New Zealand Agricultural & Resource Economics Society (Inc.)

Environmental and Social Values from Plantation Forests: A Study in New Zealand with Focus on the Hawke's Bay Region

Rosa Maria Rivas Palma[1], Bruce Manley[2], Geoffrey Kerr[3]

[1] School of Forestry, University of Canterbury,
rmp51@ext.canterbury.ac.nz

[2] School of Forestry, University of Canterbury,
bruce.manley@canterbury.ac.nz

[3] Faculty of Environment, Society and Design,
Lincoln University
geoffrey.kerr@lincoln.ac.nz

Paper presented at the 2009 NZARES Conference

Tahuna Conference Centre – Nelson, New Zealand. August 27-28, 2009

Environmental and Social Values from Plantation Forests: A Study in New Zealand with Focus on the Hawke's Bay Region

Rosa Maria Rivas Palma[1], Bruce Manley[2], Geoffrey Kerr[3]

[1] School of Forestry, University of Canterbury. Private Bag 4800. Christchurch, New Zealand. Email: rmp51@ext.canterbury.ac.nz

[2] School of Forestry, University of Canterbury. Private Bag 4800. Christchurch, New Zealand. Email: bruce.manley@canterbury.ac.nz

[3] Faculty of Environment, Society and Design Division, Lincoln University. PO Box 84. Canterbury, New Zealand. Email: geoffrey.kerr@lincoln.ac.nz

Summary

There is a need for better understanding and estimating forests non-market values. This study aimed to investigate the environmental and social values of plantation forests in New Zealand focusing in Hawke's Bay.

Identified stakeholder groups considered *Erosion control, Water quality and quantity, Employment, Increased living standard,* and *Recreation* as the most relevant values. These became the focus of the study.

The environmental value of plantation forests was estimated through choice modelling. The results indicated that respondents with higher education levels and positive attitude towards community values were more willing to pay for improved levels of land stabilisation and water quality.

Keywords: plantation forests; non-market values; stakeholders; choice modelling

1. Introduction

Forests are an important natural resource that contributes significantly to the economy of many countries. The Food and Agriculture Organisation of the United Nations (FAO) estimated that in 2005 the extent of the world's forest cover was just less than 4 billion hectares, and over ninety six percent was natural forests and less than five percent plantation forests. Productive plantations account for over seventy eight percent of plantation forests and represent a major potential for wood and fibre supply (Food and Agriculture Organization of the United Nations, 2005).

Traditionally, the use of forest resources has mainly been driven by the commercial value of the forest products. For most forests this commercial value is only placed on timber and therefore forest management has mainly been focused on the use of valuable tree species and increasing their productivity.

The need for sustainable forest management and conservation of forest resources has become an ongoing topic of discussion and action worldwide. At the 1992 United Nations Conference on Environment and Development (UNCED) the forest issue was one of the most controversial and intense negotiations, resulting in the Non-legally Binding Authoritative Statement of Principles for a Global Consensus on the Management, Conservation and Sustainable Development of All Types of Forests, also known as the "Forest Principles" (United Nations Forum on Forests, 2004).

The agenda 21 (UNCED Rio Declaration) was also produced at this conference, and emphasised the need for sustainable management practices and international forest policy developments. In Chapter 11: Combating Deforestation, it was expressed that "one of the major reasons for the widespread failure to practice sustainable forest management, and for deforestation and the transfer of forests to other land uses, was the inadequate recognition and the underestimation of the values of the total package of goods and services provided by forests at the local, regional, national and global level".

Several international meetings were convened after the Rio Summit to discuss forest management issues and propose and produce international policies, protocols, criteria and indicators, as well as national and international guidelines for sustainable forest management and to measure forest quality (e.g., Montreal Process in 1995, Tarapoto Process in 1995, and International Tropical Timber Organization (ITTO) Guidelines). The criteria and indicators from these processes take into account all forest goods, values, and services, as well as socio-economic, cultural and spiritual benefits from forests (Dudley, 2005).

The main goal of plantation forests in New Zealand is timber production (direct use value), which involves the planning and implementation of forest operations designed to maximise profit. As an ecosystem, plantation forests' functions provide a wide range of indirect benefits to human beings known as forest services (indirect use and non-use value), such as air quality, carbon sequestration, climate regulation, erosion control, water regulation, water quality, nutrient cycling, employment, recreation, landscape, cultural and educational values, to mention some (Dyck, 2003; Nasi et al., 2002).

The forest certification process has brought to light the fact that environmental and social aspects in forest management need to be reinforced. As part of the certification process, the certifier reports areas where the forest management is below standard (Hock et al., 2003).

The lack of knowledge, understanding, and estimation of the value of plantation forest services consequently creates that they are not managed adequately, which could substantially affect the provision of these benefits, and also increase the pressure for conversion to other land uses (Innes and Hoen, 2005; Nasi et al., 2002; Pattanayak and Butry, 2003).

The main aim of this research was to investigate the environmental and social value of plantation forests in New Zealand, thereby increasing knowledge and awareness of the total value of forests for use in decision-making, policy development and reporting. More specific research goals were to:

1. Identify the most relevant environmental and social values in plantation forests according to the stakeholders' perspectives.
2. Estimate willingness to pay for the most relevant environmental values provided by plantation forests.

2. Assessment of environmental and social values

2.1. Selection of forest sites

The participation of forestry companies was sought for the development of this research. Ten forestry companies were approached to ask for their participation in surveys or to provide general information. The research focused on two forestry companies in the Canterbury and Hawke's Bay regions for the development of the main components of the valuation methodology. The final valuation survey was performed on the Hawke's Bay region only.

2.2. Identification of stakeholders

A preliminary identification and classification of stakeholders of the selected forests was conducted by reviewing the stakeholder contact lists provided by the two forestry companies included in the study. The stakeholders listed were grouped in the following preliminary categories: Adjacent neighbours, Recreational users, Contractors, Authorities, Customers, Local community groups, Organisations, and Others.

A postal survey was undertaken in order to verify and identify stakeholder categories identified by other stakeholders, and explore the relationship between the stakeholders and the plantations.

For each study site, a random sample of 110 stakeholders was drawn from the stakeholder lists that had been assembled. The participants were asked to: identify the category or categories that they belonged to, state if they were part of any organisation, state how frequently they used the forests, and mention any other groups that they knew about that were not included in the categories listed.

2.2.1. Characteristics of respondents

The surveys were mostly addressed to the following stakeholder categories: *Adjacent neighbours* (48.2%), and *Contractors* and *Local groups* (14.5% each) in Canterbury; and *Contractors* (20%), and *Māori groups* (16.4%) in Hawke's Bay.

There was a higher response rate in Hawke's Bay (34.7%) than in Canterbury (27.4%). Most of the responses were from *Adjacent neighbours* (53.8%), and *Customers* (19.2%) in

Canterbury; and *Recreational groups* (20.6%), and *Local authorities* (17.6%) in Hawke's Bay.

The respondents provided one to four stakeholder categories that they considered should be included in the study. In most of the responses they provided names of activities, users or specific groups that fell within the categories already identified.

2.2.2. Frequency of use or visits to the plantation forests

The respondents gave several different answers when asked the frequency of their visits or use of the forests. These were grouped in the following categories:

Very frequently: Daily to once a week visits
Frequently: One to three times a month visits
Rarely: One to six times a year visits
Never: No visits

Most of the respondents stated that they visited the forests *Very frequently*, both in Canterbury (38.5%) and Hawke's Bay (35.3%). The stakeholders that visited the forests *Very frequently* were mostly *Adjacent neighbours* (70%) in Canterbury, and *Contractors* (25%) or *Recreational groups* (25%) in Hawke's Bay.

2.2.3. Assessment of stakeholders' relationships with the plantation forests

The relationship and degree of relative influence of each stakeholder group over the plantation forests was evaluated based on the following criteria: (i) frequency of contact or visits to the forests, (ii) proportion of the population represented, and (iii) relative influence on the forest management. The assessment of the first two criteria was based on two scales constructed with the results from the previous sections. The frequency of visits scale had three levels: (i) Very frequent (>18% visits/year), (ii) Frequent (8-18% visits/year), and (iii) Rare (1-8% visits/year). The proportion of the stakeholder population was measured by three levels: (i) High (>20%), (ii) Medium (5-20%), and (iii) Low (<5%).

The scale to measure the third criterion was constructed based on the aspects of the forest management in which the stakeholders could have direct or indirect influence to facilitate or hinder (Rietbergen-McCracken and Narayan-Parker, 1998), such as, compliance with the law (e.g., resource consents), legal or customary rights, and employment and community relationships (New Zealand Forest Owners Association, 2005). This scale was given a maximum value of 100 percent and each aspect has an equally divided weight (25% each). Three levels of influence were considered for the assessment: (i) Major (≥75%), (ii) Significant (50%), and (iii) Minor (25%). The following table presents the results of this assessment.

Considering a high to medium score in at least two criteria, the groups that had the closest relationships with the plantation forests were *Adjacent neighbours*, *Company staff*, and *Contractors*. Other groups which had high scores in one criterion were *Customers*, *Local authorities*, *National authorities*, *Māori groups,* and *Recreational groups*.

2.3. Identification and selection of forest services

Forests are complex ecosystems that offer an array of services specific to each forest type. Although ecosystem services provide well-being to society, for the purposes of this study, forest ecosystem services were classified as: (i) environmental, referring to ecosystem

services that contribute to forest ecosystem continuity (indirect use); and (ii) social, referring to non-consumable direct use or non-use values of plantation forests that benefit people.

A survey was used to identify and investigate the forest services that plantation forests in New Zealand could provide. The objectives of the survey were to:

- determine the most important plantation forest environmental and social services for the stakeholders, and
- identify the reasons why these services are important for the forestry companies and the stakeholders.

The survey listed seven plantation forest environmental services and six plantation forest social services and a brief definition for each service, from those identified in the literature review. The participants were asked to rank each forest services in the list (environmental and social) by assigning number 1 to the most important service. It was also indicated that no services should be ranked as equal. The participants were also asked to add any forest services that they considered relevant and that were not listed in the survey, and to provide a description or definition for that service.

This survey was divided into two stages. In the first stage, the survey was addressed to ten forestry companies in New Zealand and directed to the Chief Executive or General Manager and four staff members in charge of: Forest Management, Forest Operations, Social Issues and Environmental Issues (n=50). The aim of this targeted selection was that people with the same background or responsibilities in the companies would respond to the survey. In the second stage, the questionnaire used for the identification of stakeholders was also used to identify forest services. The sample size was 110 stakeholders per study site.

2.3.1. Ranking of forest services

The mean indicates the average ranking score obtained by each service, with the lowest mean indicating the most important service. The results were analysed for all the respondents of both surveys and also independently for the forestry companies' staff and stakeholders.

Environmental forest services

The most important environmental forest service was *Erosion control*, with the lowest average ranking score ($\overline{X}$ =2.82). The second most important environmental forest service was *Water regulation* ($\overline{X}$ =3.04). The third and fourth ranked services were *Carbon sequestration* ($\overline{X}$ =3.65) and *Biodiversity* ($\overline{X}$ =4.07) respectively. There was no significant difference between the ranking scores of *Erosion control* and *Water regulation*. However, *Carbon sequestration* and *Biodiversity* were ranked significantly lower than the two top-ranked services (Scheffe test, p=0.05).

Social forest services

The results for the ranking of the social forest services for all the respondents showed that the most important social forest service was *Employment* ($\overline{X}$ =1.91). The ranking score for *Employment* was significantly different than all the other social forest services (Scheffe test, p=0.05). The second and third most important social forest services were *Increased living standard* ($\overline{X}$ =3.03) and *Recreation* ($\overline{X}$ =3.22), respectively.

3. Valuation survey

3.1. Environmental valuation method

Choice modelling was the non-market valuation method selected. It was considered more suitable for this research for the following reasons:

- This technique can be used to model complex situations, framing choices consistent with real market choices, involving multiple and competing choice options (including a status quo option), and where only one choice is taken (no equal rating). This makes it the most direct method of eliciting individuals' preferences information (Holmes and Adamowicz, 2003; Louviere, 2001; Rolfe et al., 2000).
- It allows the integration of the respondents' characteristics such as demographics and attitudes in the calculation of utility (Hanley et al., 2001).
- It produces utility estimates that are consistent with utility maximisation and demand theory, as the status quo option is included for all choices, as compared with contingent ranking, contingent rating, and paired comparisons methods (Hanley et al., 2001).
- Choice experiments are less cognitively demanding, as compared with contingent ranking and rating, and therefore less confusing and tiresome for respondents (Hanley et al., 2001; Holmes and Adamowicz, 2003).
- Choice experiments have a limited set of multi-attribute choices. As a consequence, the valuation process is less costly than the traditional contingent valuation method, where respondents are asked to evaluate a current situation and one alternative option at a time (Hanley et al., 2001).
- Choice modelling is better suited to deal with multidimensional changes, allowing the identification of trade-offs made between attributes and the calculation of marginal values, and is therefore more useful in the application of benefits transfer (Ecosystem Valuation, 2004; Hanley et al., 2001; Othman et al., 2004).

3.1.1. *Theoretical basis of Choice modelling*

Choice experiment designs consist of a (Louviere, 2001):

Set of fixed choice sets,
Set of attributes (describes characteristics of the alternatives for each choice set and differentiates them),
Set of levels (values assigned to each attribute in each choice set).

Respondents are asked to make one of a sequence of several choices from samples of scenarios that have been selected from all possible combinations of alternatives, including the current situation or status quo (Bennett, 1999; Louviere, 2001).

The choice sets are planned according to an experimental design in order to satisfy the conditions for estimation of a determined choice model (Louviere, 2001). The outcome is a discrete number of values that give information about choices (Train, 2003). The results are analysed using a discrete choice regression model that relates the probability of choosing an option to the levels of each attribute, socio-economic characteristics of the respondents and other factors (Rolfe and Windle, 2003).

Choice experiments are based on Random Utility Maximisation (RUM), which proposes that it is possible to elicit part of the utility through an appropriate procedure (systematic

component), but some proportion of the utility will still remain unexplained or unobservable and can be expressed as follows (Holmes and Adamowicz, 2003; Louviere, 2001):

$$U_{in} = V_{in} + \varepsilon_{in} \;\forall\; i \qquad \text{Equation 1}$$

where U_{in} is the utility for alternative *i* held by person *n*, V_{in} is the explainable or systematic component of the utility for alternative *i* held by person *n*, and ε_{in} is the unexplainable or random component of the utility for alternative *i* held by person *n* (Holmes and Adamowicz, 2003; Louviere, 2001; Louviere et al., 2000). It is assumed that part of the utility function is the same for all individuals (V_{in}) and the random component is unique for each individual (ε_{in}) (Louviere et al., 2000; Mazzanti, 2001).

The probability that a person will choose alternative *i* from a choice set C that contains all the alternatives in the choice set, can be expressed as the probability that the utility associated with alternative *i* is greater than that of any other alternative, and is expressed as follows (Hanley et al., 2001; Holmes and Adamowicz, 2003):

$$P_{(i|C)} = P\,(U_i > U_j) = P\,(V_i + \varepsilon_i > V_j + \varepsilon_j\,), \forall\; i \neq j,\; j \in C \qquad \text{Equation 2}$$

In order to calculate the probability of choice, the distribution of the random component is specified. Different choice models are obtained from different specifications of the distribution of the random error term. Some of the most widely used choice models are the Logit and Probit models (Holmes and Adamowicz, 2003; Train, 2003).

The model most widely used is the Logit (Train, 2003). A type 1 extreme value-Gumbel distribution yields Multinomial Logit models (MNL) (Holmes and Adamowicz, 2003). The standard assumption using RUM is that random errors are Independently and Identically Distributed (IID) and that choices conform to the Independence of Irrelevant Alternatives (IIA) property. The Logit formula assumes that the probability of choosing alternative *i* over the probability of choosing alternative *j* can be calculated as their ratio, and does not depend on the presence of any other alternative or its attributes (Holmes and Adamowicz, 2003; Train, 2003).

According to the random utility framework, the choices are made based on the differences between the utility of the alternatives, which is explained as follows (from Equation 2):

$$P_{(i|C)} = P\,(V_i - V_j > \varepsilon_j - \varepsilon_i), \forall\; i \neq j,\; j \in C \qquad \text{Equation 3}$$

If the random errors have a Gumbel distribution, the MNL applies and the probability of choosing *i* from choice set C is (Holmes and Adamowicz, 2003):

$$P_{(i|C)} = \exp(\mu\, V_i) \,/\, \sum_{j \in C} \exp(\mu\, V_j) \qquad \text{Equation 4}$$

where μ is the scale parameter, which is inversely proportional to the variance of the error (Holmes and Adamowicz, 2003). Utility is represented in linear parameters: $V_i = \beta' x_i$, where x_i is a vector of the observed variables for alternative *i* and β' represents the coefficients of these variables (similar for alternative *j*). Then, the probability of choosing alternative *i* from choice set C can be expressed as (Holmes and Adamowicz, 2003; Train, 2003):

$$P_{(i|C)} = \exp(\mu\beta' x_i) \,/\, \sum_{j \in C} \exp(\mu\beta' x_j) \qquad \text{Equation 5}$$

3.2. Identification of attributes

Focus groups were used as a qualitative method to identify the most relevant environmental attributes and achieve a better understanding of the stakeholders' beliefs and attitudes towards the selected plantation forest services and forest management (Bennett and Adamowicz, 2001; Green and Tunstall, 1999; Holmes and Adamowicz, 2003).

Four focus groups per site were designed to have up to six participants from mixed gender from the same stakeholder category. The participants were randomly selected and stakeholders who were contacted for participation in the postal survey were excluded. The focus groups were led by one moderator with the help of an assistant.

There were a total of 33 participants in the focus groups, with 2 to 7 participants per group. The recruitment of participants was difficult in rural areas. The total number of participants was very similar in both sites: Canterbury (16) and Hawke's Bay (17). Most of the participants in the focus groups were male (25). Sixteen participants were 55 or more years old.

The participants were shown four sets of pictures illustrating different aspects of forest management and plantation forests that could have an effect on the plantation forest services selected (e.g., harvesting, roading, erosion, riparian strips) as identified in a literature review. Each person was asked to state the negative and positive aspects of these pictures from their perspective. At the end of the discussion, the responses were shown to the participants, and they were asked to rank what they considered were the most relevant issues raised by the group.

The statements made in the meetings were transcribed and coded, identifying broad topics (categories) and then more specific issues within each category (subcategories). The degree of agreement of every subcategory was assessed within each focus group with a unanimity or agreement rule (Chilton and Hutchinson, 1999). This approach defined a three point scale representing the following: general agreement, majority agreed but some disagreement, majority disagreed.

3.2.1. Environmental attributes

The respondents identified the same forest services selected through the survey, as the most important benefits that plantations provide to the community: *Water regulation* and *Erosion control.* The participants discussed reasons that might be affecting the delivery of plantation forest services, and the visible changes they had noticed that could describe these impacts. They indicated that the main causes for change in the plantation forest environmental services were forest operations (such as planting, harvesting, windrowing, roading, protection of riparian areas, earthworks, spraying).

Four environmental attributes were selected for the valuation survey (Table 1). With the exception of Algae in water, all the attributes were mentioned by the focus group participants. The participants originally stated that the amount of nutrients in water was an indicator of water quality. This was changed to algae, as it was thought that this could be a more graphic indicator of water quality than the level of nutrients in water, which could be more easily understood by most of the participants in the valuation survey.

Table 1: Attributes and levels used in the choice experiments

Attributes	Abbreviation	Status quo levels	Alternative levels
Amount of sediment in water	SED	Moderate	Low, High
Percentage of land stabilisation	STB	40%	60%,80%
Algae in water	ALG	Moderate	No, Lots
Level of water flow	FLW	Normal	High, Low
Cost	MONEY	$0/year	$25/year,$50/year, $100/year

3.2.2. *Social attributes*

The causes for change in plantation forest social services mentioned by participants were related with some forest operations, and mostly with management aspects related with the community, employment, and recreation in plantation forests such as security, accessibility, traffic and transport issues, and working conditions.

For the survey, these were grouped in three sections that included questions to evaluate the respondents' attitudes towards (1) plantation forests in the community, (2) employment, and (3) recreation related to plantation forests. The statements made by stakeholders in the focus groups helped to create attitudinal questions for each of these categories.

In the attitudinal questions, the respondents were asked to state their agreement or disagreement in a Likert-scale from 1 (Strongly agree) to 6 (No opinion) to evaluate statements prepared. The results from this analysis will be used to evaluate social values and also incorporated in the environmental valuation.

Factor analysis was selected as a method for the identification of principal components in the attitudes to be used in choice modelling. Factor analysis has been used in choice modelling to integrate demographic and attitudes measures in fewer variables to avoid multicollinearity and affect the calculation of the estimates (Ashok et al., 2002; Boxall and Adamowicz, 2002; Sermons and Koppelman, 1998).

Factor analysis is a statistical technique used in social sciences that aims to simplify a matrix of correlations so that they can be explained in terms of a few underlying factors (Kline, 1994). Factor analysis can be performed for exploratory or confirmatory purposes, and to summarise variables' relationships in a set of factor scores that can be used for subsequent analysis (Babbie, 2007; Kline, 1994; Thompson, 2004; Wilson and Sapsford, 2006).

Factor analysis aims to identify the correlation matrix of the variables by finding the characteristic equation of the matrix. One of the methods of factor analysis is known as principal component factor analysis. This method computes principal component eigenvectors (characteristic or latent vectors of the matrix) and eigenvalues (characteristic or latent roots of the matrix) by an iterative process, extracting as many components as variables (Kline, 1994).

The principal factor components emerge ordered by the proportion of variance they explain (eigenvalue of the component) (Kline, 1994; Norušis and SPSS Inc., 2004). In most cases, the first component explains more variance than the other components (general factor).

Subsequent factors are generally bipolar (positive and negative loadings) and the last few components are smaller and contribute very little to the variance (Kline, 1994).

A critical decision in factor analysis is to determine how many factors to extract or retain, as the reduction of factors is one of the objectives of this analysis. A standard criterion for factor selection is to extract principal factor components that have eigenvalues over 1 (Schaaf and Broussard, 2006; Thompson, 2004). However, the researcher must exercise some judgment to determine the number of factors to extract, as eigenvalues have some sampling error (Thompson, 2004). The corresponding factor loadings are the correlations of variables with the factors (Babbie, 2007; Kline, 1994). Factor loadings of 0.30 or above can be considered dominant issues that contribute to the underlying theme of the factor (Grice, 2001; Kline, 1994; Thompson, 2004).

3.3. Choice sets

Each choice set consisted of three possible options: the Status quo (SQ), Alternative one (Alt 1), and Alternative two (Alt 2). The alternatives presented in the questionnaire were unlabeled. Four choice sets per survey were included. The levels of environmental quality for each attribute were illustrated using photographs.

The fractional factorial statistical design used in the survey (main effects only) required 16 profiles (choice sets), which were evenly split over in four versions of the survey (blocks) (Hahn and Shapiro, 1966). The first alternative in the choice set was taken from the experimental design and the second alternative was a foldover of the first one. The foldover involves the reproduction of the design in a way that the levels are reversed (e.g. replace 0 with 1, and 1 with 0) (Hensher et al., 2005).

The payment vehicle chosen was an increase in regional council rates (e.g. local authority taxes). The scenario explained the existing pressures on land and water resources in Hawke's Bay, and that rates that are paid to the council are used for monitoring and enforcing laws, rules and regulations. The justification for the payment was presented as the need to increase the annual rates paid to the council by each household in order to "make monitoring more extensive, frequent and efficient for the next five years".

3.4. Survey method

The personal drop-off and pickup delivery method was considered to be more suitable for this survey. This method has been proven to: have a higher response rate, be more time and cost effective, have quick turnaround, allow substitution of respondents who are not contactable, or who provide unusable responses, allow the use of visual aids for the questions, and avoid interviewer effects (Champ, 2003; Lovelock et al., 1976). Each selected person was visited until it was possible to ask if they are willing to participate in the survey or not. If they agreed, a survey package was left and a date and time to pick it up arranged. A pre-survey letter was sent to the selected persons to advise them about the objectives of the survey and ask for participation in order to increase the response rate (Dillman, 2000).

3.5. Results

3.5.1. *Response rate*

By the end of the survey period, 521 selected people were asked if they were willing to participate in the survey (62% of total sample). Eighty-five of these people refused to participate (10.8% of total sample), 41 accepted the survey packages but did not complete the

questionnaires (4.8% of total sample), and 395 accepted and completed the questionnaires (response rate: 46.4% of total sample, 75.8% of contacted people). It was not possible to contact the rest of the sample for several reasons such as: no one at home, away in survey period, person not living at address anymore, etc. (38.8% of total sample).

Demographic characteristics from the respondents were compared with the characteristics from the Hawke's Bay region population as recorded in the 2001 census (chi-square tests). The results showed there was over representation of people with university degrees, with income over $20,000, and of households with 2 or more people living together amongst survey respondents.

3.5.2. *Analysis of attitudinal questions*

Kaiser-Meyer-Olkin (KMO) test measures the sampling adequacy by examining the variables correlation and partial correlation coefficients, giving a score from 0 to 1. The score should be 0.6 or above to proceed with factor analysis (Norušis and SPSS Inc., 2004). The results from the KMO test were 0.6 for Community, 0.8 for Recreation and 0.8 for Employment. Bartlett's test of sphericity examines the data to test the null hypothesis that the correlation matrix is an identity matrix, in which case factor analysis cannot be performed (test should be significant to proceed) (Norušis and SPSS Inc., 2004; Schaaf and Broussard, 2006).The Bartlett's test was significant for all the groups.

Principal components factor analysis produced three factors for Community, one factor for Employment, and one factor for Recreation that had eigenvalues higher than 1. These factors accounted for forty-six to sixty-five percent of the variance (65.75% for Community, 56.84% for Recreation and 46.78% for Employment). The second factors for Employment and Recreation had eigenvalues higher than 0.9, and together with the first factors accounted for over sixty percent of the variance (60.02% for Employment, and 72.82% for Recreation). Therefore, it was decided to extract two factors instead of one for the analysis of Employment and Recreation. Factors were rotated using a Varimax rotation, which is an orthogonal rotation that reduces factor correlation (Schaaf and Broussard, 2006). Each factor was named according to factor loadings greater than 0.30 (Grice, 2001; Kline, 1994). Factor score values were computed for each respondent and each extracted factor using the regression method (Thompson, 2004).

The results indicated that the three main components defining the community factors were: (1) Plantation forests provide practical services to community, (2) Good sense of community and security, and (3) Possible risks from log trucks traffic and forest fires. Employment factors were named as: (1) Forestry-related work benefits local economy, and (2) Good potential in forestry-related work. Recreational factors were named as: (1) Possible to do recreation in plantations, and (2) Potential use of plantations for recreation.

It can be assumed that the attitudinal questions that represented the higher factor loadings revealed more strongly the preferences towards the corresponding plantation social services, than the attitudinal questions that had lower factor loadings. Factor score values will be used for further analysis and in the choice modelling.

3.6. Modelling results

The models were estimated using LIMDEP 8.0 NLOGIT 3.0 software. The multinomial logit model (MNL) was fitted to the data. Respondents faced the choice of remaining in the Status

quo (SQ) (No change) or choosing one of two alternatives (Change). The Change option (Alternative 1 or 2) had different attribute levels than the SQ.

As the attribute levels in the SQ for Sediments, Algae, and Flow were qualitative and not included within the experimental design, the model coefficients for these attributes will be confounded within the Alternative Specific Constant (ASC). Also, as the money level for the SQ equals zero, the SQ utility function is expressed as follows,

$$U(SQ) = \beta + \beta_{stabilisation}\,(Z_{stabilisation}) \qquad \text{Equation 6}$$

where,

β = ASC for SQ option (accounts for the Sediments, Algae, and Flow coefficients)
$\beta_{Stabilisation}$ = Model coefficient for Stabilisation
$Z_{Stabilisation}$ = Stabilisation attribute level for the SQ

The alternatives showed two attribute levels (foldover). All the attributes, except money, had two levels. Therefore, if one of levels was chosen in one alternative, then the other alternative must include the other level. The utility function for the chosen alternative is expressed as follows,

$$U(alt.1/2) = \beta_{Money}\,(Z_{Money}) + \beta_{Stabilisation}\,(Z_{Stabilisation}) + \beta_{HSed/LSed}\,(Z_{HSed/LSed}) + \beta_{LAlg/NAlg}\,(Z_{LAlg/NAlg}) + \beta_{HFlow/LFlow}\,(Z_{HFlow/LFlow}) \qquad \text{Equation 7}$$

where,

β_{Money} = Model coefficient for Money
$\beta_{Stabilisation}$ = Model coefficient for Stabilisation
$\beta_{HSed/LSed}$ = Model coefficient for Sediment (depending on the level chosen)
$\beta_{LAlg/NAlg}$ = Model coefficient for Algae (depending on the level chosen)
$\beta_{HFlow/LFlow}$ = Model coefficient for Flow (depending on the level chosen)
Z_{Money} = Money attribute level for the alternative
$Z_{Stabilisation}$ = Stabilisation attribute level for the alternative
$Z_{HSed/LSed}$ = Sediments attribute levels (depending on the level chosen)
$Z_{LAlg/NAlg}$ = Algae attribute levels (depending on the level chosen)
$Z_{HFlow/LFlow}$ = Flow attribute levels (depending on the level chosen)

Because of the experimental design (including only two levels per attribute), there were some limitations in the application of the models results. Since the SQ attributes coefficients are included within the ASC, the estimation of part-worth or implicit prices (marginal value of change between attributes) could only be calculated for changes between the alternative attributes levels (e.g. High sediments to low sediments).

Two datasets constructed for modelling. These were based on whether the respondents agreed with the effectiveness of the payment vehicle proposed, as asked in one of the questions. In dataset a, the answer to this question was included, and coded as three dummy variables, according to the responses given in the Likert-scale (agree, neutral, disagree). This dataset comprises all the valid questionnaires (371), making up a total of 1,484 observations (four choice sets per respondent). Dataset b includes only the responses of those who agreed with the effectiveness of the payment vehicle, and consists of 146 questionnaires, which represents over thirty-nine percent (39.4%) of the valid questionnaires (584 observations).

Firstly, the basic MNL models were estimated (Including main attributes only). The test proposed by Hausman and McFadden (1984) to verify the IIA/IID assumption for these models was performed in LIMDEP. The results showed no significant differences when one of the alternatives was removed, and therefore the IIA/IID assumption was accepted for the models.

Table 2 explains the model specifications, describing the variables and interactions included. Model 1 represents the attribute-only specification (Basic MNL). The other models were constructed using the Basic MNL and including the demographic variables and factor variables in interaction with the ASC and main attributes. Other models were constructed joining the significant interactions of these models

In the basic MNL, all the attributes were significant at the 10 percent level or better and have expected signs. The explanatory power is relatively high, with an adjusted rho square (ρ^2) value of 0.3043 for dataset a (Model 1a) and 0.3404 for dataset b (Model 1b) (Table 3 and Table 4). The interpretation of the coefficients for the main attributes suggests that the respondents are willing to pay when faced with scenarios that offer better environmental conditions. The coefficient for the money attribute is negative, which indicates that increasing cost has a negative effect on utility. The addition of interactions in the models improved the model fit. The interactions allowed testing and identifying demographic characteristics and attitudes that could have an effect on the choice.

Table 2: Models constructed with demographic variables

Model*	**Model specification**
Model 1 a,b	Main attributes only – Basic MNL model
Model 2 a,b	Main attributes + SQ*demographic variables
Model 5 a,b	Main attributes + SQ*factor variables
Model 6 a,b	Main attributes + attribute*demographic variables
Model 9 a,b	Main attributes + attribute*factor variables
Model 12 a,b (2+5)	Main attributes + SQ*demographic variables + SQ*factor variables
Model 15 a,b (6+9)	Main attributes + attribute*demographic variables + attribute*factor variables
Model 18 a,b (12+15)	Main attributes + SQ*demographic variables + SQ*factor variables + attribute*demographic variables + attribute*factor variables
Model 19 a,b (2+6)	Main attributes + SQ*demographic variables + attribute*demographic variables

* a or b indicates the dataset used in the models

For analytical purposes and clarity, the results were divided by the type of variable included in the model interactions (demographic and factor variables).

The adjusted ρ^2 values for models including demographic variables reveal robust models, with values ranging from 0.3121 (Model 6a) to 0.3136 (Model 2a) (models estimated with dataset a), and from 0.3579 (Model 2b) to 0.3805 (Model 19b) (models estimated with dataset b) (Table 3). The regression coefficient estimates for all the main attributes in all the models estimated with dataset a were highly significant (at the 1% level) and had the expected signs. High flow was not a significant main attribute in Models 6b and 19b, and was not included. The coefficients for all the other main attributes included in the models estimated with dataset b were significant (at the 10% level or better) and had the expected signs.

The positive signs on interactions with Land stabilisation showed that respondents who had full-time employment, university education, and more people living at home (Stb*Full-time,

Stb*University, Stb*Number of people living at home) were more willing to pay for positive environmental changes for this attribute (Models 6a,b and 19a,b). Likewise, the interaction between High flow and Female (HFlw*Female) was highly significant (at 1% level) and had a positive sign in Models 6b and 19 b () which shows that female respondents valued higher levels of water flow more highly than males do. The positive sign on the interactions of High sediments (HSed*No dependents) and Lots of algae (LAlg*Female) indicated that respondents with no dependents and females were willing to pay less for reducing the levels of sediment and algae in water respectively (Models 6b and 19b).

Respondents who identified themselves with Māori ethnic background (Stb*Māori), those who disagreed with the payment vehicle (Stb*Disagreed rate payment), and homeowners (Stb*Own home) were willing to pay less for improvements in Land stabilisation than respondents with other ethnic backgrounds, those that agreed with the payment vehicle, or those who were renting the residence where they lived (Models 6b and 19b).

The adjusted ρ^2 values for the models including factor variables ranged from 0.3086 (Model 9a) to 0.3116 (Model 18a) (for models estimated with dataset a), and from 0.3713 (Model 9b) to 0.3862 (Model 18b) (for models estimated with dataset b) (Table 4). The explanatory power for these models is high; however, were comparatively lower than the models including demographic variables.

The main attributes were significant (at 10% level or better) and had the expected signs in all the models. The results for the interactions between the main attributes and demographics were similar to those described for the previous models. The positive signs on the interactions with Land stabilisation indicated that respondents in full-time employment, and with university education were more willing to pay for an improvement in this attribute (Models 15a,b and 18a,b). The positive sign in the interaction between Lots of algae and Female indicated that female respondents were willing to pay less for reducing the levels of algae in water as compared with male respondents.

The results indicated that respondents who had a positive attitude towards practical services that plantation forests can provide to the community (Landscape, Area for events, Road use) (Community factor 1) were more willing to pay for improved levels of Land stabilisation (Stb*Community factor 1, Models 9a,b, 15a,b and 18 a,b) and sediments (HSed*Community factor 1, Model 9b) than other respondents. Respondents who had a positive attitude towards the benefits that forestry-related work provides in the local economy (Employment factor 1) were willing to pay less for a reduction of algae levels in water (LAlg*Employment factor 1) (Model 9b). Respondents who agreed that it was possible to do recreation in plantation forests (Recreation factor 1) were less willing to pay for lower levels of sediment in water than other respondents (Model 9b).

Table 3: Comparison of model estimates including demographic variables only (Dataset a and b)

Variables/Interactions		**Model 1a**		**Model 2a**		**Model 6a**		**Model 19a**		**Model 1b**		**Model 2b**		**Model 6b**		**Model 19b**	
Main attributes	Money	-0.0073 (0.0019)	***	-0.0074 (0.0020)	***	-0.0070 (0.0020)	***	-0.0072 (0.0020)	***	-0.0059 (0.0031)	*	-0.0059 (0.0032)	*	-0.0063 (0.0034)	*	-0.0068 (0.0034)	**
	Stabilisation (Stb)	0.0196 (0.0049)	***	0.0195 (0.0052)	***	0.0180 (0.0057)	***	0.0170 (0.0055)	***	0.0256 (0.0082)	*	0.0234 (0.0085)	**	0.0240 (0.0134)	*	0.0196 (0.0089)	**
	High Sediments (HSed)	-2.4465 (0.1223)	***	-2.4556 (0.1295)	***	-2.4486 (0.1293)	***	-2.4482 (0.1294)	***	-2.6143 (0.2077)	***	-2.6394 (0.2185)	***	-3.2253 (0.2959)	***	-3.1792 (0.2890)	***
	High Algae (HAlg)	-2.1509 (0.1164)	***	-2.2240 (0.1247)	***	-2.2130 (0.1243)	***	-2.2186 (0.1246)	***	-2.5031 (0.2035)	***	-2.6229 (0.2181)	***	-3.1602 (0.3191)	***	-3.1124 (0.3149)	***
	High Flow (HFlw)	0.2916 (0.0940)	***	0.3290 (0.0993)	***	0.3370 (0.0095)	***	0.3302 (0.0994)	***	0.2725 (0.1521)	*	0.2936 (0.1584)	*				
SQ* Demographic	SQ*Full-time			-0.2721 (0.1224)	**							-0.7168 (0.2842)	**			-0.6740 (0.2130)	***
	SQ*University			-0.5950 (0.1799)	***			-0.5713 (0.1804)	***			-0.5153 (0.2060)	**				
	SQ*Own home											0.9245 (0.3067)	***			1.1865 (0.3281)	***
	SQ*Female											-0.4191 (0.2099)	**				
	SQ*Agree rate payment			-0.2872 (0.1249)	**			-0.2936 (0.1253)	**								
Attribute* Demographic	Stb*Full-time					0.0081 (0.0036)	**	0.0078 (0.0036)	**					0.0139 (0.0063)	**		
	Stb*University					0.0141 (0.0051)	***							0.0209 (0.0083)	**	0.0228 (0.0082)	***
	Stb*Māori					-0.0110 (0.0058)	*	-0.0107 (0.0058)	*								
	Stb*Disagree rate payment					-0.0083 (0.0037)	**										
	Stb*N people at home													0.0043 (0.0023)	*		
	HSed*No dependents													1.0109 (0.3227)	***	0.8816 (0.3084)	***
	LAlg*Female													0.7218 (0.3325)	**	0.6582 (0.3280)	**
	HFlw*Female													0.5910 (0.1925)	***	0.5843 (0.1911)	***
ASC	Status quo (SQ)	-1.0564 (0.2214)	***	-0.7433 (0.2438)	***	-1.0397 (0.2346)	***	-0.8593 (0.2387)	***	-1.2094 (0.3859)	**	-1.4496 (0.5164)	***	-1.3450 (0.4115)	***	-2.0540 (0.5179)	***
N		1484		1348		1344		1344		584		548		536		536	
Log-likelihood at convergence		-1128.96		-1010.52		-1009.34		-1007.73		-420.88		-383.05		-361.68		-361.02	
Log-likelihood, constant only model		-1626.19		-1477.03		-1472.73		-1472.73		-641.39		-602.02		-588.77		-588.77	
Adj. ρ2		0.3043		0.3136		0.3121		0.3132		0.3404		0.3579		0.3788		0.3805	

Table 4: Comparison of model estimates including factor variables (Dataset a and b)

Variables/Interactions		Model 1a		Model 9a		Model 15a		Model 18a		Model 1b		Model 9b		Model 15b		Model 18b	
Main attributes	Money	-0.0073 (0.0019)	***	-0.0074 (0.0021)	***	- 0.0073 (0.0021)	***	- 0.0073 (0.0021)	***	-0.0059 (0.0031)	*	-0.0104 (0.0050)	**	-0.0069 (0.0038)	*	-0.0068 (0.0038)	*
	Stabilisation (Stb)	0.0196 (0.0049)	***	0.0209 (0.0054)	***	0.0127 (0.0059)	**	0.0162 (0.0056)	***	0.0256 (0.0082)	*	0.0371 (0.2129)	***	0.0368 (0.0126)	***	0.0372 (0.0127)	***
	High Sediments (HSed)	-2.4465 (0.1223)	***	-2.4371 (0.1364)	***	- 2.4355 (0.1389)	***	- 2.4384 (0.1391)	***	-2.6143 (0.2077)	***	- 2.8891 (0.3330)	***	-2.7616 (0.2511)	***	-2.7783 (0.2526)	***
	High Algae (HAlg)	-2.1509 (0.1164)	***	-2.1857 (0.1308)	***	- 2.2067 (0.1336)	***	- 2.2092 (0.1337)	***	-2.5031 (0.2035)	***	- 2.6539 (0.3210)	***	-3.4016 (0.3639)	***	-3.3479 (0.3676)	***
	High Flow (HFlw)	0.2916 (0.0940)	***	0.3059 (0.1047)	***	0.3148 (0.1067)	***	0.3151 (0.1067)	***	0.2725 (0.1521)	*	0.6329 (0.2498)	**	0.3101 (0.1875)	*	0.3094 (0.1877)	*
SQ* Demographic	SQ*Full-time							-0.3178 (0.1327)	**							- 0.4108 (0.2333)	*
Attribute* Demographic	Stb*Full-time					0.0076 (0.0039)	*										
	Stb*University					0.0167 (0.0058)	***	0.0167 (0.0058)	***					0.0214 (0.0095)	**	0.0217 (0.0095)	**
	Stb*Own home													-0.0262 (0.0096)	***	-0.0263 (0.0097)	***
	LAlg*Female													0.9210 (0.3720)	**	0.9722 (0.3746)	***
Attribute* attitude factor	Stb*Community factor 1			0.0062 (0.0019)	***	0.0052 (0.0020)	***	0.0052 (0.0020)	***			0.0134 (0.0054)	**	0.0100 (0.0035)	***	0.0096 (0.0035)	***
	LAlg*Employment factor 1											0.3766 (0.2013)	*				
	HSed*Community factor 1											-0.9759 (0.3425)	***				
	HSed*Recreation factor 1											0.6050 (0.2607)	**				
ASC	Status quo (SQ)	-1.0564 (0.2214)	***	-1.0588 (0.2461)	***	-1.1189 (0.2510)	***	- 0.9788 (0.2569)	***	-1.2094 (0.3859)	**	-0.7427 (0.5507)		-1.4892 (0.4658)	***	-1.2727 (0.4811)	***
N		1484		1196		1156		1156		584		268		432		432	
Log-likelihood at convergence		-1128.96		-904.27		-870.52		- 869.54		-420.88		- 181.47		- 289.02		- 287.46	
Log-likelihood, constant only model		-1626.19		-1311.73		-1267.25		- 1267.25		-641.39		- 294.15		- 474.40		- 474.40	
Adj. ρ2		0.3043		0.3086		0.3103		0.3116		0.3404		0.3713		0.3836		0.3862	

3.6.1. Goodness of fit of models

The overall model significance was assessed by comparing the following statistics: Consistent Akaike Information Criterion (CAIC) and Bayesian Information Criterion (BIC) for each of the models. The CAIC criterion is defined as: CAIC = -2*LL + p*(lnN + 1), where LL is the log-likelihood at convergence, p is the number of estimated parameters in the model, and N is the number of observations; the BIC criterion is defined as: BIC = -LL + ((p/2)*lnN), where LL is the log-likelihood at convergence, p is the number of estimated parameters in the model and N is the number of observations. Lower values in these statistics indicate better goodness of fit (Ashok et al., 2002; Boxall and Adamowicz, 2002; Bozdogan, 1987). Table 5 presents these statistics for the basic models, models including interactions with attributes only (Models 6 and 15), and models that merged all significant interactions (Models 18 and 19) for both datasets.

Table 5: Goodness of fit measures for selected models*

Dataset	Model type	Model	Number of parameters	Number of observations	Adjusted ρ^2	Log-likelihood	CAIC	BIC
A	Basic MNL	1a	5	1484	0.3043	-1128.96	2299.43	1147.22
	Demographic variables	6a	9	1344	0.3121	-1009.34	2092.51	1041.76
		19a	9	1344	0.3132	-1007.73	2089.29	1040.15
	Factor variables	15a	8	1156	0.3103	-870.52	1805.46	898.73
		18a	8	1156	0.3116	-869.54	1803.50	897.75
B	Basic MNL	1b	5	584	0.3404	-420.88	878.61	436.80
	Demographic variables	6b	11	536	0.3788	-361.68	803.49	396.24
		19b	10	536	0.3805	-361.02	794.88	392.44
	Factor variables	15b	9	432	0.3836	-289.02	641.66	316.33
		18b	10	432	0.3862	-287.46	645.60	317.80

The results of this test showed that all the models had a higher level of parametric fit when compared with basic MNL model (Models 1a and 1b). These results indicated that the improvements in the model fit were quite significant with the addition of interactions, as they helped to explain a greater proportion of the choices than the more basic models.

Models that included factor variables had the highest improvement in model fit, as they had the lowest CAIC and BIC values and highest adjusted ρ^2 in each dataset. When the same model type was compared, CAIC and BIC values were lower for the models that merged all the significant interactions than those that included interactions with the attributes only.

3.6.2. Implicit prices

The model coefficients were used to estimate the willingness to pay (WTP) for marginal changes in the levels of environmental quality provided by each of the attributes. These are known as implicit prices (IP). The implicit prices can also be used to estimate changes in utility for scenarios or profiles that are constructed based on the attributes and levels. The models that had the best overall significance were used to calculate the implicit prices (Models 15b, 18a and 19a,b). In order to compare the results obtained by these models in both datasets, Models 15a and 18b were also included (Table 6).

Implicit prices for each attribute and model were calculated using the corresponding coefficients estimated by the Krinsky and Robb (1986) procedure. This procedure simulates a probability distribution, using a bootstrap approach, and extracts a number of random coefficient vectors from the covariance matrix (Poe et al., 1997; Riera and Mogas, 2004; Rolfe and Bennett, 2001). For this exercise, 1,000 random coefficient extractions were

created for each model using LIMDEP. These were then used to calculate the implicit prices and confidence interval distributions for each attribute using the percentile bootstrap method (Efron and Tibshirani, 1993). The implicit prices represent the estimated annual WTP that each respondent has for a marginal change in the environmental levels for each attribute. Demographic and factor variables were set at sample means.

Table 6: Implicit prices and confidence intervals

Model type	Model	Implicit prices per attribute* ($ per household in Hawke's Bay per year for five years)			
		Land stabilisation 1% improvement	Sediment in water From high to low	Algae in water From high to low	Level of water flow From high to low
Demographic variables	19a	2.61 (1.01;6.23)	338.18 (213.37;725.27)	304.24 (193.95;664.48)	-45.38 (-117.93;-16.56)
	19b	3.11 (-0.26;22.39)	424.42 (173.62;2234.36)	408.75 (167.94;2168.48)	-44.37 (-248.65; -7.36)
Factor variables	15a	2.56 (0.85;7.82)	332.10 (212.31;781.55)	301.05 (192.16;693.51)	-43.75 (-119.02;-13.04)
	15b	3.66 (-19.24;23.32)	377.12 (-1465.74;2598.63)	400.29 (-1603.48;2715.18)	-42.45 (-272.81;153.51)
	18a	2.54 (0.80;6.95)	331.18 (210.80;772.19)	299.65 (191.62;714.73)	-43.68 (-103.81;-12.43)
	18b	3.71 (-20.45;27.32)	382.74 (-1782.81;2483.90)	400.90 (-1877.85;2729.89)	-42.78 (-229.69;172.64)

* 95% confidence intervals are shown in brackets

The implicit price estimates confirmed that respondents viewed low level of water flow as an undesired environmental quality level, as the WTP for this level is negative. It is important to note that these results must be treated with caution, as they are relative rather than absolute. Although the implicit prices are a good indication of the WTP for one attribute, assuming that the other attributes are held constant, this would not hold in practice where multi-attribute changes are involved (Blamey and Bennett, 2001; Rolfe et al., 2000).

The differences for the implicit prices calculated for each dataset were tested using the method outlined by Poe et al. (1997), who proposed pairing the implicit prices distributions, and calculating the difference (H_o: IP_1-IP_2=0). An approximate one-sided significance of this difference is obtained by computing the proportion of the differences with the hypothesised sign (Blamey and Bennett, 2001; Poe et al., 1997). Based on this test, the models estimated with both datasets generated implicit prices that are not significantly different ($p<0.05$) for all attributes.

4. Discussion

Each step of the research leading to the estimation of values was built up on the perspectives of the stakeholder groups identified, who were participants in the identification of other stakeholders, selection of plantation forest environmental and social services and preparation of the valuation survey. The valuation process was a participatory approach that integrated stakeholders' perspectives with the aim to integrate them into policies and management actions (Harrison and Qureshi, 2000). Focus group results confirmed the premise established about which were the most relevant plantation forest services for the stakeholders and helped to expand the understanding of the topic (Greenbaum, 2000; Morgan, 1988).

The fact that over sixty percent of respondents agreed to answer the survey despite their disagreement with the payment vehicle (respondents in dataset a) raised a couple of hypotheses. Firstly, respondents may have agreed with the importance of the topics they were asked about in the questions, but they distrusted the payment vehicle or thought it would not be an efficient way to deliver the change. The other possibility is that respondents answered the questionnaire agreeing with the questions and not taking into consideration the scenarios context or expressing their true views (yea-saying) (Blamey and Bennett, 2001). This research did not gather information to test or prove the first probability, as no further questions were asked about respondents' reasons to disagree with the payment vehicle, and therefore this will remain as a hypothesis. Given the results obtained in the modelling, it is unlikely that the respondents were carelessly answering the questionnaire, as they chose from all the alternatives and not only the SQ (no cost) or most environmentally attractive options or attribute levels (Blamey and Bennett, 2001; Boyle, 2003).

In addition, it could be assumed that the results estimated with dataset b would be more reliable, and that the respondents could have shared their sincere opinion when they made their choices, as they perceived that increasing the regional council rates to improve environmental quality was a reasonable scenario (Morrison et al., 1997). However, the IP values estimated with both datasets are not statistically different. These results indicated that although the respondents stated different opinions about their agreement with the payment, their choices and WTP were the same.

This study aims to integrate stakeholders' beliefs, demographic characteristics to measure their economic preference and attitudes towards the identified plantation forest environmental and social values (services). Therefore, the model selected needs to incorporate the attitudinal component in the estimation of utility, as well as being statistically robust.

The addition of respondents' attitudes towards plantation forest social values resulted in models that improved the model fit significantly more than other variables. However, there has been little use of attitudes or perceptions in choice modelling or valuation exercises, possibly because this information is difficult to collect (Adamowicz et al., 1997).

Models including factor variables included the attitudinal component to the choice modelling, resulting in a better model fit. From these results, it can be concluded that community attitudes had stronger influences on choices, and helped in the understanding of how respondents' attitudes could influence their preferences for environmental attributes and willingness to pay for the changes in environmental quality levels (Sermons and Koppelman, 1998).

Significant demographics such as employment (full-time), education (university), and household structure (no dependents) influenced respondents' choices, and these results were consistent with other environmental valuation studies. It is hypothesised that higher WTP is positively influenced by higher levels of income, education and having fewer children (Jin et al., 2006; Morrison and Bennett, 2004; Othman et al., 2004; Stevens et al., 2000; Taylor et al., 1997). Age and gender have also been found to influence respondents' willingness to pay in other studies, although their effect varied according to the scenarios and resources valued (Jin et al., 2006; Rolfe and Bennett, 2001; Rolfe et al., 2000; Stevens et al., 2000; Taylor et al., 1997). The models in this research included significant interactions with gender (female),

indicating that female respondents had higher preferences for levels of water flow than for algae in water.

The significant factor variables included in the models (Community factor 1, Employment Factor 1, and Recreation Factor 1) indicated that respondents' positive experience and attitude towards benefits provided by plantation forests influenced their choices. Other studies have found similar results, where rural dwellers and forest users have a greater WTP than people that are not familiar with the forests (Taylor et al., 1997).

Based on the goodness of fit and implicit prices results, it is concluded that Model 18a which included factor variables would provide the best estimates of all the models. This model includes respondents' demographic and attitudinal characteristics, accounting best for heterogeneity in the choices, and therefore reducing bias in the model's estimates (Boxall and Adamowicz, 2002).

The significant coefficients in this model indicated that respondents who had university studies and those who had a positive attitude towards plantation forest community values, such as landscape, area for events and road use (Community factor 1), were more willing to pay for improved levels of land stabilisation.

The implicit prices can be used as an estimate of WTP for each attribute (Blamey and Bennett, 2001). The implicit prices estimated with Model 18a indicated that the wider community in Hawke's Bay have a greater appreciation for water quality, as the WTP for lower levels of algae and sediments were the highest as compared with the other attributes (land stabilisation and water flow).

5. Conclusions

All the models estimated were robust, as measured by adjusted ρ^2 values, according to the standards used to describe probabilistic choice models (Colombo et al., 2005; Morrison and Bennett, 2004; Rolfe et al., 2000). The integration of attitudes in the choice models was found to be adequate, improved the models' goodness of fit and the interactions included helped in the understanding of respondents' choices. Positive attitudes towards plantation forests, possibly related to personal experience and use of plantation forests have a positive influence in the environmental preferences and WTP. A model including demographic and attitude variables (Model 18a) was considered the most reliable model, providing a greater amount of the respondents' characteristics and perceptions in the estimation of utility. The implicit prices estimated through the choice modelling reflect respondent's WTP for improved environmental attributes quality levels for all plantation forests in Hawke's Bay. The application of these values in forest management scenarios or policies prescriptions needs to account the frame where the values were estimated, and therefore potential errors inherent in transfer of benefits (Brouwer, 2000; Desvousges et al., 1992).

Acknowledgements

The authors thank the contribution of the New Zealand Tertiary Education Commission, Scion Research, New Zealand Institute of Forestry, Holt Forest Trust and Pan Pac Forest Products Ltd. for their financial support in the development of this research.

6. References

Adamowicz, W.L., Swait, J.D., Boxall, P.C., Louviere, J.J. and Williams, M., 1997. Perceptions versus Objective Measures of Environmental Quality in Combined Revealed and Stated Preference Models of Environmental Valuation. Journal of Environmental Economics and Management, 32: 65-84.

Ashok, K., Dillon, W.R. and Yuan, S., 2002. Extending Discrete Choice Models to Incorporate Attitudinal and Other Latent Variables. Journal of Marketing Research, 39: 31-46.

Babbie, E., 2007. The practice of Social Research. Thomson Wadsworth, 114 pp.

Bennett, J.W., 1999. Some Fundamentals of Environmental Choice Modelling. School of Economics and Management. The University of New South Wales. Canberra, Australia.

Bennett, J.W. and Adamowicz, W.L., 2001. Some Fundamentals of Environmental Choice Modelling. In: J.W. Bennett and R.K. Blamey (Editors.), Some Fundamentals of Environmental Choice Modelling. New Horizons in Environmental Economics. Edward Elgar Publishing Limited, pp. 37-69.

Blamey, R.K. and Bennett, J.W., 2001. Yea-saying and Validation of a Choice Model of Green Product Choice. In: J.W. Bennett and R.K. Blamey (Editors.), Yea-saying and Validation of a Choice Model of Green Product Choice. New Horizons in Environmental Economics. Edward Elgar Publishing Limited, pp. 178-201.

Boxall, P.C. and Adamowicz, W.L., 2002. Understanding Heterogenous Preferences in Random Utility Models: A Latent Class Approach. Environmental and Resource Economics, 23: 421-446.

Boyle, K.J., 2003. Contingent Valuation in practice. In: P.A. Champ, K.J. Boyle and T.C. Brown (Editors.), Contingent Valuation in practice. Kluwer Academic Publishers, pp. 111-170.

Bozdogan, H., 1987. Model selection and Akaike's Information Criterion (AIC): The General Theory and its Analytical Extensions. Psychometrika, 52: 345-370.

Brouwer, R., 2000. Environmental Value Transfer: State of the Art and Future Prospects. Ecological Economics, 32: 137-152.

Champ, P.A., 2003. Collecting Survey Data for Nonmarket Valuation. In: P.A. Champ, K.J. Boyle and T.C. Brown (Editors.), Collecting Survey Data for Nonmarket Valuation. Kluwer Academic Publishers, pp. 59-98.

Chilton, S.M. and Hutchinson, W.G., 1999. Do focus groups contribute anything to the contingent valuation process? Journal of Economic Psychology, 20: 465-483.

Colombo, S., Calatrava-Requena, J. and Gonzalez-Roa, M.C., 2005. Testing choice experiment for benefit transfer. 99th seminar of the EAAE (European Association of Agricultural Economists). The Future of Rural Europe in the Global Agri-Food System, Copenhagen, Denmark.

Desvousges, W.H., Naughton, M.C. and Parson, G.R., 1992. Benefit Transfer: Conceptual Problems in Estimating Water Quality Benefits Using Existing Studies. Water Resource Research, 28: 675-683.

Dillman, D.A., 2000. Mail and internet surveys : the tailored design method. Wiley, New York, 464 pp.

Dudley, N., 2005. The emerging role of forest quality in setting perspectives in forest management. In: J.L. Innes, G.M. Hickey, H.F. Hoen and IUFRO Task Force on Environmental Change (Editors.), The emerging role of forest quality in setting perspectives in forest management. CABI Publishing. In association with the International Union of

Forestry Research Organizations (IUFRO), Wallingford, Oxfordshire, United Kingdom, pp. 15-30.
Dyck, B., 2003. Benefits of Planted Forests: Social, Ecological and Economic. Maximising the Role of Planted Forests in Sustainable Forest Management. UNFF Intersessional Experts Meeting on the Role of Planted Forests in Sustainable Forest Management, Wellington, New Zealand.
Ecosystem Valuation, 2004. The Contingent Choice Method. US.Department of Agriculture Natural Resources Conservation Service. Ecosystem Valuation (EV). Available in: http://www.ecosystemvaluation.org/contingent_choice.htm. Last accessed: September 10, 2004
Efron, B. and Tibshirani, R., 1993. An introduction to the bootstrap. Chapman & Hall, New York, 436 pp.
Food and Agriculture Organization of the United Nations, 2005. Global Forests Resources Assessment 2005 Report. Progress towards sustainable forest management. Food and Agriculture Organization of the United Nations (FAO), Rome, pp.
Green, C. and Tunstall, S., 1999. A Psychological Perspective. In: I.J. Bateman and K.G. Willis (Editors.), A Psychological Perspective. Oxford University Press, pp. 207-257.
Greenbaum, T.L., 2000. Moderating Focus Groups. A Practical Guide for Group Facilitation. Sage Publications, 249 pp.
Grice, J.W., 2001. Computing and evaluating factor scores. Psychological Methods, 6: 430-450.
Hahn, G.J. and Shapiro, S.S., 1966. A catalogue and Computer Program for the Design and Analysis of Orthogonal Symmetric and Asymmetric Fractional Factorial Experiments. General Electric Research and Development Center, New York, 110 pp.
Hanley, N., Mourato, S. and Wright, R.E., 2001. Choice Modelling Approaches: A Superior alternative for Environmental Valuation? Journal of Economic Surveys, 15: 435-462.
Harrison, S.R. and Qureshi, M.E., 2000. Choice of stakeholder groups in multicriteria decision models. Natural Resources Forum, 24: 1-19.
Hausman, J. and McFadden, D., 1984. Specification tests for the multinomial logit model. Econometrica, 52: 1219-1240.
Hensher, D.A., Rose, J.M. and Greene, W.H., 2005. Applied Choice Analysis. A Primer. Cambridge University Press, 717 pp.
Hock, B., Goulding, C., Hay, E. and Payn, T., 2003. Environmental concerns raised by forest certification: What are the issues for New Zealand? ANZIF 2003 Conference, Queenstown, New Zealand. New Zealand Institute of Forestry.
Holmes, T.P. and Adamowicz, W.L., 2003. Attribute-Based Methods. In: P.A. Champ, K.J. Boyle and T.C. Brown (Editors.), Attribute-Based Methods. Kluwer Academic Publishers, pp. 171-220.
Innes, J.L. and Hoen, H.F., 2005. The changing context of forestry. In: J.L. Innes, G.M. Hickey, H.F. Hoen and IUFRO Task Force on Environmental Change (Editors.), The changing context of forestry. CABI Publishing. In association with the International Union of Forestry Research Organizations (IUFRO), Wallingford, Oxfordshire, United Kingdom, pp. 1-15.
Jin, J., Wang, Z. and Ran, S., 2006. Estimating the public preferences for solid waste management programmes using choice experiments in Macao. Waste Management and Research, 24: 301-309.
Kline, P., 1994. An easy guide to factor analysis. Routledge, London ; New York, 194 pp.
Krinsky, I. and Robb, A.L., 1986. On Approximating the Statistical Properties of Elasticities. Review of Economics and Statistics, 68: 715-719.

Louviere, J.J., 2001. Choice Experiments: an Overview of Concepts and Issues. In: J.W. Bennett and R.K. Blamey (Editors.), Choice Experiments: an Overview of Concepts and Issues. Edward Elgar Publishing Limited, pp. 13-36.
Louviere, J.J., Hensher, D.A. and Swait, J.D., 2000. Stated Choice Methods: Analysis and Application. Cambridge University Press, 402 pp.
Lovelock, C.H., Stiff, R., Cullwick, D. and Kaufman, I.M., 1976. An Evaluation of the Effectiveness of Drop-Off Questionnaire Delivery. Journal of Marketing Research, 13: 358-364.
Mazzanti, M., 2001. Discrete Choice Models and Valuation Experiments. An Application to Cultural Heritage. XIII Conferenza. Stato o Mercato? Intervento pubblico e architettura dei mercati, Università de Pavia, Italy. Società italiana di economia pubblica. Dipartamento di economia pubblica e territoriale. Università di Pavia.
Morgan, D.L., 1988. Focus groups as Qualitative Research. Sage Publications, 83 pp.
Morrison, M. and Bennett, J., 2004. Valuing New South Wales rivers for use in benefit transfer. Australian Journal of Agricultural and Resource Economics, 48: 591-611.
Morrison, M., Bennett, J.W. and Blamey, R.K., 1997. Designing choice modelling surveys using focus groups: results from the Macquarie marshes and Gwydir wetlands case studies. School of Economics and Management. The University of New South Wales, Canberra, Australia, 45 pp.
Nasi, R., Wunder, S. and Campos, J.J., 2002. Forest Ecosystem Services: Can they pay our way out of deforestation? Costa Rica.
New Zealand Forest Owners Association, 2005. The National Standard for Environmental Certification of well-managed Plantation Forests in New Zealand. New Zealand Forest Owners Association (NZFOA). Welligton, New Zealand.
Norušis, M.J. and SPSS Inc., 2004. SPSS 12.0 guide to data analysis. Prentice Hall, Upper Saddle River, United Kingdom, 637 pp.
Othman, J., Bennett, J.W. and Blamey, R.K., 2004. Environmental values and resource management options: a choice modelling experience in Malaysia. Environmental and Development Economics, 9: 803-824.
Pattanayak, S. and Butry, D.T., 2003. Forest Ecosystem Services As Production Inputs. In: E.O. Sills and K.L. Abt (Editors.), Forest Ecosystem Services As Production Inputs. Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 361-378.
Poe, G.L., Welsh, M.P. and Champ, P.A., 1997. Measuring the Difference in Mean Willingness to Pay When Dichotomous Choice Contingent Valuation Responses Are Not Independent. Land Economics, 73: 255-267.
Riera, P. and Mogas, J., 2004. Finding the Social Value of Forests Through Stated Preference Methods. A Mediterranean Forest Valuation Exercise. Silva Lusitana, 12: 17-34.
Rietbergen-McCracken, J. and Narayan-Parker, D., 1998. Participation and Social Assessment. Tools and techniques. International Bank for Reconstruction and Development. The World Bank., Washington D. C, United States of America., 347 pp.
Rolfe, J.C. and Bennett, J.W., 2001. Framing Effects. In: J.W. Bennett and R.K. Blamey (Editors.), Framing Effects. Edward Elgar Publishing Limited., pp. 202-224.
Rolfe, J.C., Bennett, J.W. and Louviere, J.J., 2000. Choice modelling and its potential application to tropical rainforest preservation. Ecological Economics, 35: 289-302.
Rolfe, J.C. and Windle, J., 2003. Valuing the Protection of Aboriginal Cultural Heritage Sites. The Economic Record, 79: S85-S95.
Schaaf, K.A. and Broussard, S.R., 2006. Private forest policy tools: A national survey exploring the American public's perceptions and support. Forest Policy and Economics, 9: 316-334.

Sermons, M.W. and Koppelman, F.S., 1998. Factor Analytic Approach to Incorporating Systematic Taste Variation into Models of Residential Location Choice. Transportation Research Record, 1617: 194-202.
Stevens, T.H., Belkner, R., Dennis, D., Kittredge, D. and Willis, C., 2000. Comparison of contingent valuation and conjoint analysis in ecosystem management. Ecological Economics, 32: 63-74.
Taylor, K., Reaston, P., Hanley, N., Wright, R.E. and Butler, K., 1997. Valuing Landscape Improvements in British Forests. Main report. Forestry Commision. ENTEC UK Limited. Wood Holmes Marketing. Environmental Economics Research Group, University of Stirling.
Thompson, B., 2004. Exploratory and confirmatory factor analysis : understanding concepts and applications. American Psychological Association, Washington DC, United States of America, 195 pp.
Train, K.E., 2003. Discrete Choice Methods with Simulation. Cambridge University Press, 334 pp.
United Nations Forum on Forests, 2004. History and Milestones of Global Forest Policy. United Nations Forum on Forests (UNFF). Available in: http://www.un.org/esa/forests/about-history.html. Last accessed: May 10, 2004
Wilson, M. and Sapsford, R., 2006. Asking Questions. In: R. Sapsford and V. Jupp (Editors.), Asking Questions. Sage Publications, pp. 93-123.