Using Stated Choice Methods in the design of Payments for Environmental Services schemes

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1. Introduction

Payment for Environmental Services (PES) schemes have developed in response to situations of market failure for environmental goods. For example, regulation of water services flowing from upland watershed zones can provide benefits for downstream industry, agriculture and domestic users. Unrecognised off-site benefits/costs (i.e. externalities) for environmental services (ES) with public goods characteristics (e.g. non-excludable and, often, high transaction costs) may result in sub-optimal outcomes for nature and society, e.g. unsustainable deforestation (see Landell-Mills and Porras, 2002, for a discussion). The failure or inability of government to adequately respond to such situations through regulatory mechanisms has increased interest in PES mechanisms to internalise such externalities through compensations or payment mechanisms that create arrangements between resource providers and resource users. There has been growing interest that such schemes may also contribute to poverty reduction in upland watershed areas in developing countries.

However, there exists uncertainty about the socio-economic opportunities and outcomes from promoting such arrangements. Making sure that demand for the service exists is not enough. The sustainability and success of PES schemes will depend on land managers' adoption of improved or maintained land use practices over a period long enough to deliver the service.

In tropical agro-ecological systems, environmental factors may modify a land manager's decision-making between seasons or years subject to other exogenous factors. Some of these factors include markets (e.g. factor, produce, land), infrastructure (e.g. roads, electricity, water supply), macro-economic trends (e.g. employment, growth, inflation) and policy changes (e.g. food, energy). This presents a significant range of possible scenarios that can influence land managers likelihood of cooperating with PES agreements.

One approach to better understand and investigate behavioural responses to changing scenarios is the use of exploratory experiments of likely or predicted scenarios with potential participants to estimate responses using econometric techniques. This paper presents results from one such experiment investigating upland farmer adoption of the Costa Rica PES programme in a Tropical Montane Cloud Forest (TMCF) area associated with the regulation of water flows[1] to downstream users (here, hydro-electric power and irrigation).

[1] A companion study investigates hydrological response from forest to pasture land cover in the study area: www.geo.vu.nl .

2. Stated Choice Methods

Stated Choice Methods (SCM) offer an approach to investigate, estimate and predict the behaviour of potential and actual participants in a controlled experimental framework to proposed or uncertain changes in attributes of goods or services in an existing or hypothetical situation (Louviere et al., 2000). SCM aim to provide improved theory, methods and analytical tools to explain individual and aggregate choice behaviour. They are used to examine welfare implications of policy or management changes within a discrete choice framework in such diverse disciplines as marketing, transportation, psychology, environmental valuation, municipal planning and water policy (Hope and Garrod, 2004; Scarpa *et al*., 2003; Haider & Rashid, 2002; Willis & Garrod, 1998; Adamowicz *et al*., 1995). A particular appeal of SCM in economic analysis is that it is based on random utility theory, which allows a rigorous modelling framework.

2.1. What is Conjoint Analysis

Conjoint analysis (CA) is a SCM, which has been used for many years in marketing to evaluate consumers' responses to multi-attribute commodities. By successively asking the consumer to rate various combinations of attributes and make implicit trade-offs, it is possible to reveal the consumer's level of preferences and the most-preferred attribute that would increase the likelihood of purchasing a commodity.

Typically, estimates of willingness to accept or pay in environmental commodities are done through the use of Contingent Valuation Method (CVM), in which the individual is asked to state (YES or NO) their willingness to accept or reject a scenario. A number of critiques to this technique have been made and one of the most common is the failure to allow for uncertainty in responses, and to limit the attribute to price information.

In a real purchase situation, consumers do not make choices based on a single attribute, rather, they examine a range of features or attributes and then make judgements or trade-offs to determine their final purchase choice. One of the assumptions in CA is that the consumer makes decisions based not on one factor at the time (say, price), but on several factors "jointly".

Although CA has not been widely applied in resource economics, previous research indicates several reasons why CA may be preferred over CVM (Stevens, Belkner, Kittredge and Willis, 1999; Alpízar, Carlsson and Marinsson (2003)). In the first place, CA makes substitutes explicit and consequently respondents might be encouraged to explore their preferences and tradeoffs in more detail. Second, from a psychological point of view, the process of making choices in the CA format might be different from that associated with making decisions about prices. Finally, CA respondents can express ambivalence or indifference directly, thus non-response and protest behaviour may be reduced.

Conjoint Analysis technique has proven useful in assessing the individual's preferences in terms of environmental commodities comprising multi-attributes. Conjoint Analysis can be used, for example, in examining the responses that stakeholders make to different attributes of environmental programmes, and can be extremely valuable in selecting the right combination of attributes or incentives (and their levels) that a policy package must have in order to maximize the individual's welfare and the programme's likelihood of success.

2.1.1. Conjoint Analysis as a tool in environmental issues

Valuation of non-market goods and services are usually done either through revealed preference methods or through stated preference methods. The first one studies actual behaviour on a closely related market good. For example, the value of landscape beauty is inferred through hedonic prices or travel cost methods. The second one analyses consumer's behaviour in a hypothetical setting when faced with alternative policy scenarios (here referred to as commodities).

Choice methods are a versatile tool for investigating "what if" type questions. It generates defensible parameter estimates from an obtained modelling framework. Attribute design is improved by linking with qualitative methods (like focus groups and interviews). It is important to remember possible limitations. Their use requires some level of technical design and analysis and command of computing software, the selection of the right combination of attributes to define the policy package is key[2], there is a danger of reductionism (as with any model), and there could be limitations to effective local adoption.

Some examples of applications to environmental issues include:

- Domestic water policy trade-offs in South Africa (Hope and Garrod, 2004)
- Deregulation of the electricity industry in the USA could be linked to increases in atmospheric pollution. In order to understand consumer's trade-offs, Porras (1999) used Conjoint Analysis and Contingent Valuation methods (CVM) to estimate the off-site value of visibility in the New Hampshire's White Mountains.
- Roe, Boyle and Teisl (1996) Atlantic salmon fishery management.
- Duke (2004) used CA to understand public preferences for agricultural land preservation in the USA.
- Gan and Luzar (1993) used CA to provide policy-makers with information about the multi-attribute decision-making process for outdoor recreation activities. In this case, hunting permits for waterfowl in Louisiana.
- Boxall *et al* (1996) used choice methods and CVM to examine consumer's reaction to changes in forest management practices on recreational moose hunting values.
- Stevens, Barret and Willis (1997) use CA to value groundwater protection program alternatives in western Massachusetts.

[2] While CA is helpful to understand multi-attribute situations, it is important to keep the number of attributes as small as possible to help the respondent's decision-making process. A good rule-of-thumb would be 5 to 7 attributes.

- Alpizar and Otárola (2004) used choice methods to estimate WTP of a electricity utility (JASEC) for environmental management of watershed that feeds into a hydroelectric project in Costa Rica.

In the case of compensation for environmental services, the model assumes that the individual is likely to accept (or make) a PES only if her new level of utility is greater than the utility he gets from an initial (no payment) scenario. As a result, the model predicts Willingness to Accept (or to pay) linked to a probability function.

The experiment could be useful to understand both upstream willingness to engage in improved land use practices, and downstream users willingness to pay for watershed service delivery. This study presents an application of CA to estimate willingness to engage in watershed conservation (upstream scenario below).

BOX 1. Examples of possible scenarios include:
For downstream watershed service users:

The watershed where you obtain your water supplies is under threat. Inadequate land use is causing [name here the main threats affecting directly the company, i.e. increased sedimentation]. It is likely that this is affecting the operations of your company, increasing your operation and maintenance costs. Traditional measures forcing upstream land users to restrict their behaviour has not been successful. One of the reasons for this is the high opportunity cost that farmers face if they have to change or stop their current economic activities.

There are some existing experiences where downstream water users take a more pro-active role and engage in watershed conservation by directly rewarding upstream land users for “good behaviour”. [show examples]. There are important gains to be obtained by these actions. Improving the quality of the environmental service upon which your company relies will result in reductions in maintenance costs. For many companies an increase in public relations with the local communities has been a major incentive. You might find yourselves exploring a whole new niche of environmental-friendly products. And the chances are that by improving the livelihoods of upstream communities the threat to the environmental service will decrease.

We are exploring the potential of such initiatives in this area. At the moment we are talking to different water users about their preferences for a programme for watershed conservation. We would like to know about your own preferences. This information will help policy-makers device the best policies that would suit this particular area and would maximise your own benefits and those of the people living upstream.

For upstream watershed service suppliers (this is the policy scenario presented in Monteverde and discussed in this paper):

“Integrated catchment management involves improved use of land in the upper catchment area in order to maximize the private benefits of the quantity and quality of water resources for property owners and inhabitants in the lower catchment area. In some cases, this is achieved through a payment mechanism, or compensation, that the water users in the lower area pay to the property owners in the upper area for the environmental services that improved land management provides. Although this seems fair it also involves a cost.

In this case, an improved land use could benefit not only the owner of the farm but also ICE (National Institute for Communications and Electricity) and the PRAT irrigation scheme. In the case of ICE, the internalization of environmental costs from improved catchment management could result in an increase in electricity tariffs.”

The following four land use options for your property include the option of maintaining the current land use situation plus a combination of policy options that include different levels of payment for environmental services with an associated contractual obligation in years, increases in the electricity tariff, investment in road infrastructure, and access to government subsidies. For each alternative we request you to choose between 0 and 10 how likely you are to commit to this land use option fully. The information you provide is extremely valuable in order to determine the viability of a market for environmental services in the Monteverde area..

2.1.2. Model design and specification

According to Alpízar *et al* (2003), the main steps in the design of any choice experiment are:

- Definition of the attributes, levels, and customisation;
- Experimental design;
- Experimental context and questionnaire development;
- Choice of sample and sampling strategy

Selection of the attributes should be relevant to the problem being analysed, credible and realistic, easy to understand and applicable to policy analysis (Bergmann, Hanley and Wright, 2004). These steps are integrated and should provide continual feedback into the design and implementation.

In implementing the experiment respondents are presented with a card containing commodity descriptions of different attributes levels and are asked to rate them using a scale; normally 0 to 10 where "0" represents a "definitely don't like it" and "10" represents "definitely like it". Attributes may include market and non-market variables. When prices, or a monetary variable, are accounted for in the rating, it is possible to derive implicit prices for non-priced attributes (Roe, Boyle and Teisl, 1996).

Roe, Boyle and Teisl (1996) suggest that estimates of compensating variation can be derived by looking at the respondent's rating of the status quo (no project) and the alternative condition being proposed. Furthermore, the model can be stated in different forms, with relative ease, in order to test for consistency of results. Porras (1999) suggests the use of 3 forms:

1. A traditional model based on a linear combination of the attributes (Section 7.2.1). Due to its orthogonal design, the variation of each attribute is independent of the variation of all other attributes. It is possible then to obtain marginal rates of substitution for the different attributes.
2. A Ratings Difference Model (Section 7.2.2). This model uses the rating of the *status quo*, that is, the "nothing happens" scenario, as an anchoring point to analyse the increase/decrease in utility from alternative scenarios.
3. A Binary Response Model (Section 7.2.3). This model converts the continuous scale 0 to 10 into binary responses (YES or NO) and estimates the corresponding probability of accepting certain rating. There are two main ways of doing this. The first one is to estimate the probability of the alternative scenario being preferred to the status quo. The second way is to assume a "cut-off" point, where ratings above this point are considered "yes" and below are "no".

Section 7 presents detailed econometric descriptions of the CA models for interested readers. Recent improvements in the theory and supporting software now make Stated Choice Methods available for applied research. The following sections describe an applied example.

3. A case study in the Arenal Watershed

In 1996 Costa Rica introduced the first national level Payments for Environmental Services programme (Law 7575). Payments are made for forest conservation and reforestation, bundling together biodiversity, carbon fixation, scenic beauty and watershed protection services.

Intrinsic in the programme is the belief that landowners will respond to incentives and adapt their current land use practices. However, land use decision-making processes are poorly understood, particularly for marginal farmers. The CA experiment investigates this issue linked to earlier participatory and livelihoods analysis in the upper part of the Monteverde area (Hope, Porras and Miranda 2005; Porras and Miranda 2005). The study provides information about the willingness to engage into a given land use scenario for watershed conservation, and the trade-offs that households make to select their choice in term of given policy attributes and other alternatives.

The study area is characterised by large areas of cloud forests. Most of the forests on the Atlantic side of the Continental Divide are under protection as private reserves or conservation areas and already receive payments for environmental services.

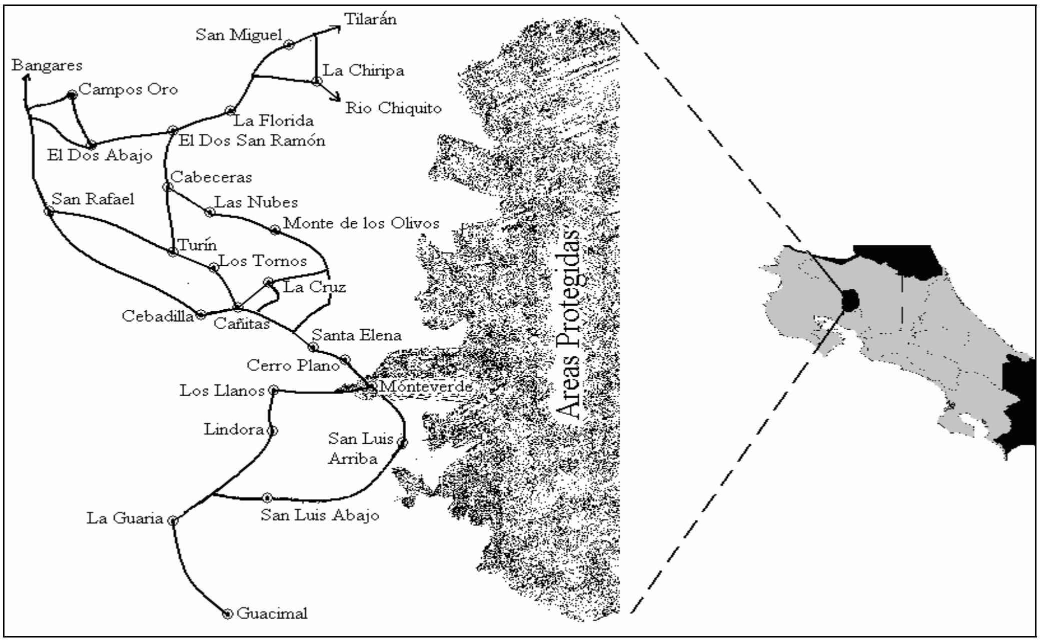
Land use changes are more evident on the Pacific side of the Continental Divide, where most human settlements are located. Furthermore, there seems to be very little engagement of small and medium farmers in the existing government PES. The Conjoint Analysis study will provide information about the willingness to engage into a given land use scenario for watershed conservation, and the trade-offs that households make to select their choice in term of the attributes. This will permit a better understanding of the opportunities for marginal farmers to benefit from the PES programme. Findings may provide guidelines for wider replication of the programme and lessons for modifying design criteria in Costa Rica and other developing countries.

3.1. Description of the area

The study site is located in the upper watershed area on the Pacific slope of the northern Tilarán range (Figure 1). The Caribbean slope, where there is little human settlement, receives the majority of precipitation from the north east trade winds that fall on the Caribbean slopes of the Tilarán range (J. Calvo, personal communication, 2002). The 'rain shadow' on the Pacific slope results in important though smaller stands of primary and secondary tropical montane cloud forest stands, whose distribution is influenced by rainfall, temperature, altitude, fog deposition, wind speed and direction and distance to the ocean (see Bruijnzeel, 2001 for a discussion). The Pacific slope was selected as the location for the socio-economic research as it has been subject to significant land use change over the last fifty years (Aylward *et al* 1998). Understanding the drivers and sequence of land use change in upper catchment areas of tropical watersheds is one of the main research goals. As such, a configuration of upper catchment communities were selected that had converted forested land for pasture or agriculture.

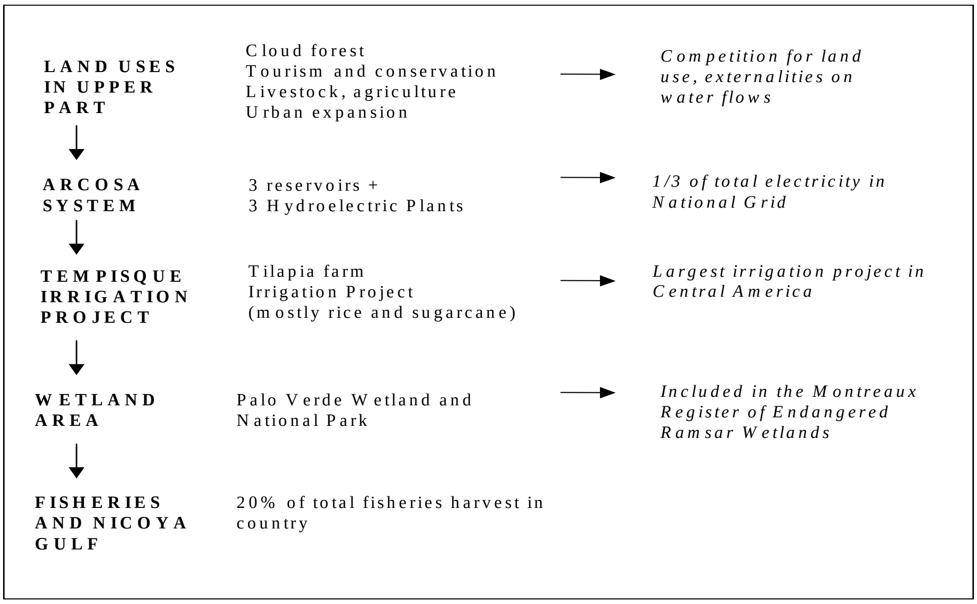
The Arenal watershed and its extension into the Tempisque watershed, is a strategic watershed in Costa Rica (Figure 2). The upper part is characterised by cloud forests, extremely rich in biodiversity. Some of this land was converted to other land uses, particularly livestock and coffee, until deforestation was halted by the introduction of new laws. Water is stored in an inter-annual lake created to feed into a system of three hydroelectric plants arranged in cascade, which provides over a third of the electricity produced in the country. The reservoir effectively transfers water from the Caribbean side of the Continental Divide to the Pacific, where water is scarcer. Below the reservoir water flows to an area of intensively irrigated farms (6000 ha), mostly dedicated to rice and sugarcane plantations, before draining into the Palo Verde National Park, an important wetland that hosts a large population of migratory birds. The wetland serves as a filter for water that drains into the Gulf of Nicoya, one of the most productive estuary ecosystems in the world, which accounts for approximately 20 percent of the total fisheries harvest in Costa Rica (Aylward et al 1998).

Figure 1. Location of the study site



The elevation of the upper watershed reaches 1,800 metres above sea level, and receives between 2,000 and 6,000 mm of rainfall per year. Approximately 90% of the upper watershed has a slope greater than 25% (Aylward *et al*., 1998). The majority of soils in the area are deep, sandy soils of volcanic origin possessing good natural drainage and of low fertility (CCT, 1980). Average annual maximum temperatures are 28°C with mean minimum temperatures of 19°C. Average annual humidity is estimated at around 80 percent. Wind is an important climatic and agricultural factor at the northern end of the range where there is a natural saddle between the Caribbean and Pacific zones (Aylward *et al*., 1998: 9-10). CCT (1980) suggest that land is primarily suited to conservation forestry (58%) or protection forestry (38%).

Figure 2. Downstream water users in the Arenal-Tempisque Watersheds



3.2. Selection of the attributes and levels

A key challenge in CA is the appropriate selection of the attributes and their levels. Examples of attributes that could be linked to the decision of changes in land use are[3]:

- monetary payment: monthly/annual/lump-sum, in-kind;
- improved access to markets for agricultural products
- technical assistance to improve other lands' productivity;
- improved roads, communication, etc

Table 1 presents the combination of attributes selected for this case study. The attributes were selected based on cumulative experience from national researchers (Aylward *et al* 1998), in addition to this project research field visits and wider national and international experience (e.g. Landell-Mills and Porras, 2002; Miranda, Porras and Moreno, 2003).

[3] Similarly, examples of attributes that might affect downstream watershed users to invest in watershed management could include: Types of land use encouraged (conservation, reforestation, combination, etc); improving land use in agricultural areas; technical assistance; improved access to product markets; better roads; improved water distribution; type of intermediary (NGO, government, local municipality, direct negotiation); engagement of small holders as opposed to dealing with larger plots; type of payment (lump-sum, annual, monthly, someone else should pay for this); etc.

Table 1. Description of policy attributes in watershed management

	Attribute	Values	Description	Units	Expected Effect
X1	Increase forest cover in proposed land use	25%, 50%, 75%, 100%	Presented in the form of increased forest cover in the farm	% of forest (will be converted into ha)	Negative
X2	Compensation (PES) PES for conservation	\$10, \$25, \$50, \$75	Compensation for watershed services from natural forests	\$/ha/yr	Positive
X3	PES for reforestation	\$50, \$75, \$100, \$150	Compensation for watershed services from natural regeneration/reforestation	\$/ha/yr	Positive
X4	% Increase in electricity bill[(a)]	0%, 10%, 15%	Possible increase in electricity bill as consequence of internalising compensation	In %, will be converted in \$	Negative
X5	Access to State Benefits[(b)] (housing, tax exemptions, etc)	YES, NO	Compensation through other state benefits (currently PSA doesn't allow)	Binary (0-1)	Positive
X6	Investment in roads/communications	0, same, more	Compensation through public investment in roads	Categorical	Positive
X7	Length of contracts	3, 5, 10	Years of contracts	3 values	Negative

[(a)] % increase in electric bill: The livelihoods survey will provide information on electric bills, and the % will be combined with this information for later analysis in numeric form. [(b)] Current State PES system in CR does not allow the household to access other state benefits. Random combinations of the selected attributes are derived from a fractional factorial designs procedure using SPSS 11.5 software.

3.3. Application of the survey

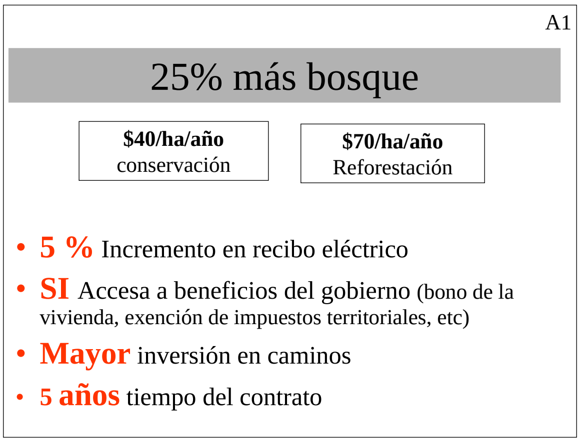
During the application of the household survey holdings were classified subject to the existing forest cover: a) less than 25%; b) 25%-75% and c) greater than 75%. Based on this classification respondents were shown a random sequence of three possible choice cards representing increased levels of forest cover, thus eliminating irrelevant scenarios inconsistent with national forest law.

Respondents are presented with a brief introduction of the watershed management problem in their area (see Section 3). It is explained by local enumerators that upstream land use has direct implications for the farmer but could also have significant effects (positive and negative) for downstream water users.

The respondent is presented with four different land use options, including keeping the current land use (status quo), with a combination of several policy options that include different levels of a payment for environmental services, electricity payments, investment in roads, length of PES contracts, and access to state benefits (Table 1).

The respondent is asked to rate from 0-10 the likelihood to commit to a land use scenario. The rating system operates from '10' (I definitely will commit) to '5' (indifferent) to '0' (I definitely will not commit):

Figure 3. Example of choice card



"If you were presented with this particular land use for your property (random choice card shown, see Figure 3*) in order to improve watershed management, would you commit to the changes?".*

Other attributes captured in the survey that are likely to affect the individual responses were also considered in the econometric analysis (Table 2).

Table 2. Household characteristics

Attribute	Values	Description	Expected Effect
Property size	Continuous	Larger properties have more possibilities of diversifying without too much risk.	Positive
Title deed	Dichotomous 1=yes, 0=no	Households with clear land property rights are more likely to engage.	Positive
Age	Continuous	Average age of members in household	?
Education level	Continuous	Average adult education in household	Positive
Gender	Dichotomous 1=male, 0=female	Of household head	?

3.4. Selection of the sample and sampling frame

The survey instrument was designed to generate a representative sample of the three main livelihood and land use activities in the study area. A project public forum (August 2002) and key informants contributed to the generation of a list of coffee (n=75), livestock (n=149) and tourism (n=99) concerns[4]. Local enumerators were recruited with experience in social research methods and a purposive sampling strategy was developed that utilized their personal contacts in communities or sectors in a sequential sampling approach. This reflected the difficulties of reaching farmers in isolated locations (often unavailable in daylight hours) or tourism managers living permanently away from their business. Further, extensive research in the study area has resulted in 'respondent fatigue', which is compounded by distrust of external 'extractive' research. Eight of the sixteen communities that are located in the upper catchment zone were included in a purposive sample (Figure 1). Thirty six percent of

[4] These were main land use activities with most farmers pursuing a diversified land use system (see Figure 6).

the total sample (n=116) were successfully interviewed: coffee (n=38); livestock (n=46) and tourism (n=32).

The survey instrument was developed from findings of a complementary qualitative study, including a series of focus groups and personal interviews (Porras and Miranda, 2005), national statistical data (INEC, 2003) and wider Central American social research (ECLAC, 2004). The survey instrument included the Conjoint Analysis choice cards at the end of survey instrument following a brief introduction to the respondents of the method.

4. Discussion of the results[5]

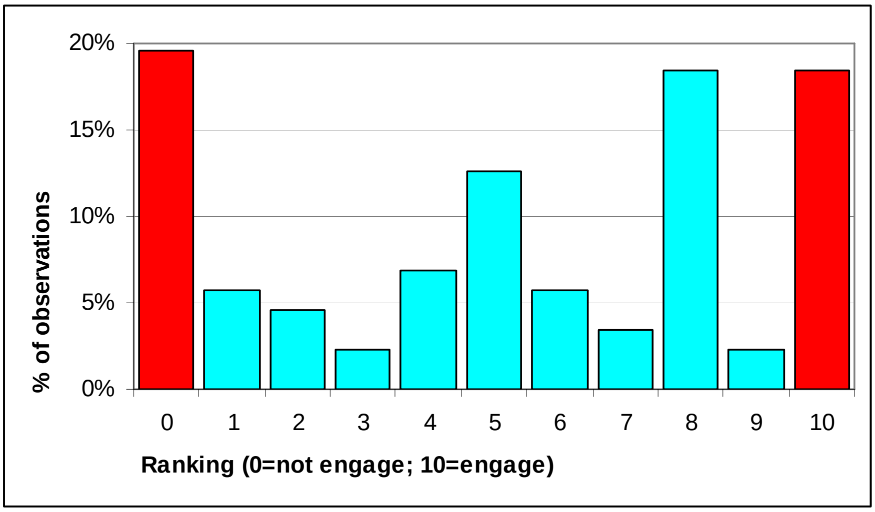
The models consistently indicate that the likelihood of engaging in improved land use increases with investments in roads, land area, existence of pastures, land title and access to subsidies. The likelihood of engaging decreases as the proportion of required forest cover and length of contract increase. The models indicated that the level of payments does not have much effect on the decision of engaging or not.

4.1. Low level of acceptance

A key finding is the low level of preference for alternative land use scenarios. For the status quo option, individuals were asked to rate the current situation of land use in the watershed. For this it was assumed that: 1) no change in land use would be presented, 2) no payment for environmental service is made[6]; 3) investment in roads would be the same as current; 4) no changes in electricity bill; and 5) no change in access to government subsidies.

Figure 4 presents the distribution of the ratings. While 13% of respondents were indifferent to the status quo, nearly half of the respondents were, in general terms, happy with the scenario (rating 6 to 10). Just under 20% of people did not commit to the status quo. An implication of responses to the status quo scenario suggests opportunities for land use change payments/compensation though a fifth of the sample report a lack of willingness to engage in any watershed programme.

Figure 4. Rating distribution of Status Quo



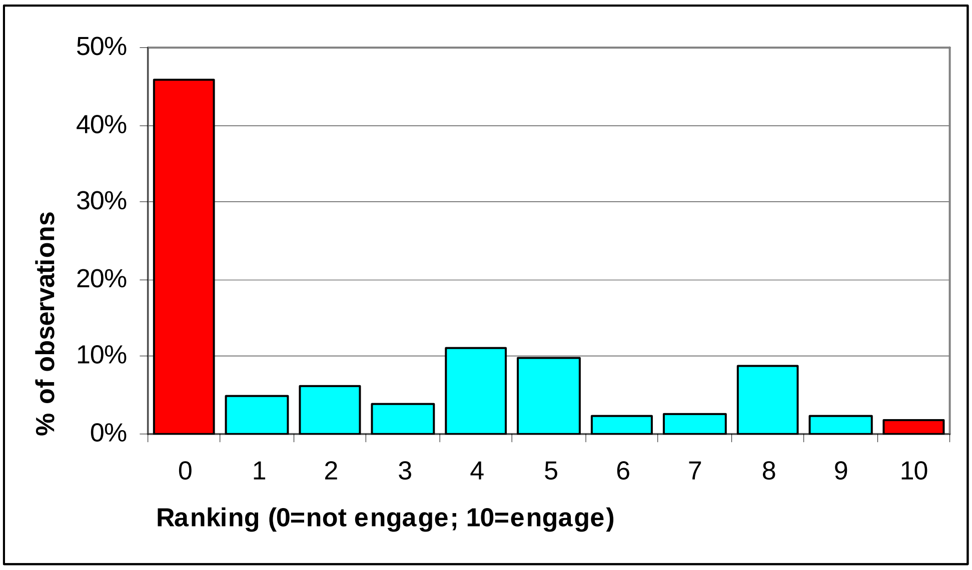
Note: mean = 5.23; sd = 3.65

Ratings to alternative scenarios are less promising. Nearly half of the sample indicated they would definitely NOT COMMIT to any of the alternative land use

[5] Section 9 in the Appendix presents a detailed analysis of the data and the application of the different model specifications.
[6] In fact, none of the respondents are part of the Payments for Environmental Services programme.

scenarios presented, regardless of the level of payments. The average rating was 2.66, with a standard deviation of 3.07.

Figure 5. Rating of alternative scenarios



This represents a significant challenge to wider participation of smallholders in the PES programme. Why are people so opposed to changing current land use? Are the payments offered too low? Or are there other institutional or political factors that negatively influence land owners commitment to government schemes?

A possible insight to these issues is revealed by high and significant correlation between ratings of different scenarios (Table 3). A pattern emerges in which respondent ratings were likely to be affected by their previous answers. Results indicate that, as one would expect, the higher respondents rated the status quo, the lower they would rate any alternative scenario (all correlation coefficients are negative). However, a strong correlation between the alternative scenarios (card 1, card 2 and card 3), indicates that respondents were influenced by their previous responses and may have taken a "standpoint", regardless of any combination of attributes presented. It is important to remember that choice cards were presented in a random order, and the combination of attributes conformed to an orthogonal design. This may indicate that if an individual is against changes promoted by the programme, they may vote NO regardless of the attractiveness of the scenarios.

Table 3. Pearson correlation of Scenarios Ratings

	Status Quo	Card 1	Card 2	Card 3
Status Quo	1			
Card 1	-.339(**)	1		
Card 2	-.215(*)	.641(**)	1	
Card 3	-.214(*)	.434(**)	.382(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

Associated studies in the area may explain this behaviour as being consistent with distrust and suspicion of entering into government land-based contracts (Miranda and Porras, 2005; Hope et al., 2005). Given the nature of most existing payments for environmental services in Costa Rica, where the government acts as intermediary through the National Forestry Fund (FONAFIFO), it is likely that respondents associate land compensation with a history of land tenure uncertainty, dispute, restrictions and appropriation.

4.2. Are payment levels too low?

Low levels of compensation were reported as a common barrier to why people do not access the government PES scheme from the total sample (Table 4). As the figures indicate coffee farmers identified this constraint in one third of cases compared to one in five livestock farmers. The latter group's response may be influenced by their general lack of information (including, payment levels) of the PES programme. It is noteworthy that estimated payment coefficients were small in all the models. Respondents' ratings were almost inelastic to changes in compensation levels, a result supported by all binary transformations showing that the odds ratios of estimated coefficients were too close to one to make a significant difference in the probability of engaging into a particular land use.

Table 4. Awareness of Payment for Environmental Services (valid percent)

	Coffee	Livestock	Tourism
Awareness of PES	46	34	22
Applied for PES	0	1	0
Receive PES	0	0	0
Main reason for **not** applying for PES			
a) Lack of information	30	61	n/a*
b) Low return (US$/ha)	32	17	n/a
c) No title deed	28	7	n/a
d) Not prepared to commit	9	13	n/a

* Most respondents for the tourism group felt unable to answer these questions.

In the case of reforestation, while PES payments can help in the short-term for larger plantations, it is still difficult for smaller properties to fulfil programme qualification criteria and the necessary co-funding to ensure success in a new plantation. According to focus groups held in 2002 with beneficiaries of reforestation PES in northern Costa Rica (see Miranda, Porras and Moreno 2003b). PES money represents about 60% of the initial costs of the plantation, and until recently it was difficult to obtain loans from banks to fund the remaining amount. High transaction costs certainly detain many small holders from applying to join the programme, and in the case of Monteverde it could be expected that transaction costs might even be higher due to the lack of a well-established intermediary like the Foundation for the Development of the Central Mountain Range (FUNDECOR).

4.3. Land opportunity cost

Opportunity costs of a non-productive (PES) land use compared to coffee or livestock do represent a barrier to small scale farmer adoption of PES schemes (Hope et al., 2005; Miranda et al., 2003). In the Arenal study area, Alyward et al. (1998) estimate a private opportunity cost of livestock production at US$247 in 1998 prices. Coffee is potentially more profitable than livestock with a gross return of US1,700 per hectare in 2003 for an upland high-quality *arabica* crop (Hope et al., 2005). If land use decisions are largely influenced by potential returns, then this information would be consistent with the model estimates of positive but low and insignificant coefficients for compensation levels. In the models, 'Pasture as Main Land Use' was the most (or second) important attribute that influences higher chances of respondents giving either higher ratings or definitely committing to alternative land use scenarios. This is consistent with higher levels of land title ownership and property sizes compared to coffee farmers. Further, it also underlines greater availability of land that could be incorporated into the PES scheme. However, other programme restrictions that prevent mixed land uses becomes a *de facto* rejection principle for many livestock farmers in Costa Rica, who manage diversified land use mosaics with strategic tree-lines providing wind-breaks to increase milk production and fodder (Miranda et al., 2003).

Forest valuation studies (Bulte et al., 2002; Echevarria et al., 1995) have estimated that protecting or expanding existing forest area has higher biodiversity or carbon sink values than conversion to agriculture in the study area. In light of existing land use restrictions in Costa Rica, a pertinent question concerns incentives to convert agricultural land to forestry. An opportunity cost perspective does much to explain farmer non-participation as a rational response to a PES scheme that is not designed or financed to adequately compensate (agricultural) land use change.

4.4. Property size

Private properties in the upper part of the Arenal watershed range from half hectare to 160 hectares. Property size varies largely with land use. Livestock properties are the largest with over 30 hectares, on average, compared to over 7 hectares for coffee farmers (Table 5).

Table 5. Land resource status and use by livelihood groups

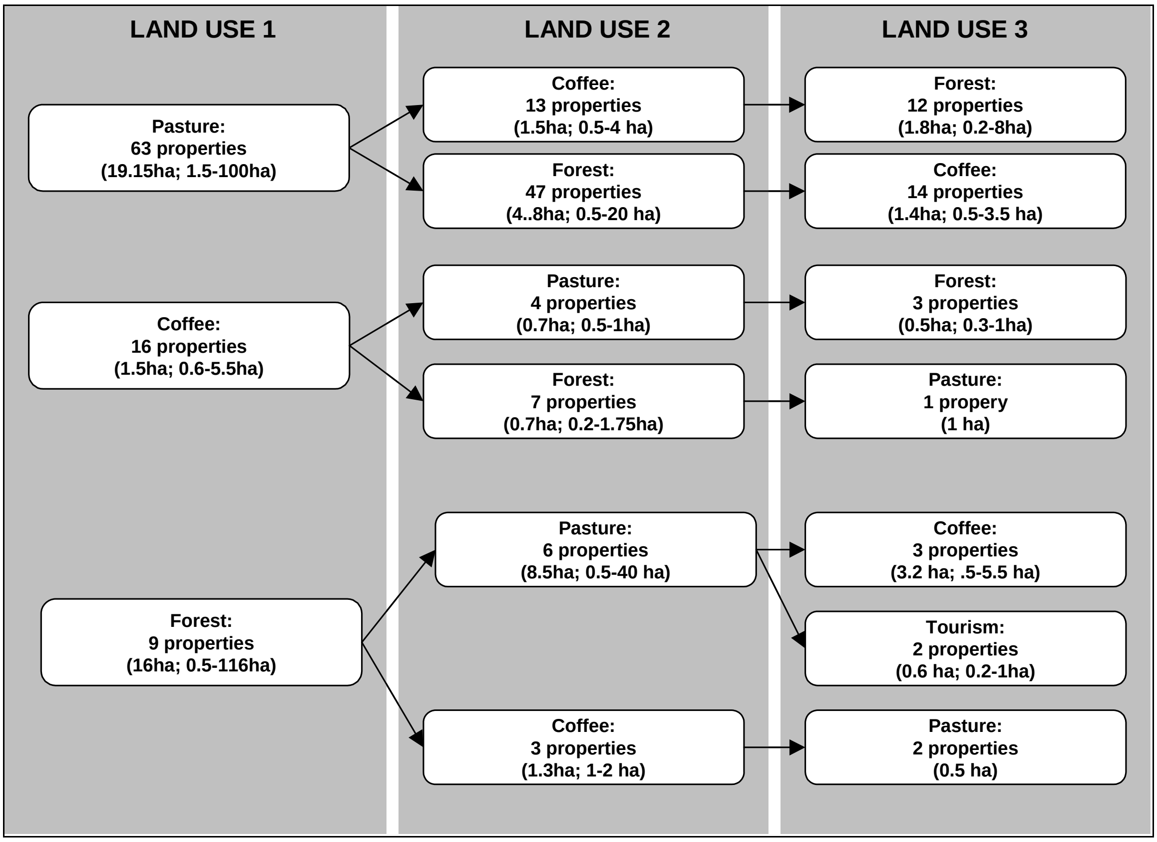
	Coffee (n=38)	Livestock (n=46)	Tourism (n=32)
Mean land area (ha)	7.47 (9.04)	31.24 (32.30)	0.49 (1.19)
Median land area (ha)	5.00	21.00	0.04
Land title (%)	32	72	31

Mean value (standard deviation).

In effect, most properties have a diversified production system (Figure 6). Diversification is a result of historical settlement patterns and drivers of land use change. The historical record illustrates initial settlement in the area in the 1950s by livestock farmers (meat, milk) with significant land holdings due to low land and population pressure. Following initial land conversion from forestry, in the late 1980s coffee farming became an increasingly popular land use due to increasing costs of livestock production and higher returns from exporting premium coffee. Coffee attracted both new farmers to the area with smallholdings dedicated to this activity alone and resulted in existing pasture holdings converting some of their land to coffee. Due to the investment and labour constraints in coffee farming, these holdings are generally small. The impact on forestry has been a reduction in the existing stands on farms both for increased pasture and the development of coffee farming. While deforestation has effectively halted in the study area, and most of Costa Rica, the new economic driver in the Arenal area is eco-tourism. This represents a new and complementary land use for many livestock and coffee farmers that have attractive, rural holdings. Many farmers are interested in diversifying into the tourism sector as a source of new employment and income that is consistent with local conservation values (pre-PES) (Hope et al., 2005; Miranda and Porras, 2005).

These historical processes contribute to livestock farmers with large properties and title deeds representing a relevant group for targeting in wider adoption of the PES programme. However, livestock farmers do not represent a poor group (Hope et al., 2005). Land owners in the study area are not poor by international or national poverty measures (ibid).

Figure 6. Land use within sampled properties



Note: parenthesis values represent (average ha; minimum-maximum ha). Please note that figures represent ALL sampled households, including very small properties, and not all of them were included for the Conjoint Analysis study.

5. Lessons and policy implications

This study has identified four lessons that may contribute to improved design and performance of PES schemes with a poverty reduction focus:

1. ***Land management decision-making is poorly understood***

It is easy to think that participation in the PES schemes in Costa Rica has been successful judging by the large number of applications received every year. However, it is important to stop and think who is applying (and who stays out), what are the main reasons for participating, and how sustainable are those decisions. In general very little is known about the decision-making process, especially of marginal landowners that are not currently benefiting from PES. To tackle this problem, participatory scenario analysis should be investigated in the design phase. One methodological advance in the study was the use of a stated choice method (Conjoint Analysis) to explore experimental scenarios of alternative compensation mechanisms (financial and other), which revealed that landowners were less influenced by cash than public goods, such as road improvements.

Policy implication: money is one possible incentive or compensation for land use change. More integrative understanding of local constraints and opportunities is likely to increase participation of vulnerable groups, who may value land titles or access to education or health goods as a fair exchange for desired and measurable land use change.

2. **Be realistic about poverty reduction**.

PES may be a useful tool for tackling poverty issues provided that environmental service provision is achieved. PES is primarily an innovative financing mechanism for improved natural resource management. This is dependent on environmental services being supplied and demanded as specified. Loading unrealistic poverty, gender or food security goals is likely to weaken the approach resulting in a poorly executed or flawed schemes. However, attention must be paid to leveraging opportunities to reduce poverty (best case) or mitigating unintended impacts on the poor (worse case) within the framework of improving socially optimal resource provison. PES schemes may help marginal farmers. However, PES is not designed to help the landless and the very poor. Seasonal landless labourers might be negatively affected if PES efforts promote land conservation as opposed to land production.

Policy implication: PES schemes may promote qualification criteria to self-select poorer groups, such as: 1) requiring labour-based land management interventions such as clearing non-indigenous tree species from riparian zones (see Hope, 2005) within water conservation mechanisms. This will either reduce incentives for wealthy land holders to sign-up or result in labour opportunities for the landless; 2) promote labour-intensive, land-intensive and environmentally-benign land uses (such as organic coffee farming) with significant rural economic multipliers.

3. **Secure land rights are often critical to benefiting from PES schemes.**

The poor and marginalised often have no or uncertain land claims in developing countries. This weakens necessary institutional arrangements between downstream payments to upstream service providers (the contingency clause). Examples illustrate here, and in other places, opportunistic elite groups forcibly and/or unfairly appropriating upland areas when land values increase as in the case of a new PES scheme.

Policy implication: If land tenure prevents PES benefits reaching poor groups, more integrative mechanisms should be considered such as wholesaling services from a community/zone and increasing community capacity through education with tangible benefits linked to improved access to credit and market support centres.

4. Lack of trust may undermine a good PES scheme

Weak participation by small holders in Arenal is influenced by historical distrust and suspicion of entering into land-based government agreements. While this is partly because of previous policies of land expropriation for the creation of national parks, the main reason might be asymmetric access to information, which constrains poor people from benefiting. Negotiating cooperative environmental agreements amongst different self-interest resource groups should consider which type of agreement is likely to be sustainable. Locally-negotiated agreements with non-government organisations or community-based organisations may provide more acceptable institutional modalities for resource user/provider groups.

Policy implication: the Costa Rica PES scheme has not attempted to build community capacity or awareness, which leaves misunderstandings or prejudices in tact. While limited programme funds fail to match applicant demands, wider uptake by identified small and medium farmers appears unlikely. Locally-negotiated institutional arrangements may be more sustainable than national level regulatory framework if an environmental service is clearly recognised by local interest groups, there is sufficient financing locally to broker agreements, transaction costs are low and self-interest fosters cooperation amongst stakeholders. Local and legitimate intermediaries may be key players in promoting such institutional arrangements, if they exist or if they can be crafted.

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7. Appendix 1: Theoretical basis of CA

The appeal of SCM in economic analysis is that it is based on random utility theory (Ben-Akiva & Lerman, 1985; McFadden, 1974). Choice variations are explained by a random preference component:

Equation 1. $U_i = V_i + \varepsilon_i$

where U_i is the unobservable but true utility of alternative *i*, V_i is an observable systematic component of utility and ε_i is the random component. The probability that respondents choose a particular alternative, say the *i*th, from the set of competing alternatives is modelled as:

Equation 2. $p(i/C) = p\left[(V_i + \varepsilon_i) > (V_j + \varepsilon_j)\right], \forall j \in C$

where $p(i/C)$ is the probability of choosing alternative *i* from the set of competing alternatives *C*.

Porras (1999) describes an individual's utility function for an environmental service with the following form:

Equation 3. $\mathbf{U_i = U\,(D, I \pm A) + e_i}$

Where:

D=	Vector of environmental quality (EQ) attributes
I=	Income
A=	Cost/compensation of programme
e=	random variable

In the case of compensation or payment for environmental service, the individual is assumed to accept the payment only if the utility derived from obtaining \$A ($U_1 = U(D, I+A)+e_1$) is greater than the utility he gets from an initial (no payment) scenario ($U_0 = (D, I) + e_0$). The resulting Willingness to Accept probability is $P_r=G(dV)$, where G is the probability function for the random component of utility and dV is the expected utility difference ($dV=U_1-U_0$). If utility is assumed to be linear, additive and separable with respect to income and environmental attributes (EQ), then dV is given by:

Equation 4. $\mathbf{dV = U_1 - U_0}$

$\mathbf{= U(D, I+A)+e_1 - U(D, I) + e_0}$

$\mathbf{= U(D) + U(+A) + e_1 - e_0}$

The Contingent Valuation Method will proceed assuming a logit function for G, in which the Willingness to Accept (WTA) is $Pr = (1+e^{-dV})^{-1}$. A median WTA is estimated by calculating the value of A* in which dV=0, which means that at the point of indifference there is a 50% chance that the individual will accept A*.

The Conjoint Analysis Model will ask the individuals to rate the current situation without the EQ programme (U_0) and a set of EQ programmes (U_1). Roe *et al* (1996) indicates that it is implicitly assumed that the individual ratings R_0 and R_1 are given by a transformation function of their respective utility levels: $R_1=h(U_1)$ and $R_0=h(U_0)$. Utility difference is given by the ratings difference:

Equation 5 $$dV = R_1 - R_0$$
$$= U(D) + U(+A) + e_1 - e_0$$

where [Equation 4] is analogous to [Equation 5].

7.1. Valuing welfare changes

Public goods, such as environmental services, are usually not traded in traditional markets, which make valuation problematic. Conceptually, the economic value of these services is measured by changes in consumer surplus. The following section presents the links of the consumer's problem from an economic point of view and how they are considered in conjoint analysis.

According to Silberberg (1990), the consumer is mostly interested in maximizing his utility subject to existing restrictions:

Equation 6. $$\text{Max } U_{x,q} = U(x, q) \text{ subject to } p*x + r*q = y$$

Where:
y is money income,
x is a vector of private goods,
q is a vector of public goods, including environmental services,
p is the vector of prices of private goods,
r is the vector of prices of public goods..

Solving this problem, the conditional demands for market goods depend on the amount of public goods that the consumer receives:

Equation 7. $$X_i = x_i (p, y-r*q, q)$$

And the indirect utility function derived by substituting the conditional demands back into the utility function is:

Equation 8. $$v = v (p, y-r*q, q)$$

If instead of maximizing utility we had minimized the cost of achieving a certain level of utility U_0 (*status quo* level of utility), the substitution of the *money-income held constant* demands into the respective objective function would have yielded the expenditure function. This function indicates the minimum expenditure needed to achieve utility U^0 at prices p^0 and r^0.

Equation 9. $$e = e (p, r, q, U^0)$$

Welfare changes can be obtained by measuring compensating and equivalent surplus (Silberberg 1990). A compensating variation (CVA) is the difference between the amount of money the consumer needs to reach the new utility level and the amount needed to reach the original utility level, evaluated at the proposed change. An equivalent variation (EVA) measures the required change in income, given the old prices and consumption level, to make the individuals as well off as they would be before the change. Although in our case prices do not change, we can represent a change in environmental service (from q_0 to q_1) in the following way:

Equation 10. $CVA = e(p, q_0, U^0) - e(p, q_1, U^0) = y - e(p, q_1, U^0)$

Equation 11. $EVA = e(p, q_1, U^1) - e(p, q_0, U^1) = e(p, q_0, U^1) - y$

Though widely used in marketing, Conjoint Analysis (CA) is relatively newer in valuing public goods. The theoretical model presented for CA is based on Roe et al (1996) and Stevens et al (1999).

7.2. Conjoint Analysis and Compensating Variation

Following Stevens *et al* (1999) we present three different CA models specifications: a traditional ratings model, a ratings difference specification and a binary response model.

7.2.1. Traditional Model

Assuming that respondent's ratings are consistent, these ratings provide roughly the same information about preferences as ordinal rankings (Gan and Luzar, 1993). Conjoint designs are orthogonal, meaning that the variation of each attribute is completely independent of the variation of all other attributes. The estimated function is:

Equation 12. $$\text{RATING} = F(ZB) = k + b_1 q_i^i + \ldots + b_k q_k^i + b_p p^i$$

Where ZB is a linear combination of k attributes and F is a transformation function, q^i_j is the commodity's jth attribute, p^i is price and the b's are weights associated with each attribute. Setting the total difference of dZB=0 (no change in the rating) and holding everything else constant we can obtain the marginal rate of substitution, $-b_j/b_i$. Since the price attribute is included then the implicit price of each attribute may be derived as $dp^i/dq_1^i = -b_1/b_p$. This value will be valid over the mid-ranges of the attribute levels offered in the conjoint design (Gan and Luzar 1993). However, the rating of a single commodity does not provide the information necessary to recover the value of moving from one commodity to another (Roe *et al*, 1996).

7.2.2. Ratings Difference Model

As pointed out by Roe *et al* (1996) "the difference between using ratings and ratings difference is subtle, but important". One of the main reasons arises from the advantage of using the *status-quo* rating as an "anchoring point". This is, we are now capable of taking into account the fact that different people could give different ratings to the *status-quo*. This eliminates the problem of misunderstanding "the attribute's impact upon the elicited rating because of different centering points". Assume that the conjoint rating (r^i) can be transformed (monotonically by Φ) to an indirect utility function:

Equation 13. $\mathbf{r^i (p^i, q^i, y, z) = \Phi\, [v^i(p^i, q^i, y, z)]}$

Where p is price, q represents visibility level, y is money income and z a vector of demographic characteristics and other observable characteristics. A change from the status-quo (program 0) to program i is given by the ratings difference, Δr:

Equation 14. $\mathbf{\Delta r = r^i (p^i, q^i, y, z) – r^0 (p^0, q^0, y, z)}$

The Hicksian compensating variation associated with a change in the status-quo to program i can be derived by adding or subtracting dollars until Δr=0:

Equation 15. $\mathbf{r^i (p^i, q^i, y\text{-}C^i, z) – r^0 (p^0, q^0, y, z) = 0}$

Where C^i is Hicksian compensating variation. The difference in the price corresponds to the offer made to the individual (i.e $A = p^i – p^0$). Solving for C^i we find the following:

Equation 16. $\mathbf{C^i = y – g[r^0 (p^0, q^0, y, z), p^i, q^i, z]}$

where g[.] is the inverse of r^i with respect to income. Assuming that utility is separable and linear in income:

Equation 17. $\mathbf{r^i (p^i, q^i, y, z) = r(q^i, z) – r(q^0, z) – a(y\text{-}p^i)}$

where *a* is a constant. Taking the difference we find:

Equation 18. $\mathbf{\Delta r = r(q^i, z) – r(q^0, z) – a\Delta\, p^i}$

Where a is a constant, $\Delta p^i = p^i\text{-}p^0$ and can be seen as the reduction in the electric bill offered. We solve for C by changing our offer $\Delta\, p^i$ until there is no difference, that is, until Equation 18 is equal to zero. This results in:

Equation 19. $\mathbf{C^i = [\{ r(q^0, z) – r(q^i, z)\}/a] - \Delta\, p^i = - \Delta\, r^i (\Delta\, p^i, q^i, q^0, z)/a}$

Following Roe *,et al* we can estimate Equation 18 and use the parameters to derive C^i according to Equation 19. Roe*, et al* argue that this value is consistent with the probability estimation of the Contingent Valuation models (see Porras 1999). Theoretically, the results of conjoint analysis stated as ratings difference and contingent valuation should be consistent and should yield similar results.

7.2.3. Binary Response Model

A binary response model can be derived from the formulation specified in Equation 18. Assume that an individual is asked to rate alternative land use scenarios, including the status-quo on a scale of 0 to 10, with 10 indicating the program, if any, the individual would definitely undertake (Stevens *et al*, 1999). The land scenario i will be selected with a probability Pr(scenario i is selected) if:

Equation 20. $\mathbf{Pr\,(level\ i\ is\ selected) = Pr(U^{i}(p^{i}, q^{i}, y,z) + e^{i} > U^{j}\,(p^{i},q^{j},y,z) + e^{j}\,)}$

where e^i and e^j are random errors. This binary model is basically the same as the dichotomous-choice contingent valuation (Roe et al, 1996).

8. Appendix 2: Data Analysis

An SPSS regression using a full-concept approach is used. In this approach, respondents rank alternative products (land use scenarios) defined by particular levels of all attributes. SPSS Conjoint Analysis estimation uses the Ordinary Least Squares procedure. Outputs from the regression include: importance ratings of attributes, part-worth (utility scores) estimates showing preference for each attribute alternatives, and correlations relating predicted ratings from the model with the observed values. A total of four different models were fitted to the data to test for sensitivity of results (see Table 6).

Table 6. Summary of estimated models

Model	Dependent Variable	Independent Variable	Estimation procedure
1	Rating (0-10): 0=definitively rejects proposed scenario; 10=definitively accepts proposed scenario	Forest conversion area; payment for conservation, payment for reforestation, increase in electric bill, access to State benefits; length of contract, investment in roads, main land use pasture, mean adult education in household, mean income per hectare, land title, land area.	OLS, Tobit, or ordered logit.
2	Ratings Difference (Status Quo minus alternative)	Same as above	OLS
3	Rating Alternative > Status Quo	Same as above	Logit
4	Binary model conversions: (a) Rating 0=No, otherwise=yes (b) Rating>0=yes, otherwise=no; (c) Rating>5=yes, otherwise=no; (d) Rating>7=yes, otherwise=no;	Same as above	Logit

8.1. Traditional conjoint model

A basic idea behind the development of markets for hydrological services is that upstream landowners will be interested in engaging in watershed improvement projects if their actions will make them better off. By introducing a payment, or compensation for improved land use management, the proponents of the idea expect that landowners will be likely to engage in new activities.

But what are the key aspects that landowners take into account when deciding whether they will be "better off"? Is it possible to isolate the main drivers of change that could be used as input into the design of improved locally-driven policy?

The following analysis examines the responses of 87 individuals[7] to the proposal of several land use changes and the levels of compensation that would be required to

[7] Fieldwork was conducted in and around the Monteverde area during July and August 2003, collecting a sample of 116. Small properties of less than one hectare (29 in total) are not included in the Conjoint Analysis.

achieve these targets. The estimates presented, far from being final figures, merely provide a basis for encouraging further discussions on how best to achieve improved land use management within the watershed.

The traditional conjoint ratings model was used to estimate the likelihood of a respondent to agree on particular proposed land use scenario. The model is estimated by regressing the rating values against the explanatory variables (presented in Table 6). Coefficients could be obtained by using ordinary least squares (OLS), ordered probit or ordered logit. While the difference between probit and logit is primarily in the distribution of the error term, these two models differ from OLS in the way they treat categorical data. For example, while OLS assumes that there is no marginal difference in the intensity of the rating values (a change from 2 to 3 is the same as the change from 9 to 10), ordered logit (or probit) assumes that this difference is not the same (Kennedy, 1998). For the purpose of this study, OLS estimation was used. Although ordered logit was an option, it was eliminated since multiple data categories may contribute to a loss in efficiency (Porras, 1999). The model to be estimated is:

Equation 21. **Rating (0-10) = F (forest cover, compensation levels, electricity bill increase, access to subsidies, length of contract, road investment, pasture main use, education, income per hectare, land title, land area)**

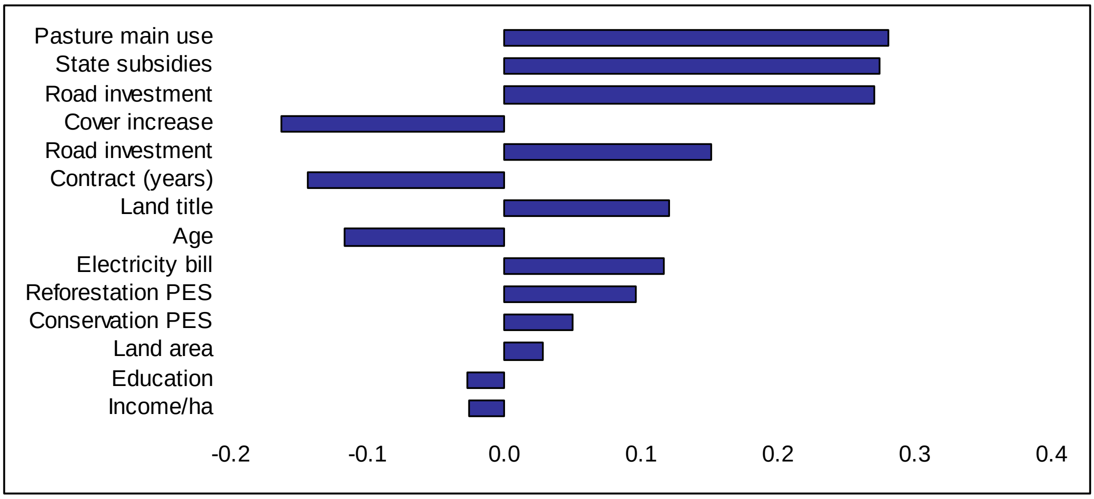
Table 7 presents the results for Equation 21. The F test indicates that we fail to reject the model as a whole (Pr>F=0.0001), and the adjusted R^2 is 0.20. Results indicate that the likelihood of engaging into an alternative land use scenario increases with the compensation amounts, the increase in electric bill (unexpected result), access to other state subsidies, more or same road investment, the existence of land titles, total land area and whether pasture is the main use. The likelihood of engaging decreases with the extra amount of land that requires forest cover, the contract duration, age in the household, education level, and average income per hectare.

Table 7. Traditional Ratings Model: OLS results (model 1)

	Estimated coefficient	Standard error	Significance level/
(Constant)	1.111	1.262	0.380
Cover increase Ha	-0.034	0.021	0.113
Conservation payment	0.006	0.007	0.402
Reforestation payment	0.008	0.005	0.102
Increase monthly payment elec ($/month)	0.113	0.065	0.081
Access to subsidies	1.683	0.453	0.000
More road investment	1.838	0.429	0.000
Same road investment	1.037	0.424	0.015
Contract duration	-0.143	0.076	0.059
Main use is Pasture	1.724	0.433	0.000
Mean adult age (>16 yrs)	-0.031	0.017	0.065
Mean adult education (years)	-0.027	0.066	0.679
Mean income per ha (thou$ pa)	-0.050	0.127	0.692
Land title	0.746	0.392	0.058
Land area (ha)	0.003	0.011	0.780

Figure 7 presents the relative importance of the different attributes and household characteristics. Out of the previously expected "key attributes", only access to other state subsidies, road investment and increase in forest cover belong to the top 5 attributes explaining rating levels. However, the main decisive factor is whether or not pasture is the main land use in the property. This is an expected result, since pasture shows the lowest return on profitability on land.

Figure 7. Relative importance of attributes in estimating utility levels



Note: Bars represent values of standardised beta coefficients.

While the estimated coefficients for compensation levels for conservation and reforestation indicate that higher compensation will increase the likelihood of acceptance, the coefficients are relatively small (0.006 and 0.008) and only statistically significant at 80% for reforestation. This indicates a rather low effect on ratings. A simple sensitivity analysis was performed using average values for all attributes in the estimation, assuming an average increase of 10 hectares of forest per property, and holding constant values of compensation for conservation ($75) when changing values for reforestation, and of reforestation ($150) when changing conservation levels (see The results of the analysis show that respondents' ratings are rather inelastic to compensation levels, and an increase from $0 to $500 per hectare, either for conservation or reforestation only resulted in an increase of approximately 3 rating points for conservation and 4 for reforestation.

In brief, the model tells us that for a new land use scenario to make effect, it should concentrate, more than just the payment for conservation and/or reforestation, in other issues such as making sure to engage landowners whose main land use is pasture, who have property titles (or to facilitate the acquisition of property titles), and to make sure that any new watershed management project includes improvements in roads and communications within the area.

Figure 8).

The results of the analysis show that respondents' ratings are rather inelastic to compensation levels, and an increase from $0 to $500 per hectare, either for conservation or reforestation only resulted in an increase of approximately 3 rating points for conservation and 4 for reforestation.

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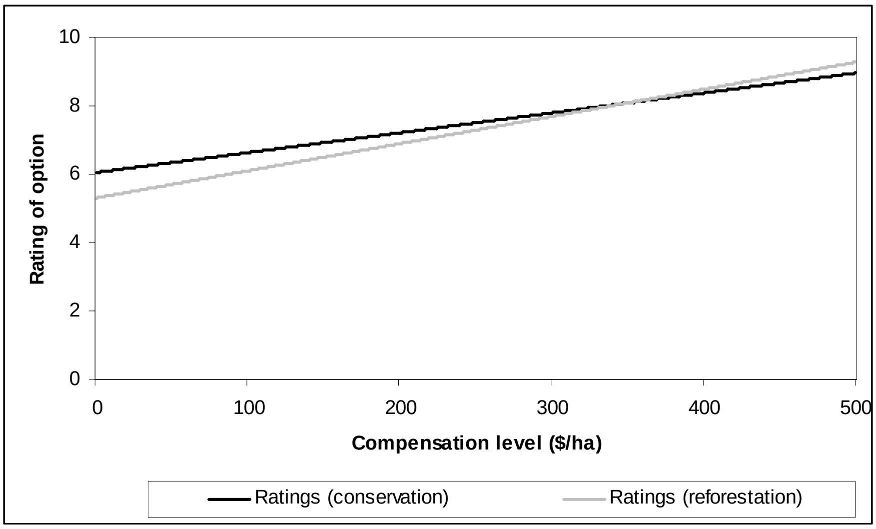
Figure 8. Sensitivity analysis of compensation levels and ratings



8.2. Ratings Difference model

The use of a ratings difference model has the advantage of using the valuation of the status quo option as an anchoring point, thus helping to remove noise from the data that arises because of the use of different centre points. The model to estimate is:

Equation 22. **Rating Difference (B-A) = F (forest cover, compensation levels, electricity bill increase, access to subsidies, length of contract, road investment, pasture main use, education, income per hectare, land title, land area)**

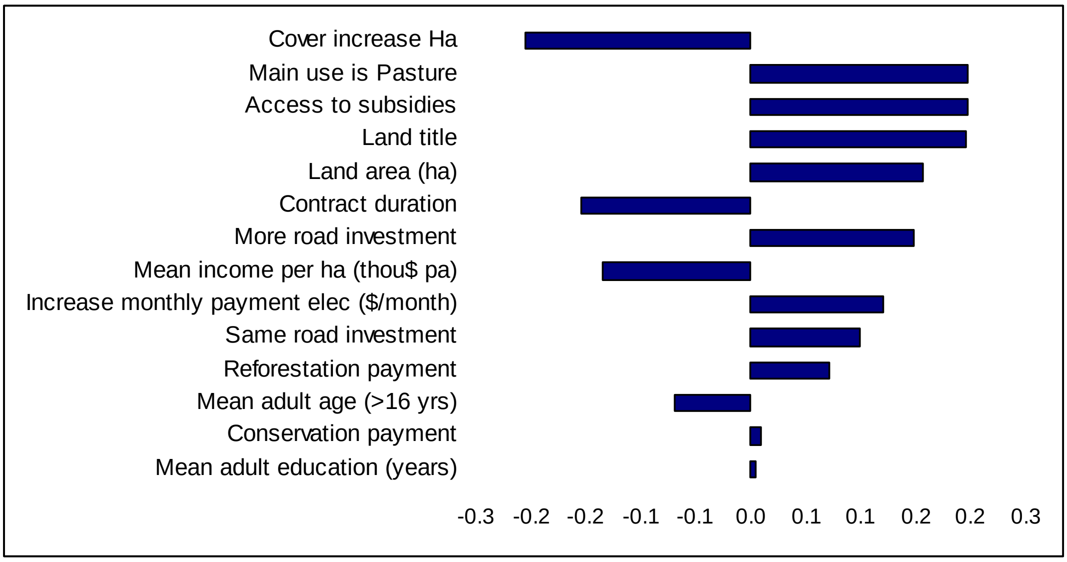
Basically, the resulting column of ratings difference indicates that the alternative land use scenario is preferred (positive values) or not with respect to the existing status quo. The regression estimates will provide information on the variables that increase the likelihood of preferring the alternative scenario.

Table 8. Estimated coefficients from Model 2: Ratings Difference

	Estimated coefficient	Standard Error	Significance level
(Constant)	-4.65	2.21	0.037
Cover increase Ha	-0.07	0.04	0.049
Conservation payment	0.002	0.01	0.863
Reforestation payment	0.01	0.01	0.225
Increase monthly payment elec ($/month)	0.21	0.11	0.070
Access to subsidies	2.10	0.79	0.009
More road investment	1.75	0.75	0.021
Same road investment	1.18	0.74	0.113
Contract duration	-0.27	0.13	0.046
Main use is Pasture	2.11	0.76	0.006
Mean adult age (>16 yrs)	-0.03	0.03	0.282
Mean adult education (years)	0.01	0.12	0.939
Mean income per ha (thou$ pa)	-0.45	0.22	0.043
Land title	2.11	0.69	0.002
Land area (ha)	0.03	0.02	0.128

Table 8 presents the results. The adjusted R^2 is 0.18 and the F test fails to reject the model as a whole (Pr>F=0.0001). Eight out of 14 variables were statistically significant. The rating that the alternative scenario gets compared to the status quo increases with: payment levels (conservation and reforestation), increase in electricity bill, access to subsidies, road investment, pasture as main land use, education, land title and total land area. Rating difference decreases with: additional forest cover, contract duration, average household adult age, and average adult income per hectare. All variables, except education, have the same sign and effect as for the traditional ratings model.

Figure 9. Relative importance of attributes in rating difference



The relative importance is fairly much the same as for the traditional ratings model (see Figure 7 and Figure 9). The main difference is that increase in forest cover becomes the main attribute decreasing the ratings difference. As in the previous model, the estimated coefficients for compensation levels are very small (0.002 for conservation and 0.01 for reforestation), and neither one is significant.

8.3. Binary Response Models

By transforming the continuous data from the ratings into a dichotomous YES/NO format, it is possible to obtain results that can be directly compared with the most common approach for estimation of willingness to pay or accept, contingent valuation (CVM), and the estimation of the probability to accept an alternative scenario:

Equation 23. **Prob (accept alternative scenario) = F (forest cover, compensation levels, electricity bill increase, access to subsidies, length of contract, road investment, pasture main use, education, income per hectare, land title, land area)**

There are different procedures on how to do this. In this particular case two models are being applied and estimated using a logit regression. In the first case we use the transformation B>A=1, 0=otherwise, meaning that a YES result will apply if the respondent rated the alternative scenario higher than the status quo. In the second transformation we use a cut-off point, or rather different cut-off points, in which it is assumed that values above the cut-off point represent YES answers. The decision as to what levels the cut-off points should be is rather arbitrary, and it is recommended to do several to test the stability of the model. In this particular exercise we use three different points: Ratings>0=YES, Ratings>5=YES, and Ratings>7=YES.

8.3.1. Binary Response Model: B>A

The first binary response model to estimate corresponds to the transformation of B>A =1 (alternative scenario rating is higher than status quo rating), and 0 = otherwise. This model will provide information about respondents' willingness to engage in other land use activities apart from the current ones.

The transformation renders a total of 39% YES answers. The results show that the percentage of correct predicted answers is 70.5. Estimated coefficients are presented in Table 9 below.

Table 9. Binary response model (B>A) Estimated Coefficients

	Estimated Coefficient	Std. Error	Odds ratio (e^b)
Cover increase	0.002	0.02	1.00
Conservation payment	-0.005	0.01	0.99
Reforestation payment	0.004	0.00	1.00
Increase monthly payment elec ($/month)	-0.002	0.05	1.00
Access to subsidies*	0.602	0.38	1.83
More road investment**	0.883	0.36	2.42
Same road investment**	0.595	0.36	1.81
Contract duration	-0.039	0.06	0.96
Main use is Pasture**	0.905	0.36	2.47
Mean adult age (>16 yrs)*	-0.030	0.02	0.97
Mean adult education (years)	-0.056	0.06	0.95
Mean income per ha (thou$ pa)	-0.171	0.13	0.84
Land title**	0.783	0.33	2.19
Land area (ha)	0.004	0.01	1.00
Constant	-0.764	1.08	0.47

* significant at 10%; ** significant at 5%

The results are, for the majority, similar to those found by the previous models. The most important factors that will improve the odds of the respondent choosing an alternative scenario over the status quo are, as before, whether or not the main use is pasture, road investment, existence of land titles, and access to other state subsidies. Odds of choosing the alternative scenario decrease with age, contract duration, education and productivity of current economic activities, represented by average income per hectare.

It is interesting to note that neither compensation levels nor changes in electricity bill have a significant effect over the odds ratio. In the case of compensation level this finding reinforces the effect shown in The results of the analysis show that respondents' ratings are rather inelastic to compensation levels, and an increase from $0 to $500 per hectare, either for conservation or reforestation only resulted in an increase of approximately 3 rating points for conservation and 4 for reforestation.

In brief, the model tells us that for a new land use scenario to make effect, it should concentrate, more than just the payment for conservation and/or reforestation, in other issues such as making sure to engage landowners whose main land use is pasture, who have property titles (or to facilitate the acquisition of property titles), and to make sure that any new watershed management project includes improvements in roads and communications within the area.

Figure 8, where respondents' ratings were rather inelastic to changes in compensation levels. Table 10 summarizes the effects on the direction of attributes' effects.

Table 10. Direction of estimated effects on probabilities

Increase Odds	Reduce Odds	No significant change in Odds
• Main use is Pasture • More road investment • Land title • Access to subsidies • Same road investment	• Mean adult age (>16 yrs) • Contract duration • Mean adult education (years) • Mean income per ha (thou$ pa)	• Reforestation payment • Land area (ha) • Cover increase • Increase monthly payment elec ($/month) • Conservation payment

8.3.2. Binary Response Model: cut-off point transformations

The second binary transformation corresponds to a transformation of ratings into YES/NO answers by the use of a cut-off point. There is no common agreement as to what the cut-off point should be, and some recommend the use of several different points (see Porras 1999). In this exercise three cut-off points were selected:

- RATINGS>0 = YES,
- RATINGS >5=YES,
- RATINGS>7=YES

Table 11 presents the overall results of the three specifications. The percentage of YES answers decreases rapidly as the cut-off point increases, with 54% of yes answers for Ratings>0, 28% for Ratings>5 and 16% for Ratings>7. The results of the last estimation are expected to be less powerful due to the lower number of positive answer, and this is reflected in the increasing standard deviations (shown in parenthesis).

In none of the model specifications was the payment for conservation significant, and only for ratings above 5 as cut-off point it takes the expected positive sign, indicating that higher compensation levels will increase the probability of accepting the alternative scenario. The compensation for reforestation, on the other hand, presents both the expected positive sign and is statistically significant in all models, although the rather small coefficient means that the effect on the odds is rather small, as expected from the results of the previous model specifications.

The coefficients for increases in electricity bill were all positive, and statistically significant. Although this is theoretically unexpected, it is also a result from the previous model specifications. Access to other government subsidies is statistically significant, and has a positive expected sign, indicating that landowners will prefer an alternative land use scenario if they still obtain access to other state benefits. Road investment (same or more) is also statistically significant and positive, increasing the probability of the respondent willing to engage in an alternative land use.

Contract duration was negative and statistically significant for the first two specifications, showing that the odds of accepting an alternative scenario decrease as the contract length increases. Pastures as main land use remains the most important variable for higher probability of engaging in an improved watershed project.

Table 11. Binary Models Comparison: sensitivity analysis for different cut-off points

	Rating>0	**Rating>5**	**Rating>7**
% of YES answers	54%	28%	16%
% of correct predictions	76.2%	77.4%	85.1%
Cover increase	-0.004	-0.028	-0.027
	(0.02)	*(0.02)*	*(0.02)*
Conservation payment	-0.001	0.006	0.005
	(0.01)	*(0.01)*	*(0.01)*
Reforestation payment	0.002	0.006	0.010
	*(0.00**)*	*(0.00)**	*(0.01)**
Increase monthly payment elec ($/month)	0.116	0.096	0.095
	*(0.06)***	*(0.05)***	*(0.06)***
Access to subsidies	0.836	2.003	1.454
	(0.39)**	(0.47)**	(0.56)**
More road investment	0.861	1.398	1.680
	*(0.38)***	*(0.40)***	*(0.46)*
Same road investment	0.698	0.894	0.577
	*(0.36)**	*(0.40)***	*(0.50)*
Contract duration	-0.118	-0.160	0.084
	*(0.06)***	*(0.08)***	*(0.09)*
Main use is Pasture	1.814	1.191	0.375
	(0.36)	*(0.40)**	*(0.46)*
Mean adult age (>16 yrs)	-0.020	-0.030	-0.012
	(0.01)	*(0.02)**	*(0.02)*
Mean adult education (years)	-0.015	-0.045	-0.023
	(0.05)	*(0.06)*	*(0.07)*
Mean income per ha (thou$ pa)	0.106	-0.183	-0.192
	(0.10)	*(0.14)*	*(0.18)*
Land title	0.931	0.619	0.532
	*(0.32)***	*(0.36)**	*(0.43)*
Land area (ha)	-0.008	0.003	0.007
	(0.01)	*(0.01)*	*(0.01)*
Constant	-0.777	-1.893	-3.700
	*(1.03)***	*(1.21)***	*(1.47)***

Notes: Standard deviations in parenthesis. * significant at 10%; ** significant at 5%.

None of the other household characteristics such as age or education were significant. Surprisingly productivity of land (estimated using average income per hectare) was not significant, although for two of the models it had the expected negative effect indicating that if current productivity is high, the landowners will be less likely to want to change. Existence of land titles was, as before, positive and statistically significant in increasing the probability of engaging in a watershed management project dealing with reforestation or forest conservation.

Figure 10. Relative importance of the odds ratio for binary model transformations

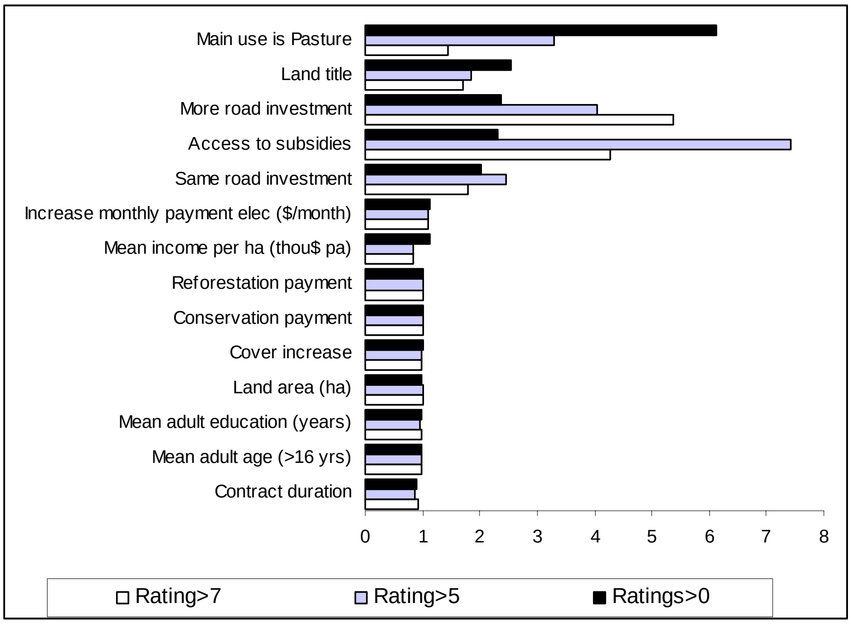


Figure 10 presents the distribution of odds ratio for the three specifications. As before, the variables that increase the odds tend to be pasture as main use, existence of land titles, investment levels in roads, and access to state subsidies. The effect of the remaining variables on the odds is rather small (odds ration close to 1).