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Choice Experiments in Environmental Impact Assessment

The Case of the Toro 3 Hydroelectric Project and the Recreo Verde Tourist Center in Costa Rica

Dora Carías Vega and Francisco Alpízar

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Choice Experiments in Enviromental Impact Assessment: The Toro 3 Hydroelectric Project and the Recreo Verde Tourist Center in Costa Rica

Dora Carías Vega and Francisco Alpízar

Abstract

Choice experiments, a stated preference valuation method, are proposed as a tool to assign monetary values to environmental externalities during the ex-ante stages of environmental impact assessment. This case study looks at the impacts of the Costa Rican Institute of Electricity's Toro 3 hydroelectric project and its affects on the Recreo Verde tourism center in San Carlos, Costa Rica. Compared to other valuation methods (e.g., travel cost and contingent valuation), choice experiments can create hypothetical but realistic scenarios for consumers and generate restoration alternatives for the affected good. Although they have limitations that must be taken into account in environmental impact assessments, incorporating economic parameters—especially resource constraints and tradeoffs—can substantially enrich the assessment process.

Key Words: stated-preference, economic valuation, choice experiments, hydropower, tourism, Costa Rica

JEL Classification: Q26, Q4

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Dora Carías Vega and Francisco Alpízar*

Introduction

The valuation of environmental changes has become an important field of specialization in economics, motivated largely by the need to value damages associated with human consumption and production, as well as the requirements of cost–benefit analysis (Mitchell and Carson 1989; Freeman 1993). Cost–benefit analysis plays an important role in reaching public sector decisions (Arrow et al. 1996) and improving their quality (Kopp et al. 1997). Economic valuation methods provide monetary estimations of baseline changes caused by environmental, health, and social impacts, so that they can be incorporated into cost–benefit analysis.

At the moment, environmental valuation in impact assessment remains scarce. Burdge (2004) makes the case for including quantitative socioeconomic indicators in the assessment process. In particular, the author refers to the use of monetary quantification and valuation of externalities (e.g., the "cost" of affecting a pristine wilderness or limiting recreational opportunities). There were similar conclusions from the 28th Annual Conference of the International Association for Impact Assessment in Perth, Australia. Concurrent Session 7.11 focused on the valuation of ecosystem services and concluded that in general the valuation of ecosystem services can bridge the gap between science and politics because it translates impacts into monetary figures for the politicians.[1] However, the valuation of ecosystem services in impact assessments is rather new and not yet widely used (Kolhoff 2008).

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[1] Karanja et al. (2008) and Kerr (2008) are two breakthrough examples of ecosystem valuation in environmental impact statements discussed during this session.

This paper describes the application of a particular valuation method, choice experiments, which were part of the impact assessment process for the Toro 3 hydropower project (hereafter Toro 3). This power plant will be built in San Carlos, in province of Alajuela in Costa Rica, and is the third in a series of hydropower projects owned by the Costa Rican Institute of Electricity (ICE, by its Spanish acronym) in the Toro River microcatchment.

Toro 3, currently under construction, underwent a compulsory environmental impact assessment (EIA), which was presented to the Costa Rican environmental impact authority (SETENA[2]) in 2005 (ICE 2005). The EIA identified a potential impact to the Recreo Verde tourist center, located 6.8 kms downstream from Toro 3's water intake, on the left bank of the Toro River. The future reduction in river flow from the power plant's operation could have a repercussion on the number of visitors to the tourist center. The main objective of the choice experiment study was to value the impact of reduced river flow on the Recreo Verde tourist center and provide guidance for a compensation package.

1. Valuation of Environmental Goods and Services

According to neoclassical economic theory, market prices are usually an adequate reference for the value that society places on goods and services. If a good or service has value, an individual will be willing to pay to acquire it or to accept compensation for its loss or damage. In ordinary markets, this value is observable as the price paid for the good, but with environmental goods and services, market imperfections distort their real prices or values, plus the value that individuals place on them cannot be readily observed. Market anomalies or imperfections have been classified by economists into public and/or common access goods, externalities, and incomplete markets or property rights. (See Baumol and Oates 1975 for a classical reference.)

Market imperfections can be found in environmental resources, education, transportation, health, and other types of social programs that produce benefits or costs for which markets do not provide an appropriate price, if at all. Economic valuation has applications in all these diverse areas.

[2] SETENA is the Spanish acronym for National Technical Environmental Secretariat.

Typically economists divide economic valuation methods into two broad categories: revealed preference methods and stated preference methods (see, e.g., Freeman 1993). The two systems differ primarily in data origin and collection methods.

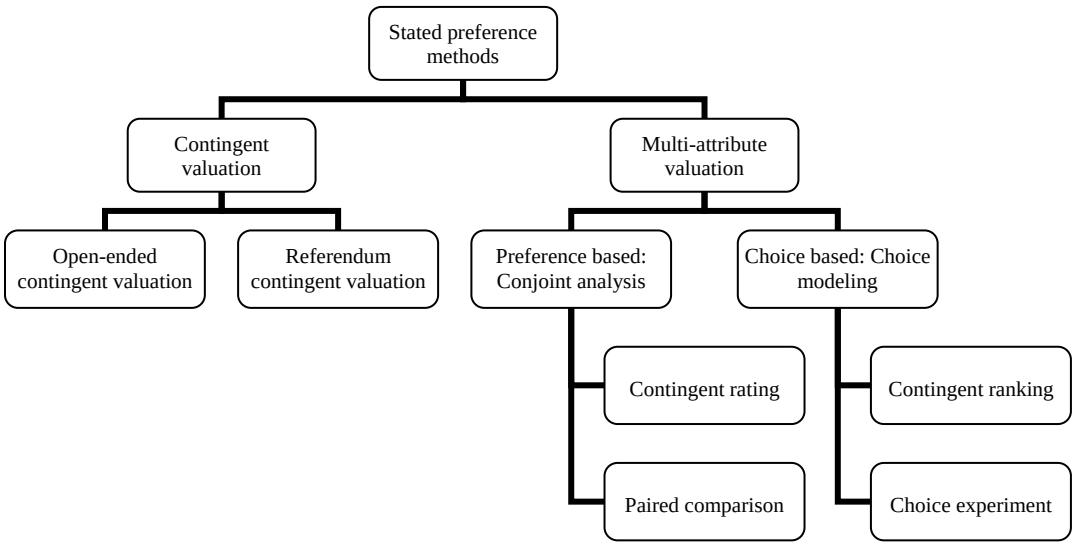
Revealed preference methods rely on actual behavior in existing markets, whether directly, as in analyzing the demand for recreation in protected areas; or indirectly, for example, when the value of safe neighborhoods is extracted from observed differences in house prices, after correcting for differences in house properties. Economists prefer to rely on observable market interactions when estimating the value of environmental goods and services, but may limit this to cases in which these goods and services somehow enter the utility level or production function of traded goods (Freeman 1993; Herriges and Kling 1999).

Stated preference techniques are a series of approaches or methods to estimate the value of goods and services not commonly bought and sold in existing markets. It gets around the absence of markets by creating hypothetical scenarios in which agents make decisions that mimic the reality of markets (Mitchell and Carson 1989). Stated preference methods offer the possibility of estimating both use and nonuse values. Use values are the monetary measurement of the utility derived from the direct or indirect consumption of a good or service. Nonuse values are less tangible and are typically motivated by the desire to bequeath some existing assets to future generations. Also, a utility may place an intrinsic value on the existence of a given environmental resource (Freeman 1993).

All methods within the stated preference family use surveys to ask respondents to state their preferences in one or more hypothetical scenarios that capture the fundamentals of a given situation. However, there are considerable differences among methods. Merino-Castello (2003) offers a classification that clarifies how the various methods and their approaches are grouped (figure 1).

Contingent valuation is an approach that asks respondents to state their maximum willingness to pay for a hypothetical change in an environmental good or service (Mitchell and Carson 1989; Hanley et al. 2001). It is the most widely used approach within stated preference and has undergone its own evolution, from initial elicitation formats with open-ended questions to referendum elicitation formats (yes/no responses to a suggested payment). Contingent

Figure 1. Family of Stated Preference Methods



Source: Merino-Castello (2003).

valuation has been considerably criticized (not least because of its frequent use in lawsuits): some of the most serious criticism involves its often-poor implementation (Whittington 2002), anchoring effects (when respondents base their responses on a feature of the scenario), and yea-saying (when respondents too easily accept the proposed payment without regard for their ability to pay).[3]

Interest in multi-attribute valuation has risen in part as a response to the problems of contingent valuation. Conjoint analysis and choice modeling both belong to the multi-attribute valuation family. In general, contingent valuation and multi-attribute valuation differ mainly in that the latter allows the practitioner to estimate values for multiple attributes of a product and their tradeoffs simultaneously, while conjoint valuation can only analyze one combination of attributes at a time (Merino-Castello 2003).

Multi-attribute techniques fall into two categories that differ according to the measurement scale used. The first category is preference-based approaches, which ask individuals to rate alternative scenarios on a cardinal scale. The second category is comprised of

[3] See Mitchell and Carson (1989), Arrow et al. (1993), and Kahneman and Knetsch (1992) for early discussions of these issues.

choice-based approaches, which ask consumers to choose (using an ordinal scale) among competing products that resemble more closely tasks performed by consumers every day. Unlike preference-based approaches, which have their origins in marketing research, choice-based approaches come from the discipline of economics (Ben-Akiva and Lerman 1985; Adamowicz et al. 1998). The basic foundations lie in Lancastrian microeconomics (Lancaster 1966; Alpízar et al. 2003), in which individuals derive utility from characteristics or attributes of a good; and in random utility theory, in which utility has a deterministic and probabilistic component (Boxall et al. 1996; Mogas et al. 2006).

Choice experiments are arguably the simplest of the choice-based approaches in terms of cognitive requirements from respondents. Also, choice experiments mirror real market situations and are consistent with welfare economics (Merino-Castello 2003). They are practical from a policy and management perspective because the information they provide can be used in the design of multidimensional policies (Hanley et al. 2001), in cost–benefit analysis, and in litigation processes (Mogas et al. 2006). The natural resource damage-assessment literature suggests using compensating "goods" as a way to avoid complicated funding issues and to disburse damage-compensation funds (Adamowicz et al. 1995).

The choice experiment in the Recreo Verde case here helps us identify changes (positive and negative) to key attributes of recreation in the tourist center as a result of the Toro 3 hydropower project. These changes can be used to construct a compensation package for the damage caused by the loss of amenities associated with the river. Other case studies describing choice experiments in the context of hydroelectric projects include Kataria (2009), who used a choice experiment to estimate how Swedish households value different environmental improvements for hydropower regulated rivers; Bergmann et al. (2006), whose choice experiments quantified people's preferences regarding multiple impacts from renewable energy schemes, such as hydro and wind power in Scotland; and Sundqvist (2002), who estimated how different environmental impacts from hydropower are perceived and valued by Swedish households.

2. Choice Experiments for Recreo Verde in the Toro 3 Environmental Impact Assessment

Recreo Verde is a tourist center in San Carlos, Costa Rica, on the left bank of the Toro River, 6.8 kms downstream from the future Toro 3 water intake. Located at the bottom of the river's canyon, Recreo Verde's main attractions include its scenic beauty, camp sites, sport fields, huts with barbecue and picnic tables, and fresh and thermal water pools. The Toro River,

while scenic, is not suitable for swimming: its water is highly acidic due to its proximity to a volcanic area (ICE 2005).

When the power plant begins operation, it will reduce the water flow down the Toro River, which can potentially impact the tourist center's scenic beauty. This potential effect was identified during the impact assessment phase of the project in 2004–2005. Not surprisingly, the owners of the center believe that the reduction in river flow will have negative effects on tourist visits.

In response, the EIA team decided that this externality could be quantified using economic valuation techniques. Given the wide array of valuation techniques, they went through a process of elimination to choose the right one. In this particular case, some key aspects had to be taken into consideration:

- The river is one of many attractions in Recreo Verde, so its value has to be placed in the context of the other features that draw visitors to the site. Other attributes of Recreo Verde will not be affected by a change in river flow and visitors may still wish to come.
- As already mentioned, the impact of Toro 3 will occur in the future. Obviously visitor behavior under future circumstances is not observable, which immediately eliminates using revealed preference methods.
- Because ICE is a state-owned enterprise (the government's electricity and telecommunications utility), monetary compensations are difficult to approve. Other forms of compensation have to be identified.
- Finally, it is important to minimize the cognitive demand of the exercise.

These four aspects point to choice experiments as the right tool to value the effect of the future hydropower plant on the recreational site.

3. Design of the Choice Experiment

In a choice experiment, individuals are asked to choose their preferred alternative from several options in a choice set, and they are usually asked to respond to a sequence of such choices. Each alternative (e.g., recreational sites A, B, and C) is described with a number of attributes or characteristics (e.g., several types of huts), where the levels of the attributes change from one alternative to the other (e.g., simple huts, simple huts with electricity, fancy huts with electricity). A monetary value is included, as are other significant attributes, when presenting

each alternative. Thus, when individuals make their choices, they implicitly make tradeoffs between the levels of the attributes in the different alternatives presented in a choice set (Alpízar et al. 2003).

There are four steps involved in the design of a choice experiment: 1) definition of attributes and attribute levels, 2) experiment design, 3) experiment context and preparation of questionnaire, and 4) choice of sample and sampling strategy.

3.1 Definition of Attributes and Their Levels

Identifying the attributes of the affected good is a key step in a choice experiment. As noted by Boxall et al. (1996, 244), choice experiments rely "on the accuracy and completeness of the characteristics and features used to describe the situation." The attributes are expected to affect respondents' choices. Additionally, the selection of attributes should be guided by their policy relevance and their ability to be changed in response to preferences.

In the Recreo Verde case, the team interviewed focus groups of visitors, as well as the owners, to identify the most important attributes drawing visitors to the tourist center. (Appendix 1 contains the semi-structured interview used with the focus groups.) Table 1 summarizes the main attributes visitors identified and their possible improvements.

Table 1. Attributes of Recreo Verde and Improvements Desired by Visitors

Attributes	Improvements
Huts	The small huts in Recreo Verde are an essential feature because visitors with low and low-to-middle incomes (the majority of visitors to Recreo Verde) can bring their own food and cook meals. Adding electricity was viewed as a positive change.
Cold and hot water pools	Visitors wanted to see improvements, such as more plants to conceal the cement walls around the swimming pools.
Access road	The state of the main access road concerned many visitors. They were pleased when the possibility of paving the road was mentioned.
River	The river and the natural surroundings of Recreo Verde are an attraction for visitors.
Admission fee	Some visitors believed that the entrance fee was exactly right, whereas others thought it was expensive.

This information was used to generate a definitive set of five attributes that were relevant from the perspective of visitor's choices and could be changed or amended in a compensation

package. The focus groups also provided information about the possible levels of those attributes. The final attributes and their levels are shown in table 2.

Table 2. Final Version of Attributes and Their Levels

Attribute	Levels
Huts	Status quo, same huts with electricity, improved huts with electricity
Pools	Status quo, more ornamental plantings
Road	Status quo, paved road
River	Actual flow, less water
Fee	CRC 2,000; 2,500; 3,000; 3,500; 4,000

Note: CRC = Costa Rican colones; 470 colones = US$ 1

3.2 Experimental Design

The main design issue is to maximize the efficiency of the survey to extract information from the respondents. Each answer to a choice set should provide additional information for the statistical model, so that eventually the preferences for different levels of the attributes are individually identified.

A design is developed in two steps: 1) obtaining the optimal combinations of attributes and attribute levels to be included in the experiment, and 2) combining those profiles into choice sets. Eventually, a third step that groups choice sets into questionnaires may be needed.

A starting point is a full factorial design, which contains all possible combinations of attribute levels that characterize the different alternatives ($3^1 2^3 5^1 = 120$, in this case). A full factorial design is, in general, very large and not tractable in a choice experiment. Therefore, a subset of all possible combinations must be chosen, following some criteria for optimality, and then choice sets constructed.

In choice experiments, design techniques used for linear models were popular in the past. Orthogonality in particular has often been used as the main component of an efficient design. More recently, researchers in marketing have developed design techniques based on D-optimal criteria for nonlinear models in a choice experiment context. Huber and Zwerina (1996) identified four principles for an efficient design of a choice experiment based on a nonlinear model: 1) orthogonality, where attribute levels within each choice set are not correlated; 2) level balance, where attribute levels occur the same number of times within a choice set; 3) minimal

overlap, where attribute levels are not repeated within a choice set; and 4) utility balance, where each alternative within a choice set has approximately the same utility.

In this study, the OPTEX procedure in the SAS statistical software was used to produce a design that met principals 1, 2, and 3 above. Although utility balance is an important characteristic that results in arguably more efficient designs and estimations, it requires acquisition of prior information, which was not possible in this case, given a limited budget and complicated field logistics.

Table 3 provides an example of one of the choice sets used in the choice experiment. Our design produced 20 such choice sets, which were grouped into five types of questionnaires with four choice sets each. The five questionnaires were randomly distributed among the interviewers and given to the target population.

Table 3. Choice Set for Type 2 Questionnaire

Characteristics of Recreo Verde	**Option 1**	**Option 2**	
Type of hut	Existing state	With electricity	
Pools	No ornamental plants	With ornamental plants	
State of the access road	Paved road	Gravel road	
State of river/scenery	Current flow	Less water	
Entrance fee per person	CRC 2,500	CRC 3,500	
B1: Which is your preferred option? __ Option 1 __ Option 2 __ Would not come			**Code**

Note: CRC = Costa Rican colones; 470 colones = US$ 1

3.3 Experimental Context and Preparation of Questionnaire

The choice sets were part of a larger questionnaire that includes an initial set of questions related to the recreational habits of the interviewees (see appendix 2). After the socioeconomic questions, the questionnaire provides an introductory text to explain the dynamics of the interview. This section is followed by the choice sets, illustrated with photographs to help in the presentation. We took photographs of the huts, pools, road, and river (some were digitally altered) to show changes in "levels." For example, the river picture captured the change in flow

by asking an existing power plant (one of the two already built) further upstream to cease operation for several hours and stop its restitution flow from going downstream.

We conducted a pilot survey to fine-tune the questionnaire, which explored the cognitive complexity of the task and helped determine the adequate number of choice sets. Thanks to this preliminary survey, the initial five choice sets were reduced to four because interviewees tired by the fifth exercise.[4] We carried out the pilot survey as if it were the actual survey, in order to mimic all the conditions that would be faced. Visitors were chosen randomly once they entered Recreo Verde and were engaged in various activities.

3.4 Choice of Sample and Sampling Strategy

The focus groups mentioned previously defined the relevant population and the sampling strategy. These focus groups revealed that overnight and day visitors were two distinct populations. Overnight visitors, who stay in cabins and pay correspondingly different entrance fees, do not use the huts and instead focus on bathing in the hot water pools. Because water will be released by the Toro 3 power plant at night, the situation during the evening will remain unchanged. Also, most visitors to Recreo Verde come from Costa Rica's Central Valley and nearby towns. Thus, for our sampling strategy, we conducted interviews only in Spanish, only during the day, and once visitors had entered and were settled in the tourist center.

Based on previous knowledge of the tourist attraction, we chose two days per week for sampling plus weekends, during March–April 2005, the two summer months. These are critical months for Recreo Verde, both in terms of water availability and number of visits by tourists, making them a priority for sampling.

Interviewers underwent several days of training to learn to conduct the survey neutrally and not influence or alter the interviewees' answers. Although the absence of a list of visitors made full randomness impossible, interviewers were instructed to be careful not to insert systematic biases when choosing their subjects. This was regularly and statistically checked during the data collection process. The administration and execution of stated preference methods greatly affects the quality of the final product, so training interviewers is an important step (Whittington 2002).

[4] This reduction in the number of choice sets required adjusting the optimal choice set design to the four choices to be presented to respondents.

4. Results

We conducted a total of 214 interviews, collecting 848 observations. (Each respondent answered four choice sets.) Only 34 observations (4 percent) answered "would not go," refusing to choose between the alternatives given and deciding to opt out. The econometric model thus included 814 observations, a solid base for the results.

The basic econometric problem in a choice experiment is explaining the effect of the selected attributes and levels on the probability of choosing one alternative over another in each choice set. For example, what is the effect on the probability of choosing alternative 1, if the attribute "road type" is paved in alternative 1 and unpaved in alternative 2? Economists use a standard random utility framework (Manski 1977), in which this probability is the result of the respondent's inner evaluation of the utility or satisfaction derived from the available alternatives in a choice set, which in turn is assumed to depend on the selected attributes and levels. Naturally, analysts can only observe the final decision from each agent, which also comes with mistakes, contradictions, strange preferences, and so on, in addition to the inner evaluation. To cope with these, we allowed a given degree of randomness as an intrinsic element of the decisionmaking process, hence the name of the framework (Alpízar et al. 2003).

In our questionnaire, respondents faced two generic alternatives, described by five attributes. We used a standard multinomial logit model to estimate the effect of changes in these attributes on the probability of choosing an alternative. The estimations were made with LIMDEP econometric software. Table 4 summarizes the main results of the model.[5]

Table 4. Variables, Coefficients, and Statistical Properties

Variable	Coefficient	P-value
Type of hut *(Very simple huts are the baseline.)*	0.213	0.0546
Type of pools *(No plants is the baseline.)*	0.737	0.000
Type of road *(Unpaved road is the baseline.)*	0.575	0.000

[5] We excluded the constant from the model because there is no intrinsic reason to prefer one or the other of the two generic alternatives presented to the respondents.

Level of river *(Actual flow is the baseline.)*	-0.831	0.000
Fee level *(Lowest fee is the baseline.)*	-0.556	0.000

As expected, given the extensive work with focus groups, all variables were statistically significant at the 1 percent level, with the exception of type of hut, which was significant at the 5 percent level. This means that all variables were relevant and contributed to explaining the behavior of visitors when confronted with the choices. All coefficients had the expected signs. In this type of probabilistic model, the estimated coefficients should only be interpreted in terms of sign and significance. The following is an analysis of the results for each variable included in the model.

Type of hut. This variable had few modifications in the model. It had three levels (see table 1), and it is possible that, although most of the respondents favored the addition of electricity, they did not necessarily desire construction of nicer, less rustic huts. A first run of the model revealed that this was indeed the case,[6] so we combined electricity and aesthetic improvements into a single variable and then compared it to the status quo. Availability of electricity was the most important difference between the two levels. In the model, the provision of electricity significantly increased the probability of choosing that alternative, making it more desirable from the point of view of visitors.

Cool and warm bathing pools. Adding ornamental plants around the pools was an improvement to the status quo and confirmed by positive sign for this variable.

Access road. The main access road was an important feature for visitors to Recreo Verde. The focus groups revealed that visitors favored improvements to the road, which was confirmed by the positive sign of the variable.

River. The river, its water flow, and its effect on welfare were the main motivation for the study. The decrease in the amount of water flowing down the river led to a drop in welfare, hence the negative sign and significant coefficient of this attribute.

[6] One hopes to capture this type of effect in the exploratory work leading to the survey, but as with most field work, surprises are always present.

Entrance fees. This variable allowed us to calculate the marginal willingness to pay (a common denominator for expressing changes in welfare) for each of the attributes or variables described above. As expected, the negative sign indicated that increases in the entrance fees had a negative effect on visitor welfare.

The huts, pools, road, and river, were all included as dummy variables in the econometric model, so we were able to compare their "sizes." (Alpízar et al. 2003). From table 4, it is possible to say that, in terms of size, the coefficient for "river" is highest, making this variable the most important. The coefficients for the "pools" and "road" variables are similar to the river variable. In this sense, although the model showed that less water flow had an important impact on the enjoyment experienced by visitors to Recreo Verde, there are alternatives which may compensate for this reduction.

The concept of marginal willingness to pay (MWTP) helps translate into monetary terms the previously analyzed parameters. MWTP indicates how much visitors are willing to pay for an improvement of a certain attribute. This is central to this analysis because monetary values of the attributes can be directly compared to each other, providing clear guidelines for a compensation package.

We obtained the values by dividing the coefficient for each variable by the price coefficient. A WALD test (an estimation procedure) was used to generate not only the value of the ratio but also its distribution and significance. The results are in table 5.

Table 5. Variables and Marginal Willingness to Pay (MWTP)

Variable	MWTP (in US$)	P-value
Willingness to pay for huts with electricity	0.81	0.035
Willingness to pay for paved access road	2.20	0.002
Willingness to pay for reduction in river flow	**-3.17**	0.000
Willingness to pay for ornamental plants around pools	2.81	0.000

MWTP for huts with improved aesthetics and electricity was US$ 0.81. (The exchange rate at the time of the study was CRC 470 colones = US$ 1). Respondents were also willing to pay an additional $2.20 if the access road to Recreo Verde was paved. The reduction in water

flow implied a reduction in welfare equal to $3.17. However, improvements to the pools (more ornamental plants, for example), were valued at $2.81. Improvements to the road, pools, and huts thus constituted a likely compensation for the reduction in water flow.

The willingness to pay estimates can be compared in magnitude and can be added together. For example, the loss of $3.17 due to decreased river flow can be approximately compensated by improving the road and huts ($2.20 + $0.81, respectively), or by improving the pools ($2.81). Making all three improvements would overcompensate the owners for the impact of Toro 3 on the tourist center. In summary, the choice experiment revealed the compensation measure or combination of measures that would return Recreo Verde visitors to a welfare state similar to the one before the change in the river level.

5. Conclusions and Discussion

First, it is important to remember that the point of this exercise was to endow ICE with a scientific baseline from which to start negotiations with the owners of Recreo Verde. Clearly, the results presented both good and bad news for both parties. On one hand, ICE had to recognize that the hydropower project indeed carried substantial losses to the affected parties. On the other hand, the owners of Recreo Verde had to face hard numbers that did not necessarily coincide with their priors. It is important to understand that this type of study serves to simplify negotiations, but seldom provides a definite verdict.

The analysis process and results were presented in detail to the owners of Recreo Verde. The alternative compensation strategies were discussed with them, namely, improvements to the huts, recreational pools, and main access road. The owners were more enthusiastic and positive about some of the compensation measures, such as paving the main access road, than others. However, the idea that the scenic quality of the center could be improved by placing more ornamental plants around the pools was not as welcome. Looking again at table 5, pool improvements show a much higher MWTP by customers than the paved road, yet the owners preferred to pave the road rather than improve the pools. The logic of this attitude seems to stem from the fact that an investment in the road is potentially more costly than an investment in pool scenery. In their view, the more “costly” compensation was more adequate or “just.”

The owners of Recreo Verde were also told that customers placed considerable value on the quality of the huts and the possibility of having electricity, so they could cook for themselves. This idea had a lukewarm reception, but the owners did not oppose it.

A major issue in the negotiation was the definition of status quo. The owners of Recreo Verde believed that a major flaw of the study was that it could not predict future or potential areas of growth for Recreo Verde, and analyze how the reduction in river flow might affect this potential. They had plans to build more infrastructure and attract foreign visitors. They believed that the valuation study should have included such potential and outline compensation for these losses.

The key issue, then, is who defines the status quo. Because this study was conducted by ICE, it inevitably used the electricity company's definition, namely, the situation prior to the hydropower project. The owners of Recreo Verde wanted to include future plans in their status quo. This is not necessarily a limitation of the study, but simply reflects the negotiation strategies of both parties. Moreover, conducting a stated preference study on a population of potential visitors, who may have no knowledge of the site and no prior experience of its amenities, can possibly extend the capacities of this method beyond responsible practice.

With respect to the accuracy of predictions from choice experiments, the literature reveals hits and misses, mostly related to data quality. Haener et al. (2001) found that the models estimated from stated choice surveys can have a predictive ability similar to revealed preference models. Some of the models they analyzed have a prediction success rate of approximately 70 percent for 11 alternative choice sets. These authors assessed the relationship between data collection methods and prediction success, and found that data collection in a central facility (such as our case), as opposed to mail surveys, results in better prediction success.

Data quality appears to be so important that, in many cases, it is preferable to transfer high-quality choice experiment data to case studies than use site-specific information. Surveys conducted in person (as we did) or in group sessions with an interviewer gather a superior quality of information than mail surveys (Adamowicz and Boxall 2001). This suggests that the procedure followed in Recreo Verde has the greatest chance of yielding a high quality and reliable product.

The ability of choice experiments to adapt to some of the conditions typically found in impact assessment, such as the need to predict future outcomes, quantify impacts, and propose compensation measures, point to their potential use in environmental impact assessments. They can help fill the void identified by Burdge (2004), regarding the need for economic indicators and monetization of externalities during the ex ante assessment. However, it is crucial that those who assess environmental impact also understand the potential shortcomings of these valuation techniques. In addition to badly implemented exercises (biases, poor sampling, bad statistical

design, and sloppy framing, and selection of attributes and levels), the criticisms tend to be aimed at the foundations of valuation, that is, the economic theories that support these methodologies. Contingent valuation has been heavily targeted and choice experiments were developed to address some of the concerns about it, but problems with some of the behavioral assumptions made in valuation also apply to choice experiments.

Neoclassical welfare economics provides the theoretical framework for nonmarket valuation and operates with the rational actor model of human behavior (Gowdy 2004; Spash and Carter 2001). "Individuals act to maximize utility according to consistent, constant, well-ordered, and well-behaved preferences. In the rational actor model, preferences are exogenous, that is, other individuals or social institutions do not influence them" (Gowdy 2004, 246). Rational choice requires the use of market mechanisms and monetary measures (O'Neill 2002).

The rational actor model has been questioned by social psychology and more recently by behavioral economics, which views individual behavior as "a complex construct dependent upon attitudes, behavior, and beliefs" (Spash and Carter 2001, 4). As such, human preferences are constructed; in other words, they are endogenous to a particular situation. If this is the case, there is no underlying set of preferences that can be revealed or discovered through valuation. Although we agree that there is some truth to this argument, one cannot help believing that there is a degree of stability and consistency in preferences and behavior. After all, if people like blue cars on a sunny day, most likely they also like them when it rains.

In any case, we believe in the importance of a more ample model of rational choice that takes into consideration the attitudes, beliefs, and social norms that factor into human behavior (Gowdy 2004; Spash et al. 2005; Spash and Carter 2001; Beckerman and Pasternak 1997). In this sense, we believe that it is important to be open to a rights-based approach and to considering that in many circumstances economic agents respond to what they think is right or wrong, and not necessarily to their inner preferences. In terms of behavioral economics, this can even be taken so far as to argue that agents derive utility from acting righteously. In our setting, although the choice experiment was based solely on the standard neoclassical model, the ensuing negotiation was, to a large degree, influenced by a rights-based approach informed by the choice experiment results.

So where does this leave choice experiments and valuation as potential tools for environmental impact assessments? Instead of throwing the baby out with the bath water, economics has to be placed within a larger perspective. Proponents of a new form of valuation suggest the need to incorporate multiple perspectives in the discussion of complex environmental

problems (Spash and Carter 2001; Spash et al. 2005). The beauty of EIA lies in its ability to bring together multidisciplinary views to analyze environmental problems, and clearly economics is one of these perspectives. Economics is valuable because it brings the idea that resource constraints exist in environmental policy and that choices must be made. Devoting resources to environmental protection means there are fewer resources available for other uses (Beckerman and Pasternak 1997). This is an important lesson from the theories that support economic valuation.

Appendix 1. Semi-structured Questionnaire for Focus Groups

1. What do you think of Recreo Verde's facilities?
2. What do you like most about Recreo Verde?
3. What is Recreo Verde's distinctive element?
4. What improvements would you like to see in Recreo Verde?
5. If the following features were changed in Recreo Verde, would you visit the same number of times/more often/less often? (This was followed by several options, such as pools, river access, cafeteria, hiking trails.)
6. Do you like the pools' appearance at the moment? What could be improved?
7. Do you believe Recreo Verde would be more appealing if hiking trails were paved?
8. Is the entrance fee to Recreo Verde expensive/acceptable/cheap?
9. If the access road to Recreo Verde were improved, would you visit the same number of times/more often/less often?
10. Is the current number of visitors to Recreo Verde too few/adequate/too many?
11. What are your thoughts on Recreo Verde's new facilities? Which of these facilities would you use more?
12. There is a project that will reduce the water flowing down the Toro River. Will this affect your enjoyment of Recreo Verde? Will this affect other people's enjoyment of Recreo Verde? Will you stop coming to Recreo Verde?

Appendix 2. Questionnaire on Visitor Recreational Preferences

Part A — QUESTIONS ON RECREATIONAL PREFERENCES

[Italicized text in brackets is instructions for interviewers.]

A1. With what frequency do you visit tourist areas in Costa Rica for one or more days?

- ❑ Less than once a month
- ❑ Once or twice a month
- ❑ Three or four times a month
- ❑ More than four times a month
- ❑ No answer

A2. What types of places do you commonly visit? You can mark more than one option.

- ❑ Mountains
- ❑ Beaches
- ❑ Spas or hotels
- ❑ National parks
- ❑ Recreation centers for businesses or associations
- ❑ Others: Please describe_____

A3. How many times have you been to Recreo Verde?

[Do not read choices out loud. Mark the most appropriate choice.]

- ❑ This is my first time._____(Go to question A5)
- ❑ Two or three times
- ❑ More than three times
- ❑ No answer

A4. What time of the year do you visit Recreo Verde?

- ❑ December through April
- ❑ May through June
- ❑ July
- ❑ August through November
- ❑ All year long
- ❑ No answer

A5. During your trips to Recreo Verde, do you also visit other recreational areas?

__ YES __ NO __ Don't know/No response

A6. Where do you live?

County_____

Province_____

A7. With what type of transportation did you come to Recreo Verde?

- ❑ Own vehicle
- ❑ Rented vehicle
- ❑ Public bus
- ❑ Private bus
- ❑ Other: Please describe_____
- ❑ Don't know/No response

A8. Who is accompanying you on this trip?

- ❑ Alone
- ❑ With my partner
- ❑ With my family (How many people are in your family?_____)
- ❑ With a group (How many people are in your group?_____)
- ❑ Other: Please describe _____

A9. What activities do you plan to do in Recreo Verde? I will read several options.

[Mark only positive answers.]

- ❑ Bathe in hot water pools
- ❑ Bathe in cool water pools
- ❑ Sports
- ❑ Visit hiking trails
- ❑ Enjoy the scenery
- ❑ Other: Please describe_____
- ❑ No answer

A10. What is your age?

_____ 18–30

_____ 31–40

_____ 41–50

_____ 50 or more

[Write down respondent's gender.]

- ❑ Male
- ❑ Female

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