected the third option "I do not trust the government to agree to such an arrangement".

The extent to which the difficulty of the survey may have led to the strong support for the status quo option was also explored. Half the respondents agreed that they "understood the information in the questionnaire" and 25% were neutral. Although 40% agree that they "needed more information than was provided", 35% were neutral. However, 60% agreed (half of which strongly agreed) that they found answering the choice sets

"confusing". This may be partly because the issue may not have been previously considered by respondents, making it difficult for them to analyse the choices.

There are always tradeoffs in a Choice Modelling survey between providing more information and putting respondents off with too much information. The results outlined above suggest that although more information could have been provided, it was presented in an understandable format. However, the choice sets were obviously confusing and this may well have influenced respondent selection and possibly the survey response rate.

One further issue was explored after the choice sets had been completed and that was attitudes to the type of management agreement and whether respondents had a preference for contracts or covenants. The highest proportion (44%) would prefer a contract, but covenants were selected by 19%, with 38% being uncertain.

5. Discussion and summary

Designing market-like mechanisms to provide environmental services poses particular design issues for economists and policy makers. While there is substantial theoretical and case study evidence that such mechanisms are effective, there are a number of key issues to address in a design process. In a typical case study, property rights need to be set and allocated, and auction design, metric design, and contract design issues addressed. At an individual case study level, there is often very limited information available to guide these design processes. However, the cost of a poor design can be very substantial in terms of creating other inefficiencies and market failure problems.

Many economists have been addressing these design needs with theoretical tools, various forms of experimental economics, and case study analyses. While the latter approaches may be powerful, they can be expensive and cumbersome, and in many cases, may not be addressing exactly the problem at hand. Drawbacks of using case studies to predict future market behaviour are that most case studies are focused on different circumstances and are *ex poste* in nature. This means that substantial assumptions need to be applied to extrapolate case study results to designing market-like mechanisms.

Experimental economic techniques have the potential to address these deficiencies by designing for the situations of theoretical interest and using relevant information (Roth 2002). The difficulties with experimental economic techniques are that they are limited in the number of variables that can be included in a single analysis, tend to be cumbersome and expensive to perform, and students (rather than specific stakeholders) are often used as participants. These issues mean that there is potential for other tools such as non-market valuation techniques to be applied for the purposes of predicting market behaviour and designing market based instruments (MBIs). The relative merits of state preference valuation over revealed preference techniques are discussed in Rolfe *et al.* (2004c).

For the first time, CM has been applied together information about landholders' attitudes and *ex ante* behaviour if a competitive tender incentive mechanism was introduced in the

region. However, the response rate was lower than anticipated and insufficient data was collected to run a statistical model. There are two primary reasons for the low response rate. First, the population from which the survey sample was selected was too limited, providing a very real constraint to the application of CM in such a situation.

There were several factors that affected the size of the sample population.

- There was no contact list of graziers in the region.
- Once contact was made, many landholders did not qualify, mainly because there was not a river of sufficient size on their property.
- The need to establish the exact river area (and river order) of interest on a database and agree this with a potential respondent further limited the sample size.

Although a larger sample size could have been gathered had there been better contact information, in general, careful consideration needs to be given to the use of CM where the sample population is limited. The implication is that the CM technique may not be appropriate for modeling many discrete case study situations where sample sizes may be limited.

The second major constraint was that the survey instrument proved difficult and confusing to complete. While the information requirements meant the survey was more complicated than a standard non market environmental valuation, there are some design issues that could have been improved.

First, there were some basic rules of survey design that were not given sufficient consideration. It is usual practice to begin a questionnaire with some simple warm-up questions to make the respondent feel that the questions will not be too difficult. In this survey, the first questions gathered information about the kilometres of waterway under respondent control (distinguishing between normal boundary, give and take boundary, and within property river frontage areas), the area already fenced and whether they had received a devolved grant. Although these questions were not difficult, they did confuse some people, which was not an ideal way to begin the survey. The other basic rule that could have been given more consideration is the use of focus groups to test the survey design. One focus group was held in the early stages of survey development, but had the final design been tested at another focus group, it is likely that the survey would have been identified as too confusing and adjustments could have been made.

Second, there were measurement issues that confounded the presentation of information in the choice sets. Usually the information presented in a choice set relates only to the choice profiles – ie, the different options available. In this survey two addition sections of information were provided in the choice set. There was a reminder about the baseline conditions that applied, and after the choice options, if a respondent had selected a rebate option, further information was collected on their capital costs.

There was one further issue that may have influenced respondents. The experimental design was based on pair wise comparisons and this did not suit the use of qualitative

variables. In each choice set, there were three "rebate" options apart from the status quo option and in each of the three rebate options, two attribute levels were the same and one was different. As a consequence, the difference between the profiles was limited, which may have made it harder for respondents to make choices. This was an unexpected consequence of moving from a two-profile to a three-profile design. The problem would not have been as marked had the attribute levels all been defined in quantitative terms. However, the "Who do I deal with" attribute had qualitative levels (local government, state government and community group). This meant that if a respondent had a specific aversion to one of these choices, eg community group, the use of pair wise comparisons meant that it was possible that two of the options could have automatically been excluded, leaving the respondent with only one remaining option. The "length of agreement" attribute also included one qualitative level (5 years, 10 years and perpetual) and any respondent that found a perpetual agreement unacceptable could also have their options limited. This is not a fault of the experimental design itself, which was developed before the attribute levels had been determined and before consideration was given to the use of qualitative levels.

Third, given that the survey was relatively complicated, a pick-up collection technique should have been applied that would have increased the response rate, although it would have also increased the survey costs.

In summary, while the survey results did not provide sufficient data to run a statistical model they did provide an indication that if a competitive tender for riparian services was held in central Queensland, it could be anticipated that there would be low participation rates. Many cattle graziers believe that they already manage their properties in an environmentally responsible way. This confirms the results of an earlier (1999) survey of graziers in central Queensland which reported a 60-80% adoption of selected sustainable industry management practices and a perception within the industry that best practice is currently widely in use (Taylor *et al.* 2000).

The use of Choice Modelling has potential to provide a broader range of information to assist in the design of market-based incentives. However, applying CM in this context is more complex that the more common environmental value applications and careful attention should be paid to survey methodology and design. Use of the method is limited in circumstances where case studies are complex and where there is a narrowly defined survey population. Further research is needed to explore how non-market valuation techniques can be adapted to predict market behaviour in these cases.

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