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Designing the Choice Modelling Survey Instrument for Establishing Riparian Buffers in the Fitzroy Basin

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Abstract

This report is focused on the design of a choice experiment for modelling the supply of riparian buffer rehabilitation by landholders in the Fitzroy Basin in central Queensland. Measuring landholders' preference for the supply of riparian buffers is a significant challenge for the improvement of water quality in streams, estuaries and the Great Barrier Reef lagoon. Such estimates of potential supply are important for policy decision making, and will aid in the evaluation and design of market-based instruments for water quality improvement in the catchment.

In this case study, choice modeling (CM) is being employed to investigate landholders' preference heterogeneity in willingness to accept direct monetary incentives for the rehabilitation/restoration of riparian buffers in the Fitzroy Basin. The technique has traditionally been applied to environmental valuation issues, but there is increasing use of CM to design agricultural markets. This study extends that application to markets for environmental actions. By predicting a supply function for riparian vegetation, the design of incentive structures and other MBIs can then be addressed.

In this report, the design stages of the choice modeling experiment are reported. 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. The report focuses on how the design process has followed three main stages, covering general policy issues, more specific framing issues and statistical considerations. These have been used to develop the questionnaire for collection in the field.

1. Introduction

This report is focused on the design of a choice experiment for modelling the supply of riparian buffer rehabilitation by landholders in the Fitzroy Basin in central Queensland. Measuring landholders' preference for the supply of riparian buffers is a significant challenge for the improvement of water quality in streams, estuaries and the Great Barrier Reef lagoon. Such estimates of potential supply are important for policy decision making, and will aid in the evaluation and design of market-based instruments for water quality improvement in the catchment.

The importance of riparian buffer zones in improving water quality has been reviewed in the second report of this series (Rolfe *et al.,* 2004b). Vegetated buffer strips are found to be highly effective in trapping sediment and nutrients from runoff. However, it is not so easy to improve the quality and supply of these narrow corridors along waterways: a large portion of this land belongs to private landholders. Therefore, establishing riparian buffers in the private property is complicated in the sense that many costs of restoration are private on the part of the landholders, but many of the benefits are public. The focus of this project is showing that better incentive mechanisms may be used to improve water quality rather than a purely regulatory approach.

Improvements in water quality have beneficial environmental impacts that show characteristics of non-rivalness and non-exclusiveness. This means there is little incentive for the private landholders or managers to supply improvements, because the costs of supply may not be recovered[1]. There is no conventional mechanism in place for landholders to capture individuals' willingness to pay (WTP) for water quality improvements. This is a classic market failure problem, where some level of government intervention may be justified to improve resource allocation. There are a range of tools that government might employ for this purpose.

The role of command-and-control (CAC) mechanisms, particularly legislative controls, was reviewed in previous reports of this series (Rolfe *et al.,* 2004a and 2004b). A number of factors, including property rights issues, complexity issues and monitoring and enforcement difficulties mean that for the rehabilitation of riparian buffers, CAC is unlikely to be viable or cost-effective. There is potential for market-based approaches to achieve water quality improvements at lower cost, but there is little data available to predict the takeup and potential efficiencies of such approaches.

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

[1] This also provokes the 'free rider' problem where individuals refuse to pay (or understate their willingness to pay) for the good because they know that they can consume the good even if they do not pay for it.

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).

There are two main groups of techniques that can be used to collect information about peoples' preferences for environmental management. These are known as revealed and stated preference methods. The use of a particular method depends on what type of economic information is needed, and the availability of data. Revealed preference methods rely on data obtained from the past/actual behavior of consumers while stated preference data are collected through surveys, where people 'state' what their choices would be in a hypothetical situation.

An example of a revealed preference approach to the issue of interest would be a hedonic pricing study. This would entail an analysis of property values (collected from sales data) to identify how land prices varied with different treatments of riparian areas. For example, it might be found that grazing properties with well managed riparian areas had higher values because purchasers are prepared to pay more money for these aspects. A study might also reveal that there are opportunity costs associated with maintaining riparian areas above some minimum threshold condition.

However, a hedonic pricing study is not suited to the case study problem for four important reasons. First, there are a number of explanatory variables that would need to be included in such a case study (e.g. soil types, fencing patterns, water access points) that are not routinely collected with property sales data. Second, hedonic analysis is very 'data hungry', and there are unlikely to be enough suitable sales in a region to run an analysis. Third, it would be difficult to isolate out values for different riparian treatments from other confounding factors that affect property values (e.g. cattle market trends). Fourth, an analysis of property sales data would not capture landholder preferences about being involved in agreements about riparian protection where different agreement and contractual structures are being proposed. The ‘frame’ of the case study of interest does not match the ‘frame’ under which property sales take place.

For this study, a stated preference method has been selected to estimate landholders’ preference for riparian buffer rehabilitation. Several stated preference techniques have been developed for eliciting consumers’ preferences and measuring their willingness to pay (WTP) for some change in the provision of the public good and service, or willingness to accept (WTA) minimum compensation for the loss of a particular benefit. The most widely used methods include the contingent valuation method (CVM), contingent ranking, and choice modeling. All these techniques involve asking respondents through a survey mechanism to consider one or more hypothetical scenarios and to express their preferences for them.

In this case study, choice modeling (CM) is being employed to investigate landholders’ preference heterogeneity in willingness to accept direct monetary incentives for the rehabilitation/restoration of riparian buffers in the Fitzroy Basin. The technique has traditionally been applied to environmental valuation issues, partly because of its ability to estimate non-use values (Bennett and Blamey 2001). There is increasing use of CM to design agricultural markets (Lusk and Hudson 2004), and this study extends that application to markets for environmental actions. By predicting a supply function for riparian vegetation, the design of incentive structures and other MBIs can then be addressed.

In this report, the design stages of the choice modeling experiment are reported. 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. The remainder of this report is set as follows. An overview of CM in terms of theoretical underpinnings and framing context is outlined in section two. The design of the experiment in relation to policy issues is outlined in section three, and the development and design of the CM questionnaire described in section four. The structure of the questionnaire and survey administration procedures are elaborated in section five, and final conclusions drawn in section six.

2. The Choice Modelling Technique

Choice modelling[2] has its origin in conjoint analysis[3] (Adamowicz *et al*., 1998a), and was initially developed in the marketing and transport literature by Louviere and Hensher (1982) and Louviere and Woodworth (1983). Over the last two decades, it has been applied in many areas, such as health research (Ryan and Hughes, 1997; Ryan, 1999). The application of CM in environmental valuation is comparatively recent (Adamowicz *et al.,* 1994; Rolfe and Bennett, 1996; Hanley *et al*., 1998; Blamey *et al.,* 2000; Bennett and Blamey, 2001). The CM technique has now been widely applied in many areas of environmental and resource economics, including; valuing remnant native vegetation (Rolfe *et al.,* 1997), valuing environmental attributes of rivers (Bennett and Morrison, 2001), modeling recreation demand for rock climbing (Hanley *et al.,* 2002), predicting user fees at public recreation sites (Schroeder and Louviere, 1999), estimating preservation of tropical rainforest (Rolfe *et al.,* 2000), valuing protection of aboriginal cultural heritage sites (Rolfe and Windle, 2003a), and valuing cultural goods, heritage and monuments (Navrud and Ready, 2002). Like CVM, CM is used for measuring both use values (Adamowicz *et al.,* 1994) and passive use values (Adamowicz *et al.,* 1998a)[4].

The underlying basis of a choice experiment is the idea that "any good can be described in terms of its attributes, or characteristics, and the levels that these take" (Bateman *et al.,* 2002: 249). In a CM experiment, respondents are presented with a series of alternative resource use options and are asked to choose their most preferred one. The set of options contained in each question is known as a choice set. A baseline alternative, corresponding to the status quo or current condition, is usually included in each choice set[5]. A choice set involves a choice between a constant "status quo" situation and a number of different "proposed" situations. Typically five to eight choice sets are included in a questionnaire. Each option is described using a common set of attributes, which across several set levels.

Choice modeling is similar in many ways to the discrete choice variant of CVM in that both share a similar theoretical basis (random utility theory) and survey design process (Blamey *et al.,* 1999). The main difference is that CM seeks to communicate differences through the use of attributes and repeated scenarios, as compared to the single tradeoff of a CVM exercise (Blamey *et al.,* 1997). While both techniques can provide surplus estimates for moving from the status quo to an alternative, CM has an advantage in that

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[2] This technique is often referred to as choice experiment (Alpizar *et al.,* 2001), stated choice (Adamowicz *et al.,* 1998b; Louviere *et al.,* 2000), and attribute based stated choice method (Adamowicz and Boxall, 2001). In this study, the terms 'choice modelling' and 'choice experiment' are used interchangeably.

[3] Many argue that the CM differs from typical conjoint method "in that individuals are asked to *choose* from alternative bundles of attributes instead of ranking or rating them" (Adamowicz *et al.,* 1998a: 64; emphasis original). However, CM is now applied both in ranking and rating attributes of alternative options (Hanley *et al.,* 2001). For a discussion on the distinct difference between these two concepts, see Louviere *et al.,* (2000).

[4] CM can also be used to measure option values, a sub-component of passive use value (Rolfe and Windle, 2003b).

[5] However, CM techniques can be used without a status quo option, where two or more alternative management or resource use options are directly compared (Alberini *et al*., 2003)

estimates can be made for a broad number of alternatives. CM also has advantages in its ability to model choice processes in different ways, and to report values for tradeoffs between price and a single attribute (Rolfe *et al.,* 2000).

Other advantage of choice experiments over the CVM are improved flexibility, increased information provision, more communication of scope issues, and increased realism (Hanley *et al.*, 2001, Rolfe *et al.,* 2000). For these reasons, CM is the preferred technique for the economic analysis of "multiple mutually exclusive policy options" (Blamey *et al*., 1999: 3). An application of both CVM and CM methods of valuation reveal that choice experiments outperform CVM in applied analysis (Adamowicz *et al.,* 1998a).

2.1 Theoretical Framework

The CM technique is based on both random utility theory (Thurstone 1927, McFadden 1973, Manski 1977) and the characteristics theory of value (Lancaster, 1966). These allow environmental goods to be valued in terms of their attributes by applying probabilistic choice models to choices between different combinations of attributes (Hanley *et al.,* 2002). By making one of these attributes a price or cost term, marginal utility estimates can be converted into monetary estimates for changes in attribute levels (Hanley *et al.,* 2002).

Within the framework of random utility, an individual's indirect utility can take the following functional form (Louviere, 2001):

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

where U_{ij} is individual *i*'s utility of choosing option *j*, V_{ij} is the deterministic (observable or explainable) component of utility that individual *i* has for option *j* and ε_{ij} is a stochastic element (random or unexplainable) that represents unobservable influences on individual choice.

Due to the influence of the random component, it is difficult to predict individual preferences. The random component allows one to model the choice of options in a probabilistic form, where the probability that individual *i* prefers option *j* in the choice set over other options *n* can be expressed as the probability that the utility associated with option *j* exceeds that associated with all other options. This can take the following form (Hanley *et al.*, 1998):

$$P\ (i \mid \mathbf{C}) = P[V_{ij} + \varepsilon_{ij}) > (V_{in} + \varepsilon_{in}),\ \text{all } n \in \mathbf{C}] \qquad (2)$$

where **C** is the complete choice set.

Different assumptions made about the distribution of the random component leads to different model forms. For instance, if the random components are assumed to follow an independent and identically distributed (IID) Type I extreme value distribution, then the probability of choosing option j takes the following form of a multinomial logit model (Hanley *et al.,* 1998)

$$P(ij) = \frac{\exp^{\omega Vij}}{\sum_{n \in C} \exp^{\omega Vin}} \quad (3)$$

where ω is scale parameter, which is inversely proportional to the standard deviation of the error distribution, and typically assumed to be one.

Equation (3) can be estimated by means of a multinomial logit regression which assumes that choices are consistent with the independence of irrelevant alternatives (IIA) property. This property requires that the probability of an option being choosen should be unaffected by the inclusion or omission of other alternative options. If a violation of the IIA assumption is found, then other model variants (e.g. multinomial probit, nested logit and random parameter logit) can be employed.

2.2 Framing the Choice Experiment

Framing stated preference experiments has been an issue of debate for some time (Hausman, 1993). A framing effect is said to occur when "a respondent to a survey is unduly sensitive to the context in which a particular tradeoff is offered" (Rolfe and Bennett, 2000: 6). Much of the discussion on framing effects in relation to CVM studies are centered on the hypothetical nature of the CVM approach, and focus on: (i) the fact that the constructed market is not real; (ii) the effect of information disclosure on the responses; (iii) the format of the survey and questions asked; (iv) the potential failure of respondents to take into account external financial constraints ; (v) the potential for responses in the hypothetical setting to be unduly influenced by various factors (including ethical and moral positions); and (vi) the estimate being derived from a sample rather than a complete enumeration (Kahneman and Knetsch, 1992; Hoevenagel, 1994).

CM has a number of advantages in minimising framing effects. The most significant is that, as Rolfe and Bennett (2000: 24) state, "it allows the simultaneous presentation of a pool of other goods. As a result, respondents are automatically required to consider complementary and substitution effects in the choice process. This also reduces potential problems of bias because the amenity of interest can be 'hidden' within the pool of available goods used in a CM experiment".

Although it is common in CVM, 'yea-saying' should not arise in CM as "the respondents will be choosing from a number of descriptions of situations, rather than a single base case compared to an improved-case situation" (Adamowicz *et al.,* 1999: 467). It is more difficult for respondents in a CM exercise to act strategically because the number of attributes and varying levels make it difficult to identify rent-seeking positions. Similarly, CM addresses embedding directly by "having respondents implicitly value components" of the whole (Adamowicz *et al.,* 1999: 468), rather than a set quantity each time.

Respondents still need to be reminded about budget constraints and competing uses of income when making choices to minimize other framing issues.

The selection of attributes in relation to the choices of interest is very important in framing a CM experiment. Blamey *et al.* (2000: 3) note that attribute selection needs to take place "from both the perspectives of the end-user (the population of interest) and the decision-makers/resource managers to ensure that the attributes are not only easily identifiable, but produce policy-relevant information". Another goal of the attribute selection process is to minimize the number of attributes as "the use of a large number of attributes is likely to lead to lower data reliability due to the excessive cognitive burden it would place on respondents" (Mogas *et al.,* 2002: 10). Identification of appropriate attribute ranges is another basic framing task in CM, as a failure to accept trade-offs indicates that "the range of attribute levels offered is not salient" (Johnson *et al.,* 2000: 313). In determining how many attributes to include in a study design, there is often a trade-off between describing tradeoffs accurately (requiring more attributes) and minimizing choice and experimental design complexity (requiring fewer attributes).

2.3 Design Stages in a Choice Experiment

In a CM application, the design of the survey instrument is a key stage. A typical choice modelling exercise has been defined as consisting of five components (Louviere *et al.,* 2000):

- i) defining attributes,
- ii) assigning attribute levels,
- iii) creating scenarios,
- iv) determining choice sets and obtaining preference data, and
- v) estimating model parameters.

Bennett (1999) described the design of a CM experiment as the following stages:

- i) establishing the issue
- ii) defining the research design
- iii) defining the attributes
- iv) defining the levels
- v) designing the questionnaire
- vi) compiling the experimental design
- vii) surveying the respondents
- viii) preparing and analyzing the data
- ix) analyzing the results

It may be more appropriate to consider the development of a CM experiment as consisting of three main stages. These consist of policy issues, framing issues and statistical issues. Here, the key considerations in each are outlined.

The policy stage is focused on identifying the key issues and structure of the CM experiment. This involves choosing the policy issue or development proposal to be considered, and defining this concisely enough so that it can be represented in a choice experiment. It is important to plan how the scenarios will be presented, taking into account the policy issues of key interest and the knowledge of the groups to be surveyed. Key considerations include the choice of the status quo option versus alternatives, the adoption of a willingness-to-pay (WTP) or willingness-to-accept (WTA) format, and the definition of the relevant group to be surveyed.

The framing stage is focused on how key tradeoffs can be framed to respondents. There are a number of information, structure, component and presentation choices to be made. The information to be presented to survey respondents is important, because this defines the task at hand. Choices about structure include decisions about whether labels will be used, and the number of alternatives that might be presented in each choice set. Choices about components involve the selection of attributes and levels, with particular attention to be paid to the choice of the payment vehicle. Other stages include the design of the overall questionnaire where additional information is required, and the presentation issues where communication of the choice tasks can be improved.

The statistical stage is focused on predicting the choice structures that need to be modeled, and then developing an experimental design for the choice experiment. Statistical issues to consider include whether nested models or specific interactions between attributes are to be considered, while experimental design issues are partly driven by the number of choice sets that can be offered to each respondent.

While these stages are in a rough order of progression, there are several interdependencies that make the design process iterative. For example, difficulties in framing a choice set might mean that the policy stage might have to be revisited, or that the experimental design needs to be changed. It is normal to use focus groups and pretests to lead and confirm many of these design issues. In the next section, these issues are considered in more detail.

3. Policy Issues and the Case Study

The case study of interest has been reviewed in the first two reports of this series (Rolfe *et al.,* 2004a and 2004b). Here, the key policy issues relevant to the design of the CM experiment are reviewed in more detail.

The key focus of the experiment is to predict the potential supply of water quality mitigation strategies in the Fitzroy Basin. This information can then be used to model how a market based instrument might be introduced. Key issues in the CM policy stage therefore include choices about the groups involved, the mitigation strategies and the MBIs to be targeted.

To avoid framing problems, a key focus of CM design is to present clearly defined alternatives to respondents where the tradeoffs are explicit. To be able to achieve this focus, it is often necessary to narrow the alternatives to a carefully defined set. These issues of definition were crucial to the design of the CM experiment in this case study. As outlined in the first report (Rolfe *et al.* 2004a), agriculture has been chosen as the sector of interest for the case study. Advantages of focusing on a single sector are that the strategies, attributes and opportunity costs are likely to be relatively consistent, making it easier to design scenarios that are relevant to all respondents. In this study, the potential respondents to the survey are landholders in the Fitzroy Basin.

There are a number of strategies that landholders could undertake to mitigate water quality impacts. Some of these were specific to particular areas or land uses, and hence were not suitable for a broad-ranging survey. Others had problems in terms of definition and communication, or were not practical in terms of implementation, monitoring and enforcement. It was desirable to select a single mitigation strategy that was applicable across most landholders in the basin. The two key strategies that were considered were ground cover and riparian vegetation. While poor ground cover is the major source of agricultural emissions, there are substantial definitional, monitoring and enforcement issues in selecting it as a mitigation strategy. As a result, the establishment and protection of riparian buffer zones was selected as the key mitigation strategy.

The key MBI of interest in this project is a cap-and-trade mechanism. An application of a cap-and-trade mechanism normally involves point source emitters, and sometimes non-point sources. It is difficult to model the cap-and-trade mechanism directly with the CM experiment because of the need to focus on a specific group and mitigation strategy. It may have been possible to model potential trade within the agricultural sector by proposing a hypothetical cap (minimum standard of riparian protection) and then asking for willingness to vary individual compliance at differing price levels. This approach was rejected on the basis that the hypothetical cap would have been at odds with perceptions of property rights, the potential variation in incentives between WTP and WTA formats, and the lack of scientific data to construct metrics to allow for variations in factors such as climate, soil type and land use across the basin.

A more practical alternative was to frame the choice tradeoffs as a competitive tender mechanism. In this setting, landholders would be asked how much they were WTA to provide improved levels of riparian zones on their properties, thus allowing a potential supply function to be estimated. Because there are existing devolved grant mechanisms being rolled out in the basin by the Fitzroy Basin Association, and because it is sympathetic to the property rights of landholders, the competitive tender scenarios are likely to be an acceptable framing mechanism. Other key advantages are that the setting is likely to be incentive-compatible for landholders (making it easier to collect surveys), and the data should be useful for government agencies and regional bodies interested in developing voluntary contracts with landholders.

Once a supply function has been estimated, the information could be used to predict how a competitive tender mechanism could be applied, perhaps as an alternative to a devolved grant mechanism. The supply information can also be compared to the mitigation costs of industry, urban and mining sectors to predict the potential gains from offset programs or cap-and-trade mechanisms, and thus can be more generally applied.

3.1 Input Controls versus Output Controls

Market based instruments tend to be focused on achieving a required level of outputs, while regulatory controls are often focused on specifying and controlling inputs (and thus meeting targeted outputs). A direct focus on outputs leads to efficiency gains, because it stimulates private consumers and businesses to find more efficient ways of achieving those outputs. In contrast, a regulatory control on inputs leaves little scope to search for more efficient ways of achieving desired outcomes.

In this case study, the key focus is on the enhancement and supply of riparian buffer zones, which can be thought of as an input to the mitigation of water quality problems. A more theoretically efficient mechanism might be to reward landholders directly for management actions that mitigate water quality impacts from their holdings. In that way, landholders would be assessed on their outputs, which might stimulate searches for more efficient ways of achieving the required controls. However, output measures are particularly difficult to design for the Fitzroy system, where most of the impacts are from non-point sources, there is little scientific knowledge about variations in water quality impacts across different management actions, soil types and enterprise mix, there is little baseline data, and little scope to measure outputs accurately.

The establishment of riparian buffers has been selected as the appropriate management action to focus on, with the underlying assumption that there is a strong correlation between this action and future water quality improvements. To make a competitive tender work in practice, a system of metrics will need to be developed to properly assess and compare the bids from landholders. For this project, the key focus is to show that there are large variations in opportunity costs across landholders, opening the door to potential gains from trade.

However, the input measures are not completely fixed, and there will be competitive pressure in the way that landholders structure their responses. The key condition that landholders have to meet is that the riparian zone is managed to meet certain stock exclusion times and minimum biomass conditions. They may do this in a number of ways, depending on their stock management program, and whether or not they need to fence the riparian zone and/or provide offstream watering points. Landholders who need to provide capital investment are likely to need higher levels of compensation before they will enter into voluntary agreements, while those who can meet the desired conditions in more effective ways may be expected to submit more cost-effective bids. As a result, the choices made in the CM experiment are likely to be influenced by the assessments of landholders about the capital costs involved.

3.2 Using the WTA Format

With stated preference techniques, the choices respondents face can be framed in either WTA or WTP formats. This means that in the case of riparian buffer management, landholders' preference for riparian buffer rehabilitation can be measured in two ways:

i) estimating landholders' WTP to avoid an obligation to rehabilitate and manage riparian buffers; and

ii) estimating landholders' WTA direct incentives for rehabilitating and managing riparian buffers.

Although theoretically these two approaches should provide uniform estimates, some empirical studies reveal unexpectedly large differences (Adamowicz *et al.,* 1993; Shogren *et al.,* 1994). No simple and completely convincing explanation of these large differences is available, although uncertainty, endowment factors and a lack of close substitutes may all contribute to WTA estimates being higher. These factors indicate that differences are not just an artifact of stated preference experiments. The NOAA panel recommended the use of the WTP format over the WTA (Arrow *et al.,* 1993). Since that recommendation there has been emerging evidence that CM is able to elicit WTA values successfully, and some concerns that a focus on WTP formats will underestimate values for WTA situations (Adamowicz *et al.,* 1998a).

For this study, the WTA format has been adopted. This is because it would have been very difficult to frame a WTP scenario to landholders, given the current institutional structure and perceptions about property rights. It is expected that landholders will face some uncertainty in assessing the values of providing riparian buffers, which may lead to higher WTA estimates. However, this is a 'real world' condition, so the WTA format will be reflecting the levels of payment that landholders might need to enter into voluntary agreements. As landholders become more familiar with the supply of riparian buffers, their WTA bids may reduce.

3.3 Dealing with Riparian Areas Already Covered Under Devolved Grants

The Fitzroy Basin Association has been developing a number of devolved grants for landholders in the past few years to protect riparian buffers. Many of these devolved grants have been for fencing and watering points, with agreements reached with landholders about some level of stock exclusion, particularly over summer. It is expected that existing arrangements have been made with landholders who are more comfortable in dealing with NRM bodies, and where the exclusion of stock has low opportunity costs. It is likely that the landholders who already have devolved grants have some interest in extending the program to cover more of their riparian zones, particularly when higher opportunity costs are involved. The effects of learning behaviour from involvement in devolved grants might mean that these landholders are willing to offer additional areas of their riparian zones for protection.

It is not appropriate in the CM survey to ask landholders about their WTA payment for riparian protection over areas already covered under devolved grant arrangements, as this would be a form of double dipping. The focus on the survey is on the potential supply of additional riparian buffers. To achieve this, respondents to the survey are asked whether they have existing devolved grant arrangements over their riparian zones, and to answer the CM scenarios only for the additional areas of riparian buffers that they might have available.

3.4 Dealing with Issues of Stream Order

The nature of streams and rivers varies according to their size and position, referred to as stream orders, and this variation has implications for riparian management (Prosser *et al.,* 1999). Stream order describes the relative size and frequency of a well-defined watercourse. First order streams are small. Streams become larger as their order rises and an increasing number of segments contribute to the flow. First order streams may occur anywhere in the catchment, however large streams and rivers (fourth and fifth order and above) are only found lower down the catchment (Prosser *et al.,* 1999).

Rivers, creeks and waterways are defined according to stream order, and "when two streams of the same order join, the resulting watercourse becomes one stream order larger. If two streams of different order join, the resultant stream order is that of the larger stream" (QDNRM, 2003: 15). In Table 1 below, the desired buffer width and stream ordering for both freehold and leasehold lands is summarized.

Table 1: Stream Ordering

Stream ordering*	Buffer width (metre)	Example
Stream order 1 & 2	50	Watercourse (e.g. gully)
Stream order 3 & 4	100	Creek
Stream order 5 & 6	200	River

Note: * stream order is derived from a 1:250 000 topographic map.

As most properties will have multiple stream orders, the variation in recommended buffer widths poses some consistency problems. To address this, landholders in the survey will be asked to only consider their highest stream order, and to nominate the name of it on the survey. This will allow the stream order to be identified. To deal with the buffer width issue, the buffer width has been defined in the survey as being a minimum of 50 metres from the top of the main channel. In areas where there are braided channels, or where fences have to be set back to avoid flood damage, the effective width of riparian zones will be higher. An additional question will be asked to ascertain the average width of buffer zones that landholders might consider.

3.5 Dealing with Control Issues

Additional difficulties in modeling the potential supply of riparian zone protection relates to control and position issues. Where streams flow along property borders, it is common for landholders not to have control over all of their land. Some riparian areas are fenced out of properties, while others have 'give and take' boundaries (where landholders have a section of both sides of the watercourse). Where these situations occur, it is only feasible to ask landholders to supply riparian protection over areas that they control.

It is expected that different issues will be associated with choices where streams flow through properties. This is because there may be additional costs in fencing or protecting riparian zones because it will interfere with existing fencing layouts and management practices. To identify these issues, it is proposed in the survey to ask landholders what length of the watercourse is under their control, whether they have one side or both sides of the watercourse, and what lengths they have within the property as compared to on the edge of the property. These factors can then be interacted with the choice model to determine their influence on choices.

3.6 Dealing with Capital Infrastructure

The cost of riparian buffer protection will also vary across properties, due to the highly variable features of riparian zones. The key costs associated with these management strategies are capital costs such as fencing or watering installation, annual maintenance costs of this equipment, and reduced carrying capacity. Cost is expected to vary across landholders depending on the level of fencing and watering points needed, and the reductions in stocking rate needed to meet conditions. Some landholders will need to erect fencing and waters to meet the condition; others already have much of this in place.

To understand how responses to the choice sets are being driven by considerations of both capital costs and opportunity costs, landholders will be asked to indicate at the bottom of each choice set the amount of fencing and number of off-stream watering points that would be needed to achieve their preferred choice set option. It will then be possible to extrapolate approximate capital costs from this information, and model the differences between capital and opportunity costs in the statistical analysis.

4. The Process of Designing the Choice Modelling Survey

The process by which both the choice modelling experiment and the survey questionnaire were designed is described in this section. This has been done through a systematic process, involving: i) planning sessions, ii) a technical group, and iii) a focus group. Key issues addressed in the design process were: i) perceptions and understanding about the problem being studied (i.e. riparian buffer rehabilitation), ii) different options to achieve the desired goals (rehabilitation of riparian buffers in private property), iii) identification of the attributes by which the rehabilitation of the riparian buffer can best be characterized, and iv) overall framing of the study design.

The process of consultation with experts and stakeholders is described below.

4.1 Planning Sessions

Two planning sessions on the design of the CM survey were held in April 2004 with project team members, technical experts and post-graduate students doing research on choice modelling. The main purpose of these sessions was to review the design process and finalise options for the choice sets.

Key issues discussed and decisions taken from these sessions are:

- Although establishing and maintaining riparian buffers along streams and improving ground cover are the two main options to improve water quality in the catchment, current management actions favour establishment of riparian buffers. The decision was taken to focus on riparian buffers.
- The major components of riparian buffer establishment identified are fencing off buffer zones, providing off-stream watering, and partial exclusion of cattle.
- Landholder trade-offs in establishing riparian buffers can be modeled in three ways, namely i) estimating supply and demand schedules separately, ii) estimating supply and demand schedules simultaneously, and iii) estimating the supply schedule only and inferring potential for trade from that with other sectors. Option (iii) was chosen for this study

A systematic process of design of the CM study through advice from a technical group, focus groups and pre-testing was decided in these planning sessions. These sessions help to provide guidance for the selection of attributes and the best way to 'frame' the choice model. Attribute selection is a key task in this process as Bennett and Morrison (2001: 34) identify[6]: "It is important because unless the natural resource that is being valued can be decomposed into a parsimonious and meaningful set of attributes, then the validity and usefulness of the estimates could be compromised". A provisional list of possible attributes was prepared from these meetings. The attributes identified are listed in Table 2 below.

Table 2: **List of provisional attributes**

Management issues	**Contract issues**
• Width of buffer strip • Stocking rates • Management actions(e.g. weeds and fire) • Percentage of stream covered on property	• Length of agreement • Covenant vs Contract • Payment type • Governing authority (Govt. vs NRM group) • Water Access

Once these attributes were defined and the focus of the research identified, a draft questionnaire was developed for testing with the technical group and in the landholder focus group.

[6] Further details about the importance and determination process of attributes and their levels are discussed later in this report.

4.2 Technical Group Meeting

A meeting with a technical group consisting representatives from the Fitzroy Basin Association (FBA), Queensland Department of Primary Industries and Fisheries (DPI) and CSIRO was held in June 2004 to outline the CM design. Some particular issues were discussed in detail, being:

- Defining appropriate attributes and their levels
- Stream orders to be targeted
- Whom to sample
- Where to sample

The provisional list of attributes developed from the planning sessions was presented to the technical group. Four attributes were culled: water access, stocking rates, management action (e.g. fire and weed control) and agreement type (e.g. covenant vs contract). Water access was removed because any levels set might have been unrealistic for some landholders. Stocking rates were removed in favour of setting a set of output conditions for riparian zones. It was decided to set management actions and agreement types in the scenarios, as a way of simplifying the choice options. This left five attributes for consideration from the technical group meeting. The modified list of attributes and their assigned levels is presented in Table 3 below.

Table 3: The modified list of attributes and their assigned levels

Attributes	Levels
Width of buffer strip (metres)	50, 75 & 100
Percentage of river zone covered	50%, 75% & 100%
Length of agreement (years)	5, 10 & perpetual
Governing authority	State Govt., Non-Govt., & Commonwealth Govt.
Payment received ($)	0, 20, 50, 100

It was decided to target only stream orders four, five and six in the survey. This was because it would have been less feasible for landholders to establish riparian zones on the smaller watercourses.

The technical group identified that it would be desirable to conduct the survey in three different grazing areas of the catchment, considering the following factors:

- Availability of information about contact details;
- Covering two major land uses (e.g. grazing and grazing/cropping);
- FBA's devolved grant coverage.

Suggestions were raised to ask landholders if they would voluntarily supply property details and permission to use those for GIS database purposes. There was potential identified to link landholder responses with soil type and vegetation cover information about the property. However, this could only be done if express permission was asked from survey respondents.

4.3 Focus Group Discussion

A focus group is considered to be a planned discussion with eight to ten participants guided by a facilitator, held in a neutral, non-threatening environment whereby participants are encouraged "to share their opinions and attitudes about the topic being discussed" (Whitten and Bennett, 2001: 14). Focus groups are an essential prerequisite to questionnaire development in non-market valuation studies.

A two-hour focus group with landholders from the Fitzroy Basin was conducted in June 2004, and facilitated by the principal investigator of this study. The focus group was used to identify and confirm attributes, as well as to determine the plausibility of scenarios presented in the draft choice sets. Participants expressed their opinions about the material presented, and drew on their own experience and circumstances to make recommendations about the best way to present choice sets to landholders.

Key issues presented to the focus group members are as follows:

- Landholder perceptions about the riparian management in general, with particular reference to issues such as fencing, access to water, off-stream water points, weed and fire management, and capital and operating costs of riparian management;
- Conditions of the constant base needed in order to construct a hypothetical riparian management scenario, such as river order, buffer width, water access and weed and fire management;
- Attributes and their levels;
- Financing mechanisms;
- Monitoring issues; and
- Confidentiality of property-specific information.

The main outcomes of the focus group included:

Landholders' perception about riparian management: Landholders were asked to discuss the reasons why riparian buffers were important for their property. They recognized that there were a number of private benefits in managing these buffer areas better. Key benefits include the avoidance of stock losses over a flood season and improved productivity through better pasture management. There was also awareness that there were public benefits in better riparian management. Improved management could be achieved by adopting moral suasion, education and new innovative approaches like MBIs. Landholders are more motivated through examples from others ("people use their eyes to learn, to look at what others are doing"; "mind change is important"). If a particular approach becomes successful, landholders will gradually adopt that approach. Fencing was recognized by participants as the most important element in controlling livestock access to riparian lands and thus its protection and rehabilitation.

Defining attributes and their levels for the CM questionnaire: The focus group discussion formed the basis for selecting the attributes used for the CM experiment. The focus group was used to develop attributes that were meaningful to potential respondents and able to characterize the riparian buffer rehabilitation issue. The discussion in this regard started with the provisional list of attributes and levels, and the 'attribute key' which described each attributes' definition and importance. The modified list of attributes agreed in the technical meeting was presented to the focus group (Table 4), and the appropriateness of each of them was discussed. This process was used to trim the list of potential attributes to a minimum number so as to define the alternatives options properly while keeping the respondent's choice task manageable.

Table 4: The list of attributes and their levels presented in the focus group

Attributes	levels
Stocking times (max. of months)	One, three & nine
Percentage of river zone covered	50%, 75% & 100%
Length of agreement (years)	Five, 10 & perpetual
Who you deal with	State Govt., Non-Govt., & local Govt.
Payment received ($)	0, 20, 50, 100

In terms of determining minimum riparian buffer widths, it was pointed out that landholders need some flexibility as conditions vary from property to property. In some cases, a 50 meter strip on each side of a watercourse is too narrow for management purposes. Therefore, it was decided to frame the issue to allow some flexibility to landholders (e.g. they will fence where it is easier for them) while maintaining a minimum condition of 50 metres from the top of the main bank on either side.

Participants were of opinion that it was not the stocking time that defined opportunity costs of riparian management. Instead, pasture biomass or ground cover was seen as the most important factors at the property level. A minimum condition for pasture biomass could be described as grass height at half of the normal size, or in terms of percentage, such as 40 to 60 percent of available biomass. Concerns were raised that respondents might misunderstand the concept of "minimum biomass condition", such as 1500kg/ha.

The focus group suggested that 'stocking times' should be dropped as an attribute. Questions were raised about whether an attribute 'stocking rate' should be included. However, this was not considered to be a suitable attribute because:

(a) it raised a number of definitional questions,
(b) it would probably make the choice sets much more complex for landholders, and
(c) there may not be any difference in impacts to water quality between different stocking rates so long as a condition of minimum biomass is met.

Dropping the 'stocking times' attribute had key advantages in terms of making the choice sets simpler and reducing choice task complexity. It also meant that a more parsimonious experimental design could be developed. The final set of attributes and levels are detailed later in this report.

Selection of an acceptable and relevant bid vehicle: Two payment options were considered: one with an upfront capital payment block and then annual payments, and the second with just annual payments. While there was some preference for the first option, it was considered that landholders would also be able to evaluate the second. Because the second option was simpler to present, it was confirmed as the payment vehicle.

Use of appropriate photos and icons for the questionnaire: It was decided to use photographs to show minimum biomass conditions for riparian areas, and appropriate icons to help represent the different attributes.

Contract design: The 'length of agreement' did not appear to be a major issue to focus group members, although some preferences were expressed for shorter time frames. There was a strong preference expressed for contracts in comparison to covenants, with the latter seen as too permanent and intrusive.

Monitoring mechanisms: Monitoring of agreed management actions was identified as important, but difficult to do for a number of reasons. Several options were considered, such as self-monitoring, random inspection with prior appointments, involvement of the State authority's weed officers, and maintenance of stocking records. Focus group participants favoured a non-political organization as the contracting and monitoring body.

Water Access: Alternative water systems and controlled crossing areas are critical management tools for riparian areas. However, it is problematic to estimate the average cost of supplying alternative water points because of different needs, geographic factors and flood risks. It may be very expensive for some landholders, and relatively easy for others. Members found it easy to identify whether they would need off-stream watering points, but more difficult to estimate the costs of providing them.

Confidentiality: Focus group members confirmed that some landholders might be suspicious and refuse to participate if permission was sought to link responses with property level soil condition and vegetation type information.

Overall, the focus group was very helpful in determining the range of attributes and levels to include in the choice sets. In the focus group meeting, it was also decided to conduct a pretest of the questionnaire before fielding for the actual survey.

5. Development and Design of Survey Questionnaire

After policy issues have been addressed, the key stages in designing a CM questionnaire are the framing and statistical issues. Here, each of those is covered in turn.

5.1 Framing Issues

Key tasks in framing issues to respondent in a CM questionnaire are to summarise the key issues to them, identify the status quo position and the improvements being considered, define the attributes and levels, and to generate an appropriate presentation style.

In the survey questionnaire, the first task was addressed by explaining to landholders that the aim of the survey was to demonstrate that there would be interest in entering into voluntary contracts for riparian management. The introduction was drafted in the following way:

> *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.*

Some ranking questions were also designed to help respondents become aware of key issues that might be involved in their choice decisions. For example, one question was designed to remind respondents about the different private benefits that might be associated with better riparian zone management:

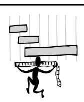
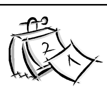
> ***Question 15:*** *Below is a list of reasons why managing waterway areas on your property separately may be beneficial. Please indicate how you feel about them by ranking them from most (1) to least (5) important.*
>
> ☐ *Stops cattle from overgrazing water frontage areas of paddock*
> ☐ *Specific management allows better grass production in waterway areas*
> ☐ *Allows removal of stock in times when risk of floods are higher*
> ☐ *Helps to reduce mustering costs / makes paddocks easier to manage*
> ☐ *Helps to cut down on erosion*

The second key framing task was to define the status quo position and the potential improvements. The status quo was defined as their current management practices, while improvements were defined as riparian areas that were managed to meet environmental objectives. The key management criteria that landholders had to meet were described 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).*

The third key framing task was to define the attributes and levels. The attribute 'key' that was included in the questionnaire is shown as follows. This identifies the icons, labels and explanation for each of the attributes used in the survey.

Table 5. Attribute key used in survey questionnaire

$	Payment received ($/km/year)	This represents the payment you would receive to meet the other option conditions.
	% of your river frontage covered	This refers to the length of river covered by an agreement. The management conditions outlined above will apply.
	Length of agreement	This is the length of time that any agreement will last.
	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.

The attribute levels are outlined in Table 6 and an explanation of how the price levels were determined is outline in Box 1.

Table 6. Attribute levels used in the choice sets

Payment received ($/km/year)	6 levels	$100, $200, $300, $750, $1500, $2500
% of your river frontage covered	6 levels	10, 20, 40, 60, 80, 100
Length of agreement	3 levels	5 years; 10 years; perpetual
Who you deal with	3 levels	**state** and **local** governments and a registered **community group**.

Box 1. Determination of levels for the price attribute

At the lower level there would be no fencing and water costs, just the opportunity costs of:

- meeting the minimum biomass conditions
- meeting the management conditions
- the pain of entering a contract

Minimum payment = $100/km/yr
To ensure there will be some acceptance of the different alternatives, a non-zero level for the lowest bid should be used. If $500 per year is used as a minimum payment and assuming the average frontage is 5 kms, this translates to $100/km/yr.

Costs – exclusion of cattle = $625/km
Assuming that the average width is 250 metres (150 metres of channel and braids, and 50 metres either side of the channels), there would be 25 hectares per kilometre. The exclusion of cattle means that there will be some opportunity costs with some alternatives, even with no water and fencing costs. If one-third of the production from cattle is lost, the amounts would look like:

Carrying capacity/hectare x annual return from cattle x loss of production
= 1/4 (1 beast to 4 ha) x $300 x 1/3 = $25/ha or $625/km

Costs – fencing and water points = $450/km/yr to $1100/km/yr
Fencing is approx $2500/km and water is about $2000/km = $4500/km. If it is amortised over 20 years at 8%, it equals approximately $450/km/yr. If landholders amortise the amounts over a shorter time frame, eg, for a 5 year contract, the cost for fencing and water rises to about $1100/km/yr.

Maximum payment = $2500/km/yr
To cover all costs a landholder might incur the maximum payment should cover all costs outlined about plus an additional amount to cover the costs of meeting the management conditions and the pain of entering into a contract.

The range for a six level price attribute
A suitable scale for per kilometre payments (over four levels) is as follows:

$100, $200, $300, $750, $1500, $2500 (all as $/km/yr per annum)

With these levels there are three levels in the range that the non-fencers will find applicable, and three levels in the range that the fencers will find applicable

A logarithmic scale was selected to better capture the possibility that many landholders may not be interested (and hence will only be attracted at the higher levels). It also makes it easier to test statistically if WTP is going to follow a linear or log relationship.

The fourth key framing task was to generate an appropriate presentation style. The key focus here was to make the choice sets comprehensible with the help of icons and layout. Colour was used to identify the status quo 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.

5.2 Statistical issues

Key statistical issues are focused on the number of alternatives, attributes and levels involved in the choice sets, the number of choice sets to be offered to respondents, the experimental design to be used, and the potential modeling that is to be carried out.

To aid in the experimental design process, it is convenient if the number of levels across attributes is the same, or a simple multiple. To minimize choice complexity, the number of attributes and levels was kept as low as possible. For two of the attributes, (*Length of agreement* and *Who you deal with*), it was relatively simple to assign only three levels to each. It was desirable to have a higher number of levels for the other two attributes (*Payment received* and *% of river frontage covered*), both to capture the possible range of each attribute and to identify better if relationships to choice followed some non-linear patterns. For these attributes, six levels were selected for each.

Many CM experiments are conducted with three profiles per choice set (a status quo base and two alternatives). This has the advantage of minimizing choice complexity for respondents, but it may lead to difficulties in satisfying IIA/IID conditions. This is because when one of the alternatives is dropped to run the IIA/IID test, it is unrealistic to expect that the relative probability of choosing the remaining alternative would not change. To avoid this problem, it was decided to present four profiles per choice set (a status quo base and three alternatives).

An experimental design was needed to select a representative sample of choice sets to respondents. The number of attributes and levels meant that there were $3^2 \times 6^2 = 324$ different profiles available. Because three separate profiles needed to be selected for each choice set, this meant that there were 5.6 million different combinations of profiles available. The experimental design with 36 choice sets was provided by Associate Professor Deborah Street from the University of Technology, Sydney. It allowed for both main effects and first order interactions between the attributes to be estimated, and had an efficiency level of approximately 82%. It is normal to present between six and eight choice sets per questionnaire (Bennett and Adamowicz 2001), so a six choice set design was selected for this project. The experimental design was blocked into six sets of profiles, and six versions of the questionnaire prepared.

5.3 Other Questionnaire Format Issues

The questionnaire follows the typical structure previously used in choice modelling, comprising of seven main sections. Careful attention was given to the structure and ordering of questions to ensure that concepts which potentially impact upon the valuation issue were introduced in a logical sequence. The questionnaire also contains behavioural, attitudinal and socio-economic questions that can be used for internal validation of individual responses to the WTA question. The questionnaire is structured as follows:

Section one provides a background about why the survey is being conducted, how the respondents are selected, and what is involved in completing the survey. In section two, questions are asked about a number of property details, such as the size of the property, stream order passing through the property, ownership, land use and profitability. In section three, the key tradeoffs of interest are described to respondents. This provides information on land use and water quality issues in the Fitzroy Basin and explains why there is interest in changing management practices. This section also provides references for additional information, with web addresses to make access convenient.

Section four is focused on framing the actual tradeoffs of interest to respondents. This is done by asking respondents to rank both positive and negative potential consequences of establishing riparian buffer zones. These framing exercises were designed to both make respondents aware of the different issues involved, as well as collect feedback about which issues they saw as being most relevant to their enterprise.

Section five contains the choice set exercises. Information and instructions about the choice sets are given, and then six choice sets are presented. From each choice set, respondents are asked to indicate their preferred option.

Follow-up questions after choice sets can be helpful in identifying framing effects (Bennett and Adamowicz, 2001). In order to investigate the reasons behind landholders' decisions, respondents are asked in section six about their motivation for responses made in the choice experiment. They are presented with a list of reasons and asked to indicate which best fit their reasons for choosing between alternatives. Also, using Likert Scale categories (i.e. strongly agree to strongly disagree), respondents are asked about the extent to which they agreed or disagreed with the issues of: (i) understandability of the information provided, (ii) whether more information was required for an informed decision, (iii) whether questions were confusing, and (iv) whether questions were biased in favour of production or environment.

Questions about socio-economic characteristic and property operations are asked in section seven. This contains questions on gender, age, income, education, household structure, off-farm income and other factors. This information can be used to establish the representativeness of the sample with the population of interest and to help in modeling the choice experiment.

6. Conclusion

Degradation of stream water quality has been linked to the livestock grazing in the Fitzroy Basin. It would be possible to mitigate many impacts through appropriate management at the property level. One management option available to farmers and catchment managers is the establishment of riparian buffers along waterways through fencing of riparian areas and reduced grazing pressures.

A CM survey instrument has been designed in order to carry out a choice experiment where landholders would be asked to choose between different alternatives for riparian buffer restoration. One alternative in each choice set is to continue with the current situation (the status quo alternative), while other alternatives have been described in terms of payment levels, length of stream protected, and contract details. By analyzing the choices that are made between the different alternatives on offer, tradeoffs between the various attributes used in the choice sets can be estimated. By including a cost attribute in the choice sets, the marginal utility of money can be used to scale changes in riparian buffer establishment.

This information together with socio-economic data will be analysed to estimate a potential supply function for landholders to provide riparian buffers in the Fitzroy Basin. From that information, the potential for market incentive mechanisms can be predicted more accurately. These include conservation tenders, offsets and cap-and-trade mechanisms. The CM experiment has been framed as a conservation tender to be consistent with property right settings, and it is likely that the results will be most applicable to that potential mechanism.

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