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RESEARCH PAPER

Attitudinal determinants of willingness-to-pay for river ecosystem improvements in central Chile: A choice experiment

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Abstract

C.A. Huenchuleo, J. Barkmann, and R. Marggraf. 2016. Attitudinal determinants of willingness-to-pay for river ecosystem quality improvements in central Chile: A choice experiment. Cien. Inv. Agr. 43(1):125-137. A respondent's preference for non-market goods depends not only on the attributes of the goods but also on the respondent's attitude towards the goods being valued. Accounting for these characteristics may substantially improve the ability of stated choice models to represent preference heterogeneity. In this regard, we analyzed the influence of respondent attitudes on the valuation of river ecosystem quality attributes affected by pulp mill wastewater in two central Chilean watersheds. We applied the Choice Experiment (CE) method to assess preferences on river pollution risk, water quality effects, threatened species and the yield in local fisheries. The payment vehicle was an additional annual charge to the electricity bill. All three environmental attributes and the payment attribute were highly significant determinants of choice ($P \leq 0.001$). A calculated mean WTP value for an optimistic policy scenario was 13 USD/year per household. As hypothesized, attitudes influenced stated respondent preferences with some differences between the two studied watersheds. Overall, our findings suggest that attitudinal variables deserve more attention in the analysis of preferences for water resource improvements in emerging economies.

Key words: Attitudes, choice modeling, economic valuation, water resource.

Introduction

Although significant improvements have been made in past years, river ecosystem quality in Chile is still poor in some places due to untreated wastewater, mainly from households and industries (Banco Mundial, 2011). In particular, the negative effect of pulp mill wastewater on river ecosystem quality has received attention in Chile (Vasconi, 2006; Espinosa, 2001). Despite substantial efforts to reduce wastewater toxicity, wastewater quality is still believed to impact aquatic organisms negatively (Orrego *et al*., 2006). Consequently, river ecosystems downstream of pulp mills are severely compromised even today (Vasconi, 2006). The protection of river ecosystem quality in Chile rests mainly on the wastewater emission standard

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D.S.90-2000 (Ministerio Secretaría General de la Presidencia, 2001). This standard is supervised by the Superintendency of the Sanitary Service and monitored by an industry self-controlled reporting system. Legal norms for water and ecosystem quality themselves are still under development for most watersheds in Chile, including the area of the present study.

Chile is an emerging economy that has been following a general strategy towards social and economic development that gives substantial weight to economic considerations. From a welfare economic perspective, the design of economically focused policies needs to pay adequate attention not only to enterprise and industry concerns but also to the economic preferences of the population. "The population", however, is not a set of individuals with necessarily uniform preferences. With respect to preferences for environmental goods, including goods referring to river ecosystems, studies conducted recently in Chile have shown substantial preference heterogeneity (Cerda *et al.,* 2012). Against this background, a deepened insight into the socio-economic and attitudinal causes for preference heterogeneity can help political analysts to devise policy options that better reflect citizen preferences. Our study responds to this assessment by analyzing the preferences of residents living downstream from two pulp mills in central Chile that affect the quality of the river ecosystem. In particular, we analyzed attitudinal determinants of preference heterogeneity (expressed as differences in willingness-to-pay; WTP) for potential river ecosystem improvements with a choice experiment (CE; a stated preference method) (Louviere *et al*., 2000).

There is evidence from several stated preference studies that attitudinal factors affect respondent preferences for river ecosystem quality improvements (Poppenborg and Koellner, 2013; Álvarez-Farizo *et al*., 2007; Morrison and Bennett, 2004). Moreover, the predictive capacity of discrete choice models can be enhanced when attitudinal variables are included as covariates (Greiner, 2015; Barkmann *et al*., 2008). Most importantly, respondents having a 'pro-environmental' orientation are more likely to pay for river ecosystem quality, while those who have a 'pro-development' orientation are less willing to choose options for river ecosystem quality improvements (Morrison and Bennett, 2004). The respondents who have no particular interest in the river but are aware of its poor ecological condition may still be more likely to pay for water quality improvements based on altruist motivations (Álvarez-Farizo *et al*., 2007). Those with business interests in the river ecosystem quality may also be more likely to take action to improve river ecosystem quality (Álvarez-Farizo *et al*., 2007).

CEs were applied to the valuation of different attributes of river ecosystem improvements. Attributes addressing river ecology such as the presence of certain water plants, fish, birds and other animal species were studied by Morrison and Bennett (2004), Hanley *et al*. (2006ab), and Álvarez-Farizo *et al*. (2007). Recreation attributes (boating, fishing, and swimming) were analyzed by Morrison and Bennett (2004). The effect of an invasive alga was analyzed by Beville *et al.* (2012). Finally, the importance of river flow rate and local jobs (Hanley *et al*., 2006a), aesthetics (Hanley *et al*., 2006b), and of water supply (Álvarez-Farizo *et al*., 2007) have been analyzed. In all cases, river ecosystem quality was a significant determinant of choice.

In spite of the relative abundance of stated preference studies on non-market aspects of water quality and river ecosystems, none of the studies were conducted in Chile. Consequently, the acute lack of data on the non-use and indirect use value of water quality attributes is frequently mentioned as a restriction in applied cost-benefit analyses prepared for legislative purposes in Chile (CONAMA, 2006; EULA, 2006). Against this background, the objective of this study is twofold. First, we attempted to determine the WTP of central Chilean citizens for improvements in several policy-relevant attributes of river ecosystem

quality at the Mataquito and Itata rivers. Specifically, we included attributes on river pollution risk and on water quality effects impacting the river ecosystem and the river ecosystem services such as the habitat for potentially threatened species or yields in local fisheries. Second, the analysis of the influence of attitudinal factors on WTP allows for the identification of variables affecting respondent preferences when water resources are impacted by pulp mill emissions.

Materials and methods

The study area is located at the downstream sections of the Mataquito and Itata river watersheds in the VII Maule region and the VIII Bío-Bío region of central Chile, respectively. The Mataquito river basin occupies an area of 619,000 ha and includes land uses such as agriculture (80,051 ha), forestry plantations (32,074 ha), and native forests (62,365 ha). The main agricultural products are fruits, such as apples and cherries, vineyards and cereals. The Itata river basin covers a surface of 1,129,400 ha comprised mainly of agriculture (156,108 ha), forestry plantations (60,020 ha), and native forests (146,236 ha) (INE, 2009; Figure 1). The main crops are cereals, such as wheat and oats, forage, industrial crops, and vineyards. Plantations of exotic *Pinus radiata* (Monterrey Pine) dominate both river basins and supply the wood to the pulp mills that have harmed the local fisheries at the estuary.

The design of the choice experiment

The policy option outcomes ('scenarios') were described through selected attributes of river ecosystem quality and a payment to be made. Based on local information collected, three attributes on river ecosystem improvements were constructed: the river pollution risk, the number of threatened species, and the local fishery yields. Each attribute and its respective levels were explained to the respondents using examples with visual aids. For each attribute, one level corresponds to the current situation (*status quo*).

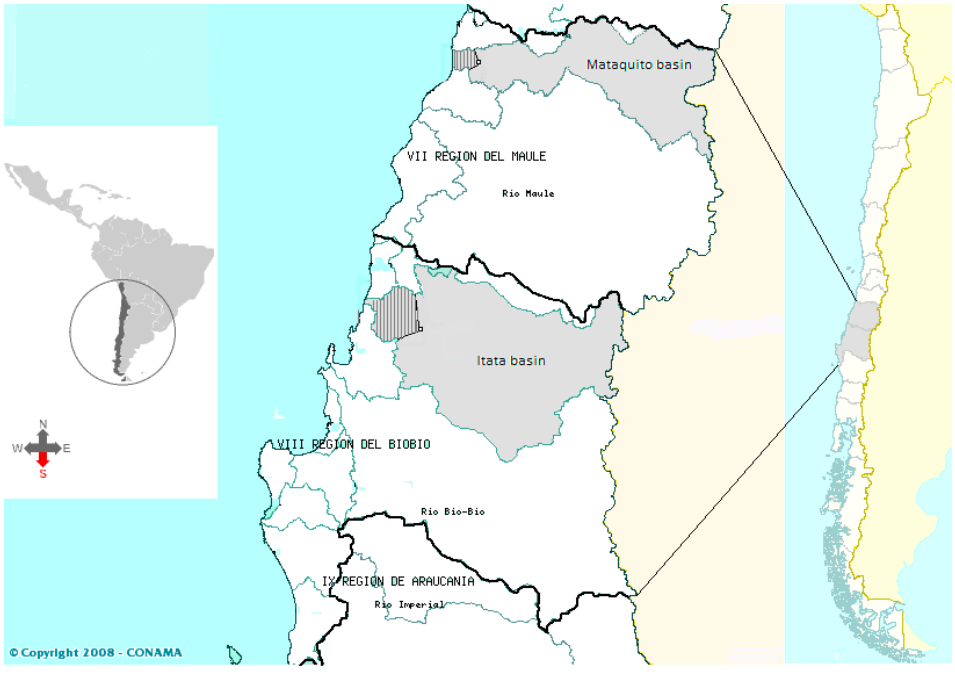

Figure 1. The location of the study area (adapted from SINIA, 2008); the actual study area hatched.

The pulp mills are the main industrial installations in the research area (at the Mataquito research site, the pulp mill is the only industrial installation, while there are two industrial installations at the Itata study area, one of which is the pulp mill). Pollution spills leading to violations of national water quality standards have been a recurrent feature of the operation of the pulp mills. Therefore, we decided to construct an attribute on river pollution risk that directly addresses such violations. In our CE design, a violation 25% of the time corresponds to the current situation or *status quo*. Additionally, we offered respondents reductions of river pollution risk to 20%, 15% or 10%. The threatened species attributes addresses the number of fish and waterfowl species living in the river ecosystem with a poor ("threatened") conservation status. Currently, there are on average 25 such threatened species in the Mataquito and Itata rivers (Cade-Idepe, 2004ab). The proposed attribute levels were a reduction to 20, 15, and 10 threatened species. The yield of local fisheries attribute refers to the yield of small fisheries operating mainly in the estuaries of the two rivers. We chose the estuarine species Robalo (*Eleginops maclovinus*), which is a well-known species in the study area. Recently, the current average yields in local fisheries for Robalo were 1 ton/year (Mataquito) and 10 ton/year (Itata) (Araya *et al.,* 2006). Given the high yield fluctuation during the last five years, we proposed to respondents an increase in fishery yields of 10%, 25%, and 50%. For the payment attribute, an additional mandatory annual payment per household to the electricity bill was utilized. We explained to the respondents that the money raised would be used to enforce pulp mill compliance with the potentially more stringent legislation on improving river ecosystem quality. Based on pre-study results, we proposed four payment levels (500, 1,000, 2,000 and 3,000 Chilean pesos (CLP) per household per year in addition to a zero *status quo* payment (1 USD ≈ 606 CLP, February 2009).

From a full-factorial design of four attributes with four levels each, 256 (4^4) possible attribute level combinations could be obtained. We included the zero payment level only in the *status quo* card of the choice sets. Therefore, only the four other attribute levels are included in the experimental design of the non-status quo choice cards. From an orthogonal main effects design, we generated a reduced orthogonal experimental design with 16 different scenarios (=choice cards) (Hensher *et al*., 2005). The choice cards were organized into 16 choice sets using the shifting procedure (Chrzan and Orme, 2000). The choice sets were randomly assigned to four blocks of four choice sets each. Each choice set consisted of two river ecosystem improvement scenarios (A and B) and an opt-out scenario that represented the *status quo* with zero payment (scenario C). Each respondent was asked to choose one scenario from each of the four choice sets.

Attitudinal variables

For the analysis of attitudinal impacts on preferences and WTP, the results from theoretically elaborated approaches are available. More elaborate approaches tend to use formal social psychology theories for analyzing attitudes, beliefs and motivations (Greiner, 2015; Poppenborg and Koellner, 2013; Barkmann *et al*., 2008; Lam, 2006; Forsyth *et al*., 2004). Less elaborate approaches lack explicit underpinning in theory. Instead, they offer more freedom to directly investigate *prima facie* policy-relevant attitudinal impacts on preferences. This study follows the second, theoretically less elaborate approach because of its more applied research goals. However, there is a need in Chile for studies applying more formal social psychology theories for stated preferences and in other fields of the applied environmental sciences (with respect to soil conservation, see Huenchuleo *et al*., 2012).

Interaction terms of CE attributes and attitudinal variables can improve the predictive capacity of CE models and can be used to test hypotheses

about socio-economic and attitudinal influences on preferences (Barkmann *et al*., 2008). Based on previous studies (Morrison and Bennett, 2004; Birol *et al*., 2006; Álvarez-Farizo *et al*., 2007) and results from our pre-study, we analyzed the influence of two types of attitudinal variables on respondent WTP (Table 1). These included the respondent's attitudes and beliefs about river resources and pollutant effects and the respondent's attitudes towards hypothetical payment scenarios (cf. Greiner, 2015). Moreover, we incorporated items on the respondent's relationship with the river and demographic variables.

For the survey, we considered households fulfilling two conditions: (1) they were located downstream from the pulp mills on either the Mataquito or Itata rivers, and (2) they were located on the main roads adjacent to the rivers. The total number of households at the Mataquito and Itata river site was 883 and 4,001, respectively (INE, 2005). We sampled a minimum of 150 households from each site using a systematic sampling procedure (Babbie, 2008). First, the sampling ratio was calculated (Mataquito: 0.17; Itata: 0.04) to achieve a total of 300 observations. Based in the inverse of the sampling ratio, every 6th household at the Mataquito site and every 25th household at the Itata site were chosen for an interview.

Statistical analysis

From the CE data, we estimated two-level nested logit (NL) models for the Mataquito and for the Itata samples. A suitable NL model tree structure

Table 1. The socio-demographic and attitudinal variables studied.

Variable	Definition	Means comparison	
		Mataquito	Itata
Quality	River water quality is very good[1.a]	2.06	1.95
Drinking	Drinking water quality in my house is very good[1.a]	2.39	2.56
Expectation	River pollution will be worse in the next 10 years[1.a]	3.96***	4.32***
Protection	The river is well protected by our laws[1.a]	2.11	1.99
Wastewater	Wastewater into the river reduces fish quantity[1.a]	4.24	4.22
Fertilizers	Fertilizers spoil river water quality[1.a]	3.58**	3.85**
Vehicle	Adequacy of the electricity bill to collect money[1.b]	3.12	3.35
Certainty	Certainty about choices at the payment scenario[1.c]	4.04	4.06
River business	Business related with river (1: Yes, 0: No)	0.60***	0.19***
River recreation	Recreation in the river (1: Yes, 0: No)	0.21	0.29
Age	Respondent age (years)	52	51
Education	Respondent educational level[2]	2.03	2.24
Income	Monthly household income[3]	1.50	1.57
Sex	Respondent sex (1: Male, 0: Female)	0.48**	0.31**
Residence	Residence of respondents (1: rural, 0: urban)	0.87***	0.36***

[1]5-points Likert scales: (a) completely disagree = 1, disagree = 2, neither/nor = 3, agree = 4, completely agree = 5; (b) very bad = 1, bad= 2, neither/nor = 3, good = 4, very good = 5; (c) very uncertain = 1, uncertain = 2, neither/nor = 3, certain = 4, very certain = 5.
[2]5 points ordinal scale: 1 (no formal education); 2 (primary education); 3 (secondary education); 4 (technical- higher education); 5 (higher education).
[3]7 points ordinal scale: 1 (0-160,000 CLP); 2 (160,000-320,000 CLP); 7 (more than 960,000 CLP). The national monthly minimum income is approximately 160,000 CLP (January, 2009).
***significant at P≤0.001; **significant at P≤0.01; *significant at P≤0.05.

was identified (cf. Louviere *et al*., 2000), and the corresponding models were estimated with NLOGIT 4.0. The vector of utility coefficients was estimated with maximum likelihood estimation procedures (Hensher *et al*., 2005). As model statistics, we report the conservative pseudo-R^2 values in relationship to a 'constants only' model. Values between 0.24 and 0.3 correspond to R^2 values of 0.5 and 0.6 in their ordinary least squares (OLS) equivalents (Hensher *et al*., 2005).

All interaction terms were introduced into an initial model (only containing attribute terms and the alternative specific constant) one at a time. Then, all the statistically significant interactions terms (P>0.05) of these single interaction models were introduced to the initial model without interaction terms. The final 'improved', parsimonious model was generated by the stepwise exclusion of non-significant interaction terms one-by-one (Barkmann *et al*., 2008). For the NL models, we only utilized data from respondents who selected at least once a scenario a choice other than the zero payment *status quo* alternative ('payers', Mataquito 79%, n=125; Itata 90%, n=138). Preliminary analyses showed that models often displayed a significant coefficient for the alternative specific constant (ASC) with a negative sign giving rise to an unwarranted '*status quo* bias' (Meyerhoff and Liebe, 2009). In the displayed 'payers' model, the numerical value of the ASC coefficient was small and not significant. However, in calculating the aggregated scenario WTP values, all non-payers are included and represented as stating zero WTP.

The CE results can be used to calculate welfare measures, particularly for an estimation of sample WTP (Bateman *et al*., 2002). Based on the quantification of the utility coefficients of the NL models, a maximum marginal WTP (*mWTP*) for a 1-unit attribute level change can be estimated as:

$$mWTP = -\frac{\beta_X}{\beta_c} \qquad (1)$$

where:

β_x: the utility coefficient of any of the environmental attributes and,

β_c: the marginal utility of income given by the coefficient of the payment attribute.

Furthermore, the welfare change generated by an improvement in river ecosystem quality was calculated. The change from river quality level (Q^0; *status quo*) to an improved level (Q^1) was calculated as a compensating variation (*CV)* (Louviere *et al*., 2000). *CV* is the change in respondent income that is needed to adjust the *status quo* utility level (U^0) of the respondents with respect to the utility level of the improved level (U^1). In other words, the *CV* can be expressed as a respondent's maximum willingness to pay to achieve the river ecosystem improvement:

$$CV\left(Q^0 \rightarrow Q^1\right) = -\frac{1}{\beta_C} * \left[U^1 \quad U^0\right] \qquad (2)$$

To calculate the *CV*, we used an optimistic scenario with River Pollution Risk that was reduced to 15%, the number of Threatened Species was decreased to 15, and Fisheries Yield was increased by 50%. Adjusting for the respondents that never deviated from the *status quo*, 3,585 (90%) and 694 (79%) households at the Itata and Mataquito river sites, respectively, were included for the estimation of total aggregated WTP on the two project regions.

Results and discussion

On average, the respondents were 52 years old at both river sites. For the Itata respondents, 69% were women compared with only 52% at the Mataquito river site (P≤0.01). A total of 87% of the Mataquito respondents were rural compared with 36% of the Itata respondents (P≤0.001). A large percentage of the respondents did not have any formal education (Mataquito: 38%; Itata: 31%).

Of the respondent households, 62% received less than the monthly national minimum income at both river sites (~264 USD). While 60% of the Mataquito respondents indicated that their occupation (business) was related to the river, only 19% of the Itata respondents indicated the same ($P \leq 0.001$). A minority of respondents (Mataquito: 21%; Itata: 29%) had conducted recreational activities related to the river in the last two years.

The estimated models were overall significant (Table 2; $P(\chi^2)<0.0001$). All attributes were significant predictors of choice with high pseudo-R^2 values of 0.24-0.30 corresponding to R^2 values between ~0.5 and ~0.6 in their OLS model equivalents (Hensher *et al*., 2005). The attribute coefficients displayed the expected signs. The results indicated a disutility for higher river pollution risk, for higher numbers of species that are threatened, and for higher payments for river ecosystem quality improvements. Positive utility was derived for higher fishery yields. The ASC was not significant in the models. The attributes interacting with attitudinal and socio-demographic variables yielded several significant predictors of choice (see below). Judged by nested logit model results, the Threatened Species attribute had a significant relationship with most of the attitudinal and socio-demographic variables. Although this attribute represents a non-use value of river water quality, the respondents considered it important to improve the ecological status of the local rivers.

In the Mataquito model (a), the respondents that strongly believed the Mataquito river was already well protected by law were likely to be willing to pay less for a reduction in the number of threatened species (Threatened species*Protection). Our payment scenario directly proposed a more

Table 2. The valuation of river water quality improvements in central Chile.

Variable	(a) Mataquito	P-value	(b) Itata	P-value
River pollution risk	-0.094***	0.000	-0.184***	0.000
Threatened species	-0.122***	0.000	-0.155***	0.000
Fisheries yield	0 .026***	0.000	0.032***	0.000
Payment[1]	-0.058***	0.000	-0.078***	0.000
non Status Quo ASC	12.210 n.s.	0.913	-3.091 n.s.	0.338
River pollution risk * Residence	-0.041***	0.000		
Threatened species * Education			-0.061***	0.000
Threatened species * Protection	0.031**	0.007		
Threatened species * Business[2]			0.023*	0.032
Threatened species * Vehicle			-0.033**	0.009
Threatened species * Certainty			-0.020*	0.047
Fisheries yield * Fertilizers			-0.012**	0.009
Payment * Income			0.025***	0.000
Payment * Education	0.040***	0.000		
Log-likelihood	-288.27		-320.78	
P(Chi^2); DF	<0.0001; 9		<0.0001; 12	
IV non degenerated branch (nonSQ)	0.026		0.516	
Pseudo-R^2 (constants only)	0.241		0.297	
Number of respondents	125		138	

***significant at $P \leq 0.001$; **significant at $P \leq 0.01$; *significant at $P \leq 0.05$.
[1]Payment attribute in hundred Chilean pesos; n.s.: no significant coefficient.
[2]Null hypothesis on the positive effect of *Business* on WTP was rejected at 95% level of significance (two-tailed t-test).

restrictive regulation to increase supervision of the pulp mills in the study area. Therefore, respondents agreeing with current regulations had no motivation to pay for more restrictive policies for river ecosystem quality improvements. Although, only 13% of the sample held those respective beliefs, the significance of the interaction term suggests that the stated preferences meaningfully conform to the stated beliefs (internal validity). This result also highlights that most of people believe that the current river water quality regulation is weak. Therefore, the implementation of secondary water quality norms for protecting river ecosystem quality needs to be considered a priority for adequate watershed management.

On average, the Mataquito respondents from explicitly rural areas were willing to pay more for reductions in river pollution risk compared with the urban respondents (River pollution risk*Residence). In contrast, Alvarez-Farizo *et al*. (2007) indicated that respondents working in the agricultural sector were less likely to take action to improve river water quality. However, even from our rural Mataquito sample, only a minority (16%) of the respondents were farmers. Moreover, the respondents with a higher level of formal educational were more likely to choose higher payments on the choice set scenarios (Payment*Education).

In the Itata model (b), the respondents that believed fertilizers negatively affect river quality were, on average, willing to pay less for higher fishery yields (Fisheries yield*Fertilizers). The majority of the Itata respondents believed that fertilizers negatively affect river quality (88%). This counter-intuitive result can be explained by the very low percentage of respondents involved in the local fishery business (0.02%, n=3) because they do not see any direct positive impact of improving fishery yield on their welfare. Under the emerging economy situation in rural Chile, environmental knowledge on fertilizer effects does not appear to translate into a behavioral intention (willingness-to-pay) if a respective environmental improvement does not affect the material welfare of the respondents. In contrast, the respondents without strong beliefs on fertilizer effects were willing to pay more. In applied terms, this finding shows that most of the local population is prone to supporting river quality regulations if it directly benefits them. The current development of secondary water quality norms is mainly focused on measurements of physical-chemical parameters, however, more attention should be considered to river ecosystem services recognized by people.

The Itata respondents that agreed with the adequacy of our payment vehicle (electricity bill) tended to be willing to pay more for reductions in the number of threatened species, i.e., fewer species with conservation problems (Threatened species*Vehicle). A total of 55% of the respondents believed that the electricity bill was an adequate payment vehicle. This result highlights the importance of a credible payment scenario that properly elicits respondent preferences. Moreover, the respondents that were more certain about their choices were likely to express a higher WTP for reductions in the number of threatened species (Threatened species*Certainty). These two findings are in line with the finding from Greiner (2015) who found that a positive attitude towards a payment for environmental service (PES) scheme was a significant predictor of choice. In this study, we found that 85% of the respondents were certain about their choices. This result indicates that the respondents substantially understood our choice experiment. It also showed that scenario plausibility play a significant role in respondent preferences for river based ecosystem service attributes. In applied terms, this finding highlights the importance of a good understanding about water quality regulations, which facilitates the acceptance and support of a new policy.

The Itata respondents with a higher level of formal education were more likely to be willing to pay for reductions in the number of threatened species (Threatened species*Education). Similar results

were shown by Álvarez-Farizo *et al*. (2007) who indicated that respondents with a higher education were more likely to pay for an improvement in river ecosystem quality attributes in Navarra, Spain. In this regard, lack of access to formal education may represent a significant barrier to respondents taking action to improve river ecosystem quality in the study area. This issue is substantially important considering that 31% of the Itata respondents at the study site had no formal education.

The Itata respondents who related their business (occupation) with the river were more likely to be less willing to pay for reductions in the number of threatened species (Threatened species*River business). This result was contrary to our expectation. The respondents may see more restrictive river ecosystem quality polices as a restriction to carry out their business. For example, local farmers may be forced to treat river water after using it or reduce the application of fertilizers and plant protection chemicals. Nevertheless, only 19% of Itata respondents actually related their business with the river. Moreover, the Itata respondents with a higher income level were more likely to choose the higher payments on the alternative choice set scenarios (Payment*Income). A previous study showed that farmers with a higher income level express positive attitudes toward ecosystem services in a South Korean watershed (Poppenborg and Koellner, 2013). A similar influence of income interacting with the payment attribute on improved river health was found by Morrison and Bennett (2004) in New South Wales, Australia, which is expected by basic economic theory.

A higher percentage of the Mataquito respondents lived in explicitly rural areas (87%) and related their business with the river (60%) compared with only 36% and 19% of Itata respondents, respectively. In fact, nested logit models displayed a significant influence of Residence (Mataquito) and Business (Itata) on respondent WTP for attributes of river ecosystem quality. Morrison and Bennett (2004) also found that respondent preferences for river ecosystem quality are site-specific. However, when residents outside the river sites were sampled, they found that value estimates were similar.

The results of the simplified policy scenario analysis are shown in Table 3. The marginal mean WTP values per household ranged between 162-236 CLP/year by 1% reduction in River Pollution Risk, 199-210 CLP/year by 1 fewer Threatened Species, and 41-45 CLP/year by 1% of increased Fisheries Yield. We obtain a total mean WTP

Table 3. The marginal stated preferences, WTP and exemplary policy scenario calculations.

	Mataquito	Itata
Marginal WTP:		
River pollution risk (1% less)	162	236
Threatened species (1 fewer)	210	199
Fisheries yield (1% increase)	45	41
Policy scenario:		
River pollution risk (15% less)	2,431	3,538
Threatened species (15 fewer)	3,155	2,981
Fisheries yield (50% increase)	2,241	2,051
Total scenario WTP household yr^{-1}	7,828	8,571
Total aggregated scenario WTP (Mio CLP yr^{-1})	5.43 (N: 694)	30.73 (N: 3,585)

[1]USD ~ 606 CLP (February, 2009).

per household of 7,828 CLP/year and 8,571 CLP/year for the Mataquito and the Itata sites, respectively. Given the difference in the number of residents at the two sites, the estimated total aggregated WTP (compensating surplus) for the scenario differed substantially (Mataquito: 5.43 million CLP/year; Itata: 30.73 million CLP/year). Considering that 62% of the households earn less than the national minimum income (~264 USD per month), the valuation scenario probably captures a considerable share of total WTP for river ecosystem quality improvement. It may represent a significant amount, at least, for improving government supervision downstream from the pulp mills. The WTP values were also substantial if we consider that a relatively low percentage of respondents conduct recreational activities in the river ecosystem and its surroundings.

Interestingly, the influence of attitudinal and socio-economic variables was site-specific. This finding highlights the difficulties of benefit transfer for economic valuation studies (Morrison and Bennett, 2004; Hanley *et al*., 2006a). We found interesting influences of respondent attitudes and beliefs on WTP for improving the regulative and monitoring capacity of government agencies with respect to future, more stringent water quality regulations and the resulting improvements in river water quality. In particular, the CE models displayed only two significant attitudinal variables, which were also site-specific: attitudes towards the efficiency of water quality laws (Mataquito river site) and attitudes towards the negative effects of fertilizers on water quality (Itata river site). These results either indicate a genuine lack of influence, influences masked by correlated socio-demographic variables, or deficits on the part of the construction of our attitudinal and belief items. In this regard, Kumar and Kumar (2008) argued for interactions of economic sciences with disciplines such as psychology, sociology and other social sciences to make a more comprehensive valuation of ecosystem services. With respect to variable construction, there is certainly room for improvement as formal social psychology theories could be used more stringently for variable construction. The Protection Motivation Theory (Rogers and Prentice-Dunn, 1997), the Theory of Planned Behavior (Ajzen, 1991), and the Value Belief Norm Theory of environmentalism (Stern *et al*., 1999) have all been shown to influence pro-environmental action although they have not yet been used systematically in the context of river ecosystem quality in emerging economies.

The success of environmental policies for protecting river ecosystem services not only depends on economic considerations but also on attitudes and beliefs of local communities who are the primary beneficiaries. We demonstrated with a basic approach that beliefs on the efficacy of water policy and the awareness of the impact of fertilizers on river quality influence people's support of water quality regulations. Therefore, a clear description of a policy is crucial for motivating participation. It is critical to fit an environmental protection scheme to the needs of the target biodiversity, the local situation and the people's preferences (Greiner, 2015). The current development of secondary water quality regulations at the study area needs the consideration of these social psychology issues in adapting its application to local attitudes and beliefs.

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Resumen

C.A. Huenchuleo, J. Barkmann y R. Marggraf. 2016. Determinantes actitudinales de la disposición a pagar por mejoras en los ecosistemas rivereños de Chile central: un experimento de elección. Cien. Inv. Agr. **43(1):125-137.** Las preferencias por bienes sin mercados dependen no solo de los atributos del bien, sino también de las actitudes hacia el bien que está siendo valorado. La consideración de estas características puede mejorar sustancialmente la capacidad de los modelos de elección declarados para representar la heterogeneidad de preferencias. En este sentido, se analizó la influencia de las actitudes de los individuos sobre la valoración de atributos de la calidad ecosistemas rivereños, afectados por aguas residuales de la celulosa en Chile central. Se aplicó el método Experimentos de Elección para la evaluación de preferencias acerca del riesgo de contaminación del río, los efectos de la calidad del ecosistema rivereño sobre las especies amenazadas y la productividad de las pesquerías locales. El vehículo de pago fue un cargo anual adicional a la cuenta de electricidad. Los atributos ambientales y de pago fueron determinantes significativos de las elecciones ($P \leq 0{,}001$). La disposición a pagar media calculada para un escenario optimista fue 13 USD/ año por hogar. Como era esperado, las actitudes influenciaron las preferencias declaradas por los entrevistados con algunas diferencias entre las dos cuencas estudiadas. Los resultados sugieren que las variables actitudinales merecen mayor atención en el análisis de preferencias por mejoras en los recursos hídricos de economías emergentes.

Palabras clave: Actitudes, modelación de elecciones, recurso hídrico, valoración económica.

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