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Nonmarket valuation of water quality in a rural transition economy in Turkey applying an a posteriori bid design

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[1] In this paper, we investigate the economic benefits associated with public investments in wastewater treatment in one of the special protected areas along Turkey's touristic Mediterranean coast, the Köyceğiz-Dalyan watershed. The benefits, measured in terms of boatable, fishable, swimmable and drinkable water quality, are estimated using a public survey format following the contingent valuation (CV) method. The study presented here is the first of its kind in Turkey. The study's main objective is to assess public perception, understanding, and valuation of improved wastewater treatment facilities in the two largest population centers in the watershed, facing the same water pollution problems as a result of lack of appropriate wastewater treatment. We test the validity and reliability of the application of the CV methodology to this specific environmental problem in a rural transition economy and evaluate the transferability of the results within the watershed. In order to facilitate willingness to pay (WTP) value elicitation we apply a novel dichotomous choice procedure where bid design takes place a posteriori instead of a priori. The statistical efficiency of different bid vectors is evaluated in terms of the estimated welfare measures' mean square errors using Monte Carlo simulation. The robustness of bid function specification is analyzed through average WTP and standard deviation estimated using parametric and nonparametric methods.

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1. Introduction

[2] Wastewater from households, industry and agriculture exerts a significant pressure on the water environment. Wastewater is discharged into the environment, either directly or after treatment. The percentage of the population connected to wastewater collecting systems has increased significantly in most European Union Member States, especially after the introduction of the Urban Wastewater Treatment Directive (UWWTD) in 1991 (91/271/EEC). Highly industrialized countries have connection rates of 80% and higher, of which almost 100% is linked to wastewater treatment facilities [*Wieland*, 2003]. For most Candidate Countries, with typically large rural populations and independent wastewater treatment like septic tanks, this rate is much lower. In Turkey, approximately 62% of the total population is connected to the sewerage system, but less than 40% of the total population is actually served by wastewater treatment plants [*Turkey State Institute of Statistics*, 2004a]. In 2002, 210 of the 3,227 municipalities in total were served by 140 wastewater treatment plants (WWTP), of which a majority of 94 plants (67%) uses secondary treatment methods. The total treatment capacity of these 140 WWTPs is about 2.5 billion m^3/yr. In 2002, they treated approximately 1.4 billion m^3 wastewater [*Turkey State Institute of Statistics*, 2004a].

[3] The availability of public funds often is one of the main constraints in Turkey to increase investments in public wastewater treatment. In a case study carried out in a special protected area (SPA) in the tourist intensive southwest coast of Turkey, the Köyceğiz-Dalyan watershed, we investigate public perception and valuation of wastewater treatment problems. The UWWTD requires tertiary treatment of wastewater in sensitive areas like the SPA. WWTP have already been built in the area, including tertiary treatment facilities, but no public funds are available to actually operate the WWTP. Population growth, wastewater leaking from septic tanks and discharge of untreated wastewater into the Köyceğiz Lake and Dalyan Lagoon are the main pressures on the water environment in the area, threatening the natural beauty of the area, recreation and tourism and private drinking water wells. The local authorities are looking for ways to recover the operation and maintenance costs of the WWTP through wastewater fees on top of local households' water bill. In a dichotomous choice (DC) contingent valuation (CV) survey, we investigate public willingness to pay (WTP) for the operation and maintenance costs of the built WWTP and through this the sustainable protection of the region's natural resources and recreational opportunities. The study's main objective is to assess public perception, understanding and valuation of improved wastewater treatment facilities in the two largest population centers in the watershed (Dalyan and Köyceğiz) facing the same water pollution problems in order to protect the local water environment. We investigate the validity and reliabil-

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ity of the application of the CV methodology to this specific environmental problem in a rural transition economy in Turkey and evaluate the transferability of the results between the two towns in the watershed. In order to facilitate value elicitation and circumvent some of the difficulties encountered in the bid design, we apply a novel value elicitation format and test the statistical efficiency of different bid design vectors and their impact on average WTP.

[4] The remainder of this paper is organized as follows. In section 2 we present more details about the study area. In section 3 we discuss the survey design, including the structure and setup of the questionnaire and the sampling procedure. Section 4 presents the CV results. First, the parametric and nonparametric estimation procedures used to derive the WTP values are described, followed by a discussion of the outcomes of the robustness tests related to the specification and estimation of different univariate WTP bid models. Secondly, the multivariate WTP models are presented, including the evaluation of their transferability across the two population centers in the watershed. Finally, section 5 gives the conclusions.

2. Köyceğiz-Dalyan Watershed

[5] Köyceğiz and Dalyan, the two towns where the survey was conducted, are situated in the Köyceğiz-Dalyan watershed in the province Muğla on the southwest coast of Turkey (see Figure 1).

[6] The watershed consists of the Köyceğiz Lake, which is connected to the Dalyan Lagoon near the Mediterranean Sea through a 10 km long channel (also referred to as Dalyan Creek). The watershed covers an area of approximately 1200 km^2 and is bordered on the east and west side by mountains covered by forests. Köyceğiz and Dalyan are the two largest population centers in the watershed area with a total population of 7,525 and 4,850 people respectively according to the 2000 census. The total population in the watershed area is just over 43 thousand residents, of which 74% live around Köyceğiz Lake and the rest along Dalyan Creek [*Gönenç et al.*, 2002]. The area's economy is mainly based on agriculture, tourism, fishery and forestry. There are no significant industrial activities in the area. Throughout the centuries a variety of civilizations such as Hellenistic, Lycian, Persian, Egyptian, Syrian, Pergamon and Byzantine influenced the area and its built environment. The remains of theaters, Roman baths, Palaestra and ancient city walls have been maintained well and are an important tourist attraction.

[7] According to research carried out by the Hacettepe University [*Guner et al.*, 1993], some 700 species of flowering plants, ferns and conifers are found in the region. The most important plant species is the endemic oriental sweet gum tree (*Liquidambar orientalis*), which is not found anywhere else in the world. Bird species such as coot (*Fulica atra*), stork (*Ciconia ciconia*), white-breasted kingfisher (*Halcyon smyrnensis*), swallow (*Hirundo rustica*), reed warbler (*Acrocephalus scirpaceus*), gullbilled tern (*Gelochelidon nilotica*), gull (*Larus marinus*) and little egret (*Egretta garzetta*) use the area for nesting and breeding. Mediterranean maquis, reeds and marshes are the major vegetation types in the area, while the hills and mountains surrounding the watershed are forest zones. One of the most important tourist attractions in the watershed is Iztuzu or Turtle Beach. Turtle Beach is a sandbar of the Dalyan Lagoon, a national conservation area and one of the last breeding places in Europe for the protected loggerhead sea turtle (*Carretta carretta*).

[8] The Köyceğiz-Dalyan watershed was declared a SPA by the Turkish Government in 1988 because of its historical and cultural heritage and unique biodiversity. The SPA was increased to a total area of 385 km^2 in 1990 and is nowadays one of the twelve SPAs in Turkey, of which nine are located along the coast of the Mediterranean and Aegean seas [*Yüksel and Keskin*, 1993]. The SPAs are managed since 1989 by the Authority for the Protection of Special Areas (APSA). The authority's primary objective is to protect the environmental features of SPAs, eliminate environmental pressures and pollution and take the necessary measures for their sustainable protection and conservation based on their ecosystem carrying capacity.

[9] The region can be characterized as a rural transition economy. Because of a growing population, the development of tourism in the region and the absence of adequate wastewater treatment facilities, environmental pollution is increasingly becoming a problem in the watershed, resulting in the deterioration of water quality and the unique aquatic habitats. As a result, the APSA initiated in 1995 the Köyceğiz-Dalyan Environmental Protection Project and started to develop plans for the construction of municipal WWTP. The construction work, including new wastewater networks, pumping stations and WWTP in Köyceğiz and Dalyan, started in 1999 and was completed in the second half of 2002. Total costs amounted to about 22 million US dollars, of which 40% was financed by APSA as the responsible authority for the area's conservation, and 60% by a German financial cooperation as a grant within the framework of Turkish-German cooperation. There was no direct financial contribution to the project by the local municipalities or the local population except for the construction of house connections. The grant was provided under the condition that through the construction of the WWTP, EU standards would be met, such as the ones prescribed by the UWWTD requiring tertiary treatment of wastewater in sensitive areas. Because of lack of subsequent public funding to actually operate the WWTP, the Union of Municipalities considers the introduction of a new wastewater treatment fee for local residents connected to the plants over and above their existing water bill to be paid to the local municipal authorities.

3. Methodology

3.1. General Questionnaire Design

[10] The survey questionnaire was developed in a number of steps. After a first visit to the study site in November 2001, the two municipalities were informed about the research and a survey plan was developed together with the local authorities. A first version of the questionnaire was drafted and a short survey study was carried out to collect additional background information about public perceptions and opinions about the current conditions in the watershed. Interviews were conducted with representatives from business communities (hotels, restaurants and shops), local residents, government agencies (Dalyan and Köyceğiz Municipalities, Köyceğiz-Dalyan Environmental Protection Union and the APSA) as well as nongovernment organizations in the region. On the basis of these interviews, the draft questionnaire was modified

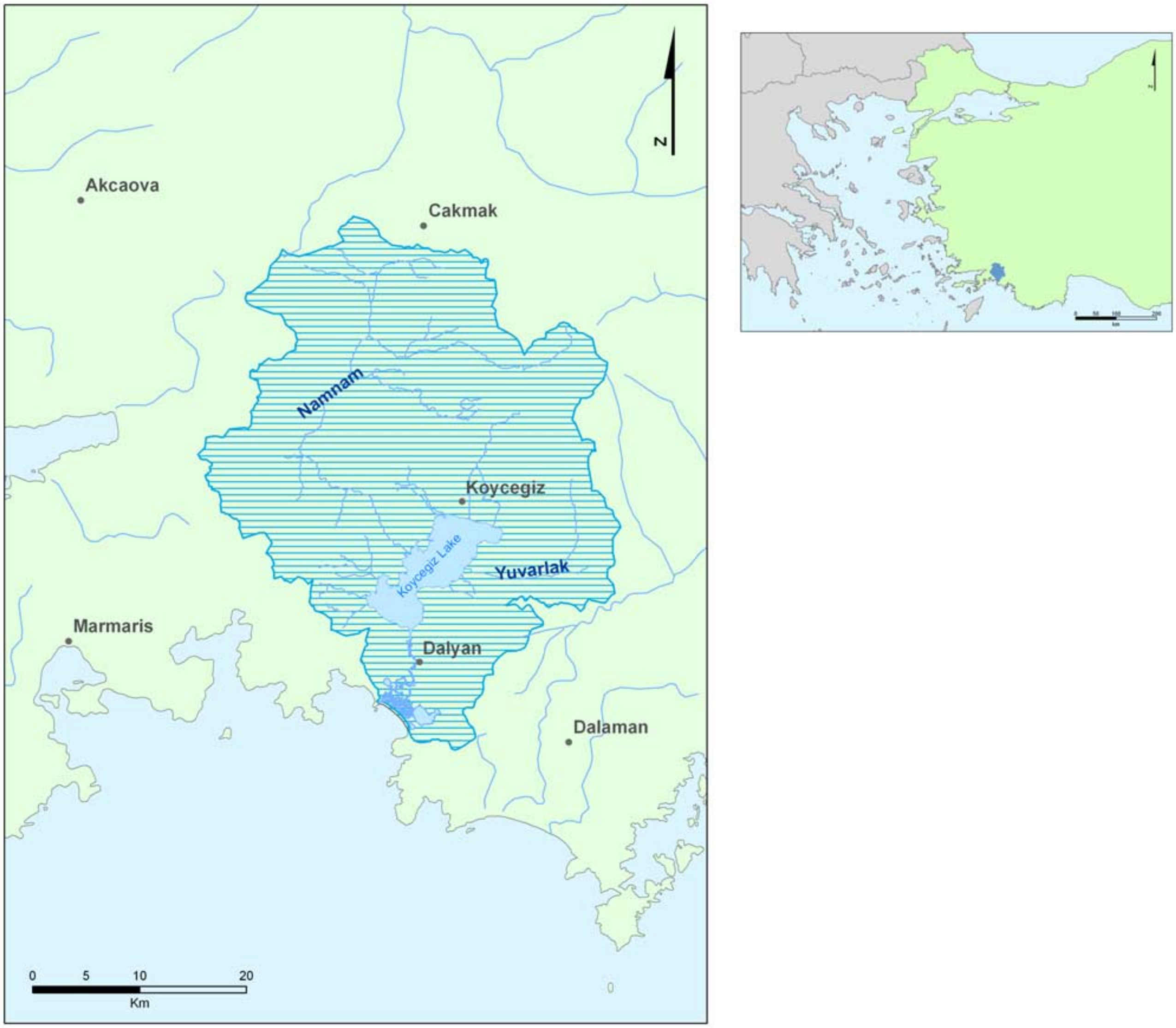

Figure 1. Location of the Köyceğiz-Dalyan watershed.

and extended to include a number of additional relevant questions, a valuation scenario and WTP questions. Also a stratified sampling strategy was designed (see section 3.3). Next, the adjusted questionnaire was pretested twice through face-to-face interviews by trained interviewers and further modified after each pretest. A more detailed description of the survey design procedure is given by *Bederli Tümay* [2005].

[11] The questionnaire consists of 37 questions in total, of which 20 are related to the problem of wastewater collection and treatment in the SPA and 17 to respondents' demographic and socioeconomic characteristics. The first five questions refer to the respondents' drinking water and wastewater collection system (whether they have a private well, whether they use well water as drinking water, whether they have a septic tank, whether they ever experience problems with their septic tank, whether they are connected to the sewerage system). The next three questions are related to respondent engagement in recreational activities in the area, followed by three questions about respondent perception of the local environment, how polluted they believe the environment is and what can be done to improve the area.

[12] After these questions, a half-page information statement is read out loud (in cases where respondents are literate, they are also allowed to read the information themselves), describing the current level of water pollution, the expected future situation if no additional measures are taken, i.e., if the constructed WWTP are not used, and the expected future situation with the operational WWTP. The presented information is inspired by the water quality ladder introduced by *Carson and Mitchell* [1993] and is reproduced in Appendix A. Respondents are asked how familiar they are with the presented information, whether they believe the presented scenario if no additional measures are taken and what would be the main benefits if the WWTP would become operational. Following these questions, the WTP questions are introduced. Respondents are first asked whether they are willing to pay in principle for the wastewater treatment services provided by the WWTP, followed by a question about their current water bill. Those respondents who answer that they are willing to pay in principle are then asked in a second DC WTP question whether they are willing to pay a specific amount of money (bid amount) over

and above their current water bill. After each WTP question respondents are asked in an open-ended question to clarify why they are or why they are not willing to pay extra.

[13] The final part of the questionnaire consists of a series of questions related to the respondents' household situation, including age, education level, occupation (including whether or not the respondent works in the recreation or tourism sector and for how long), household size, household income, whether they own or rent the house they live in, whether they own (agricultural) land or a boat and who makes the important financial decisions in the household.

3.2. Bid Vector Design

[14] The selection of appropriate bid amounts for the DC WTP question (bid vector) was a long and complex process. The selection is based upon the open-ended WTP question used in the first pretest of the questionnaire. However, eliciting an open-ended maximum WTP value appeared to be very hard if not impossible for most local residents. Bid levels were determined based on the open-ended WTP results with the help of municipality officials responsible for current water billing and the design of future wastewater collection and treatment fees. An important challenge was to come up with the appropriate range of bid amounts. In the second pretest, more than half of the residents interviewed in both towns experienced problems answering "yes" or "no" to the specific predetermined bid amounts. An important reason for this was the wide range in current water bills and therefore the lack of a realistic reference point for the proposed increase in the current water bill.

[15] We anticipated this result based on the first pretest and therefore asked respondents in the second pretest alternatively also for a percentage over and above their current water bill. This was considered by a majority of the respondents as a better understandable and more meaningful elicitation format than the presented absolute bid amount. After consulting the responsible local authorities once again about this finding, and considering the implications for the statistical analysis, it was decided that this is the most incentive-compatible way to ask respondents the WTP question. Hence, instead of asking respondents directly for their WTP a specific money amount in a DC CV format, they were instead first asked whether they are willing to pay a specific percentage over and above their current monthly water bill to operate the new built WWTP in their town. The following percentages were used in the survey: 30, 40, 50, 60, 70, 80, 90 and 100%. These percentages are based on the pretest results and the suggestions from the municipality officials consulted during the design of the questionnaire.

[16] The percentage was then converted each time by the interviewer into the corresponding money amount, and respondents were then asked once again whether they are willing to pay the specific money amount. Those respondents who are unable to state how much they currently pay every month for their water bill (8.8% of the total sample population in both towns) were informed that the average water bill is 10 million Turkish liras (TRL), which is equal to approximately 7 US dollars (since 1 January 2005 the TRL has been replaced by the New Turkish lira (TRY) where ten million TRL equals ten TRY). This novel elicitation procedure has a number of consequences for the statistical analysis of the results as we will discuss next.

[17] Multiplying the fixed percentages by each individual water bill, a continuum of bid amounts results. On the basis of the frequency distribution of this continuum of bid amounts and using an arbitrary acceptance rate of the highest bid as a truncation rule (e.g., 20%) in order to avoid possible fat tail problems [*Kriesel and Randall*, 1986], we design a posteriori instead of a priori, in what *Elnagheeb and Jordan* [1995] would refer to as an ad hoc approach, a number of alternative bid vectors (three alternative approaches exist in the literature for optimal DC bid selection based on open-ended WTP pretest results and distributional assumptions [see *Elnagheeb and Jordan*, 1995]).

[18] The optimal bid design is found through minimization of the mean square error (MSE) of the corresponding welfare measures [e.g., *Cooper*, 1993; *Alberini*, 1995]. Here, we follow exactly this procedure, assuming that the estimated WTP welfare measure (μ) is normally distributed with no a priori assumptions regarding standard deviation (σ) and using three alternative bid vectors. The following bid vectors are used: (1) bid vector 1, million TRL 1, 2, 3, 5, 10, 30; (2) bid vector 2, million TRL 1, 2, 3, 4, 5, 10, 20, 30; and (3) bid vector 3, million TRL 1, 2, 3, 4, 5, 7.5, 10, 15, 20, 30.

[19] MSE are calculated using Monte Carlo simulation based on 100 random draws. The statistical efficiency of the estimated bivariate WTP models is furthermore analyzed in terms of their standard deviation and variation coefficient.

[20] The bid amounts from each of the three alternative bid vectors are allocated across respondents based on (1) their "yes" or "no" reply and (2) the combination of the specific percentage and their water bill:

$$B_i = B_{i-1} \quad \text{if} \quad WTP = \text{``yes''} \tag{1}$$

$$B_i = B_{i+1} \quad \text{if} \quad WTP = \text{``no''} \tag{2}$$

$$B_i = B_i \quad \text{if} \quad B_i = \text{fixed bid level in million TRL irrespective of WTP} \tag{3}$$

where B_i is an ad hoc and a posteriori fixed bid level (i.e., based on an analysis of the frequency distribution of the continuum of bid amounts resulting from the product of percentages and individual water bills), B_{i-1} the lower bound bid level and B_{i+1} the higher bound bid level of the bid interval [B_{i-1}; B_{i+1}] in which Bi falls. So, for example, if a respondent says "yes" to an increase of 30% of his current water bill of for example 7 million TRL (i.e., 2.1 million TRL), then the respondent is expected to be willing to pay also the next lowest a posteriori fixed bid of for example 2 million TRL. On the other hand, if the respondent says "no" to this bid level of 2.1 million TRL, the respondent is expected to also say "no" to the next highest a posteriori fixed bid of 3 million TRL. In those cases where the product of the percentage and the current water bill exactly equals one of the a posteriori fixed bid levels, the bid level stays the same. For example, if one of the a posteriori fixed bid levels in the bid vector is 3 million TRL and a respondent currently paying 10 million TRL is asked for his WTP for an increase in his current water bill by 30%, the allocated bid amount remains 3 million TRL irrespective of the respondent's reply to the WTP question.

3.3. Statistical Models

[21] Going through the procedure outlined above, we find the WTP cumulative probability distribution functions (CPDF) for the various bid functions. Mean WTP measures for the DC responses are inferred from this statistical CPDF [*Hanemann and Kanninen*, 1999]. Different mean WTP values can be calculated depending on the statistical specification and estimation of the bid function and the applied truncation strategy. In this study, we use both parametric (logistic) and nonparametric (Turnbull) estimation methods, with the latter estimator yielding a lower bound on WTP [*Haab and McConnell*, 1997].

[22] The reduced form of the logistic probability or logit model is [e.g., *Langford and Bateman*, 1993]:

$$\Pr[y_{i=1}] = \frac{e^{\beta' x}}{1 + e^{\beta' x}} \tag{4}$$

where $\Pr[y_{i=1}]$ is the probability that a respondent says "yes" to a specific bid amount. Beta (β) is a vector of variable parameters to be estimated, while x is the corresponding vector of explanatory variables. The error terms of the logit model are logistic distributed with zero mean and standard deviation of $\pi/\sqrt{3}$. Mean WTP is found by dividing the estimated constant by the negative of the slope parameter belonging to the bid vector [*Hanemann*, 1984].

[23] An important problem when using referendum type of models is the possibility of negative WTP [e.g., *Hanemann*, 1989; *Johansson et al.*, 1989]. The distribution of WTP also has a negative tail, unless the CPDF is truncated so as to include positive bids only or bids are transformed into their logarithmic form. However, also in these cases, the problem may persist. In those cases where negative WTP is neither expected nor plausible, the nonparametric Turnbull estimator has been proposed as an alternative solution to the parametric model presented above [*Haab and McConnell*, 1997]. The Turnbull estimator is based on a grouping of binary responses in bid intervals. In order to guarantee nonnegative outcomes for WTP, the probability of WTP responses is constrained to be positive and sum to unity across bid intervals. Furthermore, a monotonically increasing CPDF is guaranteed by pooling intervals where needed. Mean WTP can be calculated as the sum of the probabilities of respondent voting behavior times the various bid levels used. An attractive feature of the approach is the use of the lower bound of each interval in order to estimate a conservative lower bound WTP [*Carson et al.*, 1994]:

$$E(WTP) = \sum_{i=1}^{m+1} P_i * B_{i-1} \tag{5}$$

where P_i is the probability of respondents voting "no" in the bid interval [B_{i-1}, B_i], B_{i-1} the lower bound bid level, and m the maximum bid. The probability of respondent voting behavior in the constructed intervals (P_i) is calculated as the difference between the proportion of respondent voting behavior across the two bid levels B_{i-1} and B_i [*Haab and McConnell*, 1997]:

$$P_i = N_i - N_{i-1} = \frac{n_i}{n_i + y_i} - \frac{n_{i-1}}{n_{i-1} + y_{i-1}} \tag{6}$$

where n_i is the number of "no" votes to bid level B_i and y_i the number of "yes" votes to bid level B_i. The lower bound estimate can be applied if the probabilities of voting behavior in constructed intervals are based on "no" responses. An upper bound can also be determined if all respondents offered the largest bid amount respond "no" and hence the upper bound takes on a finite value.

3.4. Sampling Procedure

[24] A stratified sampling strategy was developed together with officials from the two municipalities. Neighborhoods in the two towns were selected based upon city maps obtained from the Environmental Protection Union. Sites where the interviews were to take place such as public buildings, banks, schools, shops, etc. were indicated on the map. Moreover, the Municipalities of Köyceğiz and Dalyan provided lists of occupational activities in the region. This allowed us to check to what extent different occupations were underrepresented or overrepresented during the survey and adjust the sample accordingly. The stratified sampling strategy aimed to obtain a representative sample, including sufficient observations from different occupational groups in the region.

[25] Eight hundred face-to-face interviews were carried out in total in June 2002, half of which took place in Köyceğiz and half in Dalyan. Interviews lasted about 20 min on average. In total seven interviewers, five women and two men, M.Sc. and Ph.D. students at the Istanbul Technical University, were recruited and thoroughly trained. They were guided through the questions in the questionnaire and informed about the underlying reasons why specific questions were asked. Special attention was paid to the WTP questions. All interviewers were also involved in the pretest of the questionnaire and therefore considered experienced interviewers when they conducted the final survey. On average, about 15 interviews were conducted per interviewer per day. Each evening the interviewers were debriefed individually about their experiences and the interview results from that day.

[26] The overall attitude of the respondents toward the survey was positive, resulting in a high response rate of about 90% in both towns. Only a few respondents complained that the local authorities should have informed them about the survey. When approached by an interviewer, respondents were informed that the survey was part of a research project carried out by the Istanbul Technical University and that it was not carried out for a local or central government authority like the municipality, the Environmental Protection Union or the Department for the Protection of Special Areas. Respondents were furthermore informed that the results would be treated confidentially and that answers would remain anonymous in order to make respondents feel at ease and stimulate "truthful answers."

4. Results

4.1. General Respondent Characteristics

[27] The demographic and socioeconomic characteristics of the two samples are summarized in Table 1. Respondents

Table 1. Summary Statistics of Respondent Characteristics in the Two Surveys

Sample Characteristic	Dalyan	Köyceğiz
Percentage men/women	78.4/21.6	67.0/33.0
Average age	38	42
Percentage head of household	50.8	39.5
Average household income[a]	TRL 507 million/month	TRL 532 million/month
Average household size	2.2	2.4
Percentage households with children	74.3	87.9
Average number of children	1.0	1.1
Education level (median)	high school	high school
Percentage house owner	59.8	55.2
Percentage employed in tourist sector	64.6	16.6

[a]TRL 507 million = US$355, and TRL 532 million = US$372.

in the two samples (5.3 and 8.2% of the total population of Köyceğiz and Dalyan, respectively) differ significantly in terms of age, gender, education, whether or not the respondent is the head of the household, household size and whether or not the respondent works in the tourist industry. Differences were tested statistically using both the Mann-Whitney and t test. No significant differences can be detected in household income and whether or not respondents own the house they live in. The samples are representative in terms of professional occupation. Significantly more Dalyan residents work in the tourist industry. The number of farmers and agricultural laborers are more or less the same in both towns, but Dalyan has significantly more fishermen than Köyceğiz (10 and 1.5%, respectively). In both towns, about 20% of the labor force are tradesmen. In Köyceğiz relatively more inhabitants are civil servant (about 25% compared to only 5% in Dalyan) and relatively more retired people were interviewed in Köyceğiz (11%) than in Dalyan (5%).

[28] Women are underrepresented in the samples. Approximately half of the total population in the two towns consist of women, whereas in our sample only one in every fifth or third respondent is female. The age group between 41 and 50 is furthermore relatively overrepresented. Between 40 and 50% of the respondents are the head of their households. The number of household members is lower than the national average of 4.5 in rural Turkey [*Turkey State Institute of Statistics*, 2004b]. The same applies for average household income. In 2003, average disposable household income in rural Turkey was approximately US$ 460 per month [*Turkey State Institute of Statistics*, 2004b], whereas average disposable household income in our samples varies between US$355 and US$370. Accounting for inflation (about 8–10% annually during the period 2002–2004), average disposable household income in the two samples is still lower compared to the national rural average.

Table 2. Summary Statistics Current Drinking and Wastewater Situation and Water Bill

Sample Characteristic	Dalyan	Köyceğiz
Percentage with private well	47.7	36.0
Percentage using water from well for drinking	11.2	43.2
Percentage connected to sewerage system	27.3	40.4
Percentage with septic tank	74.9	88.5
Percentage experiencing problems with septic tank	31.1	29.6
Average water bill,[a] TRL million/month	12.0	8.6

[a]TRL 12.0 million = US$8.4, and TRL 8.6 million = US$6.0.

[29] Although responses to household income questions can be unreliable in survey based social research, this is nevertheless an unexpected finding given the relatively high level of education in both towns and high positive correlation between education level and household income (Spearman's rho is 0.31 ($p < 0.01$) in Dalyan and 0.54 ($p < 0.01$) in Köyceğiz.). Thirty percent of the Dalyan sample population and 25% of the Köyceğiz sample population finished primary school. About 35% of the respondents in both samples finished high school and 20% of the respondents in Dalyan and 28% of the respondents in Köyceğiz have a university degree.

4.2. Public Perception of Water Quality Problems and Benefits

[30] Almost 50% of all respondents in Dalyan have a private well, compared to just over a third in Köyceğiz (Table 2). However, substantially more Köyceğiz residents use their well water as drinking water. In Köyceğiz a larger share of the sample population is connected to the sewerage system and also more respondents have a septic tank than in Dalyan. The numbers in Table 2 do not add up to 100%, because residents can have a septic tank and be connected to the sewerage system at the same time. An equal amount of respondents experience problems with their septic tanks, for example during heavy rainfall. The average water bill is significantly higher in absolute terms in Dalyan, but not in relative terms compared to household income. The monthly water bill is, on average, 2.3% of monthly household income in Köyceğiz and 3.2% in Dalyan (Mann-Whitney $Z = -1.241$ ($p < 0.22$) in the case of the relative water bill and $Z = -3.203$ ($p < 0.01$) when looking at the absolute difference in water bills between the two towns).

[31] A majority of two thirds of the Köyceğiz sample and about half of the Dalyan sample claims that the area's natural beauty and tranquility are among its most important characteristic features. Köyceğiz Lake was mentioned as the second most important feature by Köyceğiz residents, while the second most important characteristic mentioned by Dalyan residents is the sea turtles. Water recreation by local residents is limited (Table 3). About a third of the sample population in Köyceğiz and Dalyan recreate often. Slightly more people in Dalyan than in Köyceğiz swim in the Köyceğiz Lake and Dalyan Creek.

[32] Respondent belief in the area's degree of environmental pollution differs significantly across the two samples

Table 3. Recreational Water Use

	Dalyan, %	Köyceğiz, %
Intensity of recreational activities in the area[a]		
Never	13.2	9.3
Not very often	57.4	54.9
Often	29.4	35.8
Type of recreational activity[b]		
Bathing	57.5	48.4
Fishing	39.0	20.2
Boating	40.6	31.6
Hiking	56.3	60.0

[a]Water-related recreation.
[b]Percentage of respondents who indicated to undertake the specific recreational activity.

(Mann-Whitney Z = −2.764; $p < 0.01$). More residents in Dalyan than in Köyceğiz believe that the local environment is polluted (46 and 39%, respectively), while more Köyceğiz respondents claim that the area is clean (29 versus 19% in Dalyan). No significant difference can be found between the two samples when asking respondents how familiar they are with the presented information about the actual and expected level of pollution in the area. A majority of 55–60% in both samples indicates that the described baseline situation corresponds more or less with their own belief and assessment of the current situation. Twenty percent expected the current situation to be worse and another 20% that the situation is actually better. A majority of respondents in Köyceğiz and Dalyan (about 92% in both towns) believes that the predicted deterioration of the water environment will take place if no additional measures are taken.

[33] When asked for the main benefits if the WWTP would become operational, clean drinking water from private wells is mentioned most often in both Köyceğiz and Dalyan by about a quarter of the sample population. This is followed by clean bathing water (mentioned by approximately 15% in both samples). Between 35 and 45% of the sample population considers clean drinking water and bathing water equally important.

4.3. Willingness to Pay for Wastewater Treatment and Water Quality

[34] When asked whether they are willing to pay in principle for the wastewater treatment services provided by the WWTP given the perceived benefits of improved water quality, a majority of 89% of the sample population in Dalyan and 86% in Köyceğiz agree to pay extra. The reasons of respondents who say "no" to the WTP question are thoroughly analyzed in order to distinguish legitimate zero bidders from protest bidders. Protest bidders typically object against the imposed market structure in a CV study [*Jorgensen et al.*, 1999; *Meyerhoff and Liebe*, 2006]. In this study, most protest bidders do not believe that the responsible authority will operate the plant in a proper and efficient way or do not trust that they will actually receive the wastewater services. Another part feels that wastewater treatment is a public service, which should be provided free of charge. The number of respondents protesting against the WTP question based on these considerations is relatively low and less than 10% in both samples (3.9 and 7.3% in Köyceğiz and Dalyan respectively). Although no straightforward guidelines exist regarding acceptable numbers of protest bids in CV research [*Brouwer*, 2006], these low percentages provide sufficient confidence in the validity and reliability of the study. Compared with nonprotest bidders, protest bidders appear to be slightly, but significantly younger and higher educated. Significantly more protest bidders furthermore work in and hence depend upon the

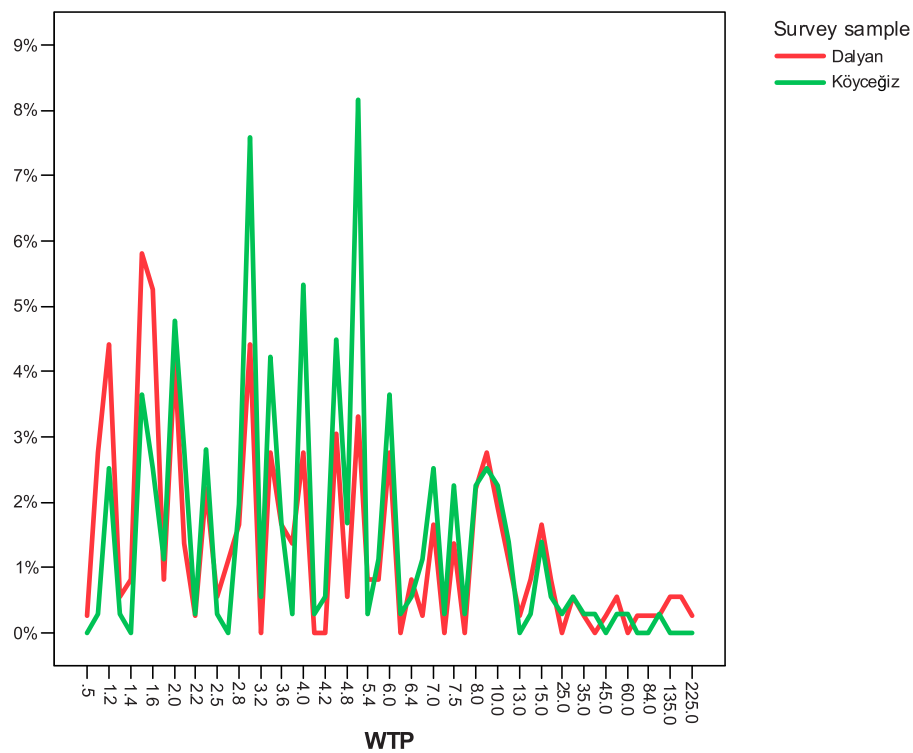

Figure 2. Distribution of stated WTP amounts in million TRL per household per month based on the proposed percentages over and above respondents' current water bill.

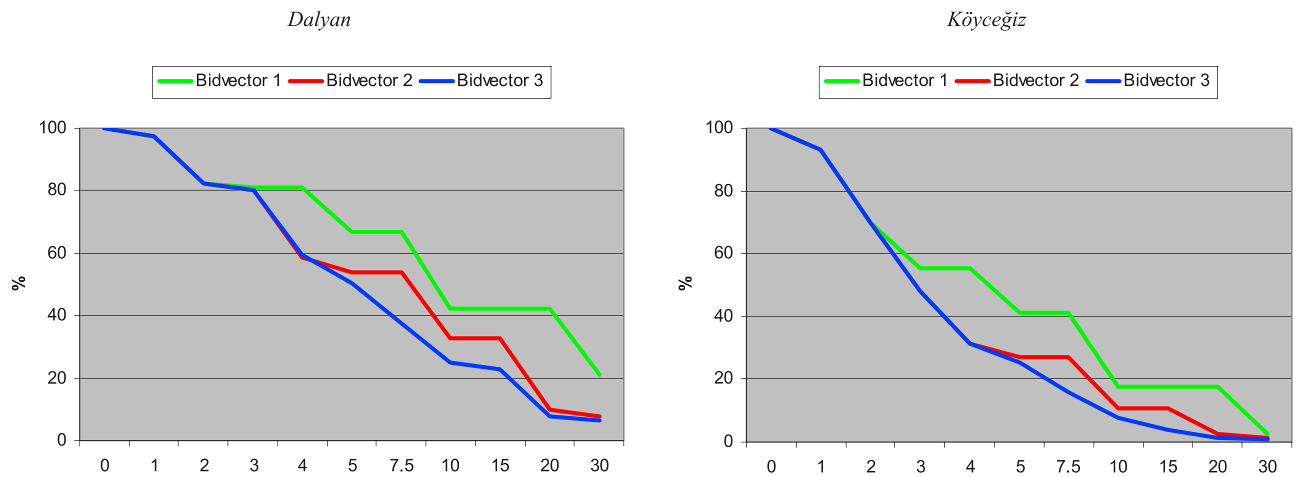

Figure 3. WTP probability distribution function for Dalyan and Köyceğiz using three alternative bid vectors (in million TRL/household/month).

tourist industry (the calculated Mann-Whitney Z statistic equals −2.286 ($p < 0.05$) for respondent age, −2.118 ($p < 0.05$) for respondent education level and −2.772 ($p < 0.01$) for whether or not respondents work in the tourist industry). No significant differences can be found between the two groups in terms of household income, ownership of private well or septic tank and connection to the sewerage system.

[35] Turning to the second WTP question, instead of asking respondents for their WTP a specific money amount in a conventional DC format, they are asked whether they are willing to pay a specific percentage over and above their current water bill. This percentage is converted into a real money amount for which they are then asked their WTP once again, resulting in a continuum of bid amounts (Figure 2).

[36] Going through the procedure outlined in section 3.2 and excluding protest bidders, we find the PDF for the three alternatively specified bid functions in Figure 3 for Köyceğiz and Dalyan. Figure 3 shows that irrespective of bid vector specification the PDF is somewhat steeper and approaches zero quicker in the case of Köyceğiz. The average acceptance rate of the highest bid of 30 million TRL is 1.5% in Köyceğiz and 11.7% in Dalyan.

[37] The logistic and Turnbull estimation results for Köyceğiz and Dalyan are presented in Table 4. Mean WTP values based on the estimated logit models are calculated following conventional procedures for binary WTP response data [*Hanemann*, 1984] and are, as expected, significantly higher than the Turnbull estimators. In the case of Köyceğiz the estimated parametric WTP value is almost four times higher than the lower bound Turnbull estimator, while the parametric WTP value is almost eight times higher in Dalyan.

[38] Compared to the current water bill, the parametric logistic results suggest that residents in Köyceğiz are willingness to pay on average a factor 1.4 extra over and above their current water bill (2.3% of their household income), while Dalyan residents are willingness to pay more than twice than what they currently pay (5.5% of their household income). These percentages are much lower in the case of the nonparametric Turnbull estimates. On the basis of these latter results, respondents in Köyceğiz are willingness to pay on

Table 4. Estimated Mean WTP Values for Dalyan and Köyceğiz Based on Two Different Estimation Procedures and Using Three Alternative Bid Functions

	Dalyan			Köyceğiz		
	Bid Vector 1	Bid Vector 2	Bid Vector 3	Bid Vector 1	Bid Vector 2	Bid Vector 3
Logistic model						
Mean WTP[a]	24.4	26.2	33.3	10.6	11.6	14.5
Standard error	6.3	7.7	12.5	3.2	3.5	5.5
Variation coefficient	25.8	29.4	37.5	30.2	30.2	37.9
Mean square error	3983	6639	15250	1169	1237	2808
N	338	338	338	363	363	363
Turnbull model						
Mean WTP[b]	3.4	3.5	4.0	3.0	3.2	3.6
Standard error	0.3	0.3	0.4	0.2	0.2	0.3
Variation coefficient	9.8	9.6	9.3	7.0	7.1	6.9
N	285	285	285	256	256	256

[a]TRL 24.4 million = US$17.1; TRL 26.2 million = US$18.3; TRL 33.3 million = US$23.3; TRL 10.6 million = US$7.4; TRL 11.6 million = US$8.1; TRL 14.5 million = US$10.2.
[b]TRL 3.4 million = US$2.4; TRL 3.5 million = US$2.5; TRL 4.0 million = US$2.8; TRL 3.0 million = US$2.1; TRL 3.2 million = US$2.3; TRL 3.6 million = US$2.5.

Table 5. Multivariate Logistic Regression Results[a]

Explanatory Factor	Value Range	Parameter Estimates Model 1	Parameter Estimates Model 2
Constant	-	−1.404 (1.187)	−0.487 (1.133)
Bid level	TRL 1−30 million (6 levels)	−0.478[b] (0.067)	−0.129[b] (0.019)
Current monthly water bill	TRL 0.4−275 million	0.294[b] (0.054)	-
Survey location	0 = Dalyan; 1 = Köyceğiz	−1.276[b] (0.261)	−1.030[b] (0.234)
Household net monthly income	TRL 90-1250 million	0.389[c](0.188)	0.367[c] (0.171)
Water recreation intensity	0 = never to 2 = very often	0.444[c] (0.198)	0.466[b] (0.180)
Belief in baseline scenario	dummy (1 = yes)	0.897[c] (0.384)	0.687[d](0.395)
Water quality perception	dummy (1 = if respondent believed water quality to be better)	-	−0.561[c] (0.255)
Head of household	dummy (1 = yes)	-	−0.376[d] (0.220)
−2 Log likelihood		448.871	532.016
χ^2		168.128 (6df; $p < 0.01$)	101.791 (7df; $p < 0.01$)
Correctly predicted	%	84.9	80.4
R^2		0.38	0.24
N		595	598

[a]Standard errors of the parameter estimates are in parentheses; df is degrees of freedom.
[b]Significance $p < 0.01$.
[c]Significance $p < 0.05$.
[d]Significance $p < 0.10$.

average a maximum of 38% extra over and above their current water bill (0.6% of household income) and in Dalyan 30% (0.7% of household income).

[39] Corresponding with our expectations based on Figure 3, the mean WTP values derived from the bivariate logistic regression are significantly higher in Dalyan than in Köyceğiz when applying the z test and controlling for possible bid vector design effects. Although differences between the Turnbull estimators are much smaller, they are nevertheless significantly higher in Dalyan than in Köyceğiz, largely due to the low dispersion of the estimated mean values (test results are available from the authors on request). Standard errors of the Turnbull WTP values are calculated based on bootstrap procedures [e.g., *Efron and Tibshirani*, 1993], and are much lower than those for the logistic probability model estimates.

[40] Comparing results across the three alternative bid vectors, the estimated welfare measures are fairly robust, suggesting that the impact of the bid design on average WTP is limited, even though the observed differences between the welfare estimates are all statistically significant when using the z test. The difference between WTP value estimates is maximum 35% in the case of the logistic WTP estimates and not higher than 20% in the case of the Turnbull estimators. In the former case of the logistic models bid vector 1, consisting of the lowest number of bid levels, produces the most conservative welfare estimate at the highest level of precision based on the estimated variation coefficient and MSE. MSE are only calculated for the logistic estimators assuming a normal distributed mean WTP value.

4.4. Factors Influencing Willingness to Pay for Wastewater Treatment and Water Quality

[41] We estimate a multivariate logistic model to identify how different variables influence stated WTP for public wastewater treatment and water quality. The model results are presented in Table 5. The data sets of the two towns are pooled into one data set to increase the total number of observations in the estimation procedure. A dummy variable is included for the place where the interview took place. If the dummy is statistically significant, this implies that the estimated WTP models are not the same for the two towns and the results are not transferable [e.g., *Downing and Ozuna*, 1996], even though the two towns are located in the same watershed. The models presented in Table 5 are the statistically best fit models, including variables which are significant at the 10% level.

[42] Two different models are presented, one including (model 1) and one excluding (model 2) the current water bill as an explanatory factor. Both models explain the probability that a respondent says "yes" to the WTP question. As expected and corresponding with previous findings in the literature [e.g., *Bateman et al.*, 2005], there is significant positive anchoring of stated WTP on the current price paid for the good in question. Given the applied elicitation procedure in this study, the current water bill and bid level are obviously highly correlated (r = 0.675; $p < 0.01$), causing multicollinearity. We also tested their interaction (excluding them as separate factors in the multivariate model), but this is statistically not significant at the 10% level. The inclusion of the former variable furthermore also influences the significance level of other explanatory factors. We therefore present two different models here, one including and one excluding water bill as an explanatory factor. As usual, possible correlations between the other explanatory variables are tested, but are negligible (r < 0.15).

[43] Both models are statistically significant, as can be seen from the chi-square statistic. The null hypothesis that all parameter estimates are zero is convincingly rejected at the 1% level. The explanatory power of both models measured through R-square is not very high, but not unusual given the range of values generally found in the literature for cross-section CV data. The overall predictive power of the models is good, ranging between 80 and 85%, implying that the estimated models are able to correctly predict a "yes" or "no" answer to the WTP question in approximately 80−85% of the cases included in the analysis. The number of observations used for the estimation of the models is lower than the original number of observations as a result of missing values for one or more of the explanatory variables.

[44] Five explanatory factors are common in both models: bid level, the place where the interview took place, household income, water recreation intensity and respondent belief in the presented baseline scenario. All the explanatory factors show the expected sign. Bid level provides an important value cue and has a negative impact on stated WTP [*Mitchell and Carson*, 1989]. The higher the bid, the lower the probability of saying "yes" to the WTP question. Table 5 presents the results for the bid vector, which yields the most conservative welfare estimate at the highest level of precision in the previous section (bid vector 1). The statistically best fit models remain the same when including the two alternative bid vectors. Only their explanatory power is slightly lower. For instance, the R-square for model 2 (excluding the current water bill) is reduced to 0.20 when including bid vector 2 and decreases further to 0.15 when including bid vector 3.

[45] As furthermore predicted by economic theory, WTP is significantly influenced by household income and use of the good in question. The lower a respondent's disposable (net) household income, the lower the probability that he answers positively to the WTP question and vice versa. In the models presented in Table 5 income is transformed into its natural log form. The more a respondent uses the water environment for recreational purposes, the higher the probability of saying "yes" to the presented bid, all other things being equal.

[46] The place of residence also significantly influences stated WTP, implying that we are dealing with two different value functions, even when accounting for possible influencing demographic and socioeconomic factors. Hence the results are not transferable between survey sites. Corresponding with the results found for mean WTP based on the univariate logistic model, the probability that Köyceğiz residents say "yes" to the WTP question is also ceteris paribus in the multivariate logistic model significantly lower than the probability that Dalyan residents do. In other words, while controlling for bid level and other explanatory factors such as household income, Dalyan residents are more likely to say "yes" to a specific bid level than Köyceğiz residents.

[47] A number of possible explanations can be put forward for this finding, such as the higher share of the Dalyan sample population that depends on the tourist industry (see Table 1), which is in turn highly dependent on good water quality. A relatively higher share of the Dalyan sample furthermore believes that the watershed is polluted and a higher share is fishermen (see section 4.1). Also here a higher value attached to improved water quality can be expected. Finally, although clean drinking water is considered the most important benefit by most residents in both towns, significantly more Dalyan residents own a private well, but less currently use their well water as drinking water (see Table 2). Improvements up to drinking water quality may therefore be more beneficial to Dalyan residents.

[48] Demographic and socioeconomic conditions such as age, gender, education level, household size, whether or not a respondent has children (and how many), whether the respondent is dependent on the tourist sector for his income (including interaction terms with place of residence) and whether the respondent owns a house do not have a significant impact on stated WTP, either in model 1 or model 2. Other factors that we tested, but which have no significant effect at $p < 0.10$ include factors such as whether or not the respondent owns a private well or a septic tank, whether respondents ever experienced problems with their septic tank, respondent perception of the level of water pollution, respondent familiarity with the information provided in the survey, specific recreational activities undertaken by respondents or benefits derived from water quality improvements (including interaction terms of all of these factors with place of residence).

[49] An interesting finding is that respondent belief in the baseline scenario, i.e., further deterioration of the water environment if no additional measures are taken, has a significant positive effect on stated WTP. This implies that respondents who believe the baseline scenario are more likely to say "yes" to the WTP question than respondents who do not believe this scenario. A similar result is found by *Powe and Bateman* [2004], who examined the effect of respondent belief in the feasibility of the presented valuation scenario on stated WTP. Their research shows that respondent belief is both a significant determinant of stated WTP and a substantial contributor to the explanatory power of their CV model. Not believing the presented valuation scenario, including the baseline scenario, may indicate that the respondent does not trust the presented information or that the respondent trusts the information, but fails to see its relevance. Uncertainty about the source and scientific foundation of the information, incomplete beliefs as a result of institutional choice [*Crocker et al.*, 1998] and the direct or indirect implications for the respondent may also have played a role here. However, the possible role of uncertainty, either in preferences [e.g., *Ready et al.*, 1995; *Alberini et al.*, 2003] or in the presented information and valuation scenario [e.g., *Poe and Bishop*, 2001] was not investigated explicitly in the survey.

[50] In model 2, we find that respondent perception of current water quality is uncorrelated with respondent belief in the presented baseline scenario and has a significant negative impact on stated WTP (here too we explicitly tested the significance of their possible interaction, but this explanatory factor fails to pass the $p < 0.10$ threshold). If a respondent, before going through the interview, thinks that the situation is better than presented during the interview, he is less likely to state a positive WTP. This seems to suggest that the impact of the presented information in this study is limited in the construction of preferences [e.g., *Payne et al.*, 1999].

[51] Finally, we find in model 2 that whether or not the respondent considers him or herself the head of the household, i.e., whether the respondent makes the relevant financial decisions on behalf of the entire household, also significantly affects stated WTP. All other things held constant, heads of household are more likely to say "no" to the WTP question than those who are not. Not only is the power structure in a household an underexposed issue in CV research, although less perhaps in developing countries, there exists very little evidence of the impact of the family and household power structure on CV results [e.g., *Bateman and Brouwer*, 2006].

5. Discussion and Conclusions

[52] In this paper, we present the results of the first CV study carried out in a rural transition economy in Turkey

related to water quality protection in one of the nine special protected areas along the country's Mediterranean and Aegean coast, the Köyceğiz-Dalyan watershed. The main objective of the CV study is to assess public perception, understanding and valuation of a region-wide wastewater treatment program to protect water quality in the watershed, transforming surface water back into fishable and swimmable quality and groundwater into drinkable quality.

[53] The survey was carried out in the two largest population centers in the watershed (Köyceğiz and Dalyan), facing the same water pollution problems as a result of lack of adequate wastewater treatment. A majority of almost 90% of the total sample population is willingness to pay extra in principle for the proposed improvements. Although not tested explicitly, some degree of yea-saying may have played a role here. As many as 67% of the Köyceğiz and 78% of the Dalyan sample furthermore agree to pay the proposed increase in their current water bill.

[54] Our study shows big differences between the outcomes of the parametric and nonparametric estimation procedures, where the nonparametric lower bound Turnbull estimates equal maximum 30% of the parametric logistic estimates. Irrespective of the underlying distributional assumptions, the estimated compensating surplus welfare measures in the two towns are not transferable, using either the simple unit transfer or the function transfer approach. In view of the fact that respondents in the two towns in the same watershed are asked to value the same good using the same valuation method, possible explanations for the observed differences have to be sought primarily in terms of population-related characteristics. However, WTP values and value functions remain nontransferable when accounting for differences in these characteristics. The estimated WTP value is significantly higher in Dalyan inter alia because of the population's higher dependency on tourism and the higher share of private wells.

[55] The internal consistency of the estimated WTP values is tested using different multivariate regression models. As predicted by economic theory, WTP is significantly determined by ability to pay and level of water use. Furthermore, what people already pay provides a significant value cue when they reply to the WTP question. Given the setup of our bid elicitation procedure, we find a high correlation between bid vector and current water bill, invalidating their joint use in the estimated multivariate WTP model. Examining the number of protest bids against the WTP question as an "external" indicator of study validity and reliability, this number appears to be very low, adding to the confidence in the validity and reliability of the estimated WTP models.

[56] The CV study is carried out following as much as possible conventional guidelines for CV research, for instance as outlined by *Arrow et al.* [1993]. A DC elicitation format is used, but in an unconventional way given the difficulties encountered during the pretest regarding the identification and selection of appropriate bid amounts in the bid vector. Lack of familiarity with the WTP question and the high variability of the current water bill led to the modification of the DC WTP question by asking respondents for their WTP in terms of a fixed percentage over and above their current household water bill and converting this into real money terms. Respondents are then asked once again if they are willingness to pay this specific money amount.

[57] This unconventional approach brings with it a number of serious concerns and difficulties. Most importantly, we are unable to estimate a value distribution function based upon a limited number of monetary bids as usually is the case when using a DC CV format. Instead we end up with a wide range of monetary values, which need to be converted into a statistical probability distribution function before any analysis can be performed and monetary WTP values derived. It is this conversion of a continuous series of bid amounts into a limited set of discrete bid levels, which may give rise to discussion in view of the fact that we do not impose any distributional assumptions during the bid vector design procedure as per *Cooper* [1993] or *Elnagheeb and Jordan* [1995].

[58] Instead, we select bid levels a posteriori and in an ad hoc way based on an assessment of the frequency distribution of "yes" and "no" responses across the wide range of calculated bid amounts, applying a 20% acceptance rate of the highest bid as a truncation rule in order to avoid any fat tail problems. This obviously introduces a degree of arbitrariness in the analysis. Previous CV research shows that the statistical specification of the bid vector and the applied truncation strategy have a significant impact on the estimation of WTP [e.g., *Langford and Bateman*, 1993]. In other words, selecting other monetary bid levels may result in different WTP values.

[59] We tested possible bid design effects explicitly in this case study based on alternative bid vectors. The steps in our statistical analysis correspond with existing procedures in the literature where the optimal bid design is found by minimizing the mean square error of the estimated welfare measures obtained through Monte Carlo simulation. We designed three alternative bid vectors and tested the statistical efficiency of the estimated bivariate WTP models in terms of their standard deviation. Our findings suggest that the results are fairly robust irrespective of bid vector design.

[60] Although not without problems as shown in this study, the use of an incentive-compatible elicitation format and the provision of appropriate value cues is an important procedural step in CV research, especially in developing and transition economies, to facilitate the value elicitation process and produce meaningful WTP replies. On the basis of previous experiences [e.g., *Green et al.*, 1998; *Bateman et al.*, 2005], we expected to find some degree of procedural anchoring bias in our WTP model given the most appropriate institutional mode of payment in our case study. Although perhaps partly invalidating our utility maximization model, we argue that the decision to use the alternative, unconventional elicitation procedure here is based on a studied trade-off between incentive compatibility on the one hand and procedural anchoring bias on the other in DC CV research.

Appendix A: Information Statement and Valuation Scenario Used in the Survey

A1. Description Baseline (Reference) Scenario

[61] I would now like to give you some information about the current and expected future state of the environment in this area. Leaking septic tanks and the discharge of untreated

wastewater into Köyceğiz Lake and Dalyan Creek affect both groundwater and surface water in this area. Pollution from leaking septic tanks affects groundwater and in time also water quality in the Lake, Creek and the connected Dalyan Lagoon. Current water quality of the Lake and the Creek makes swimming sometimes impossible because of the high level of pollution.

[62] In the future, the pressure on water quality will increase even further because of population growth. Directly or indirectly everybody in the area will be affected by this further deterioration of water quality. Well water will become undrinkable. Fishermen will suffer income losses because of loss of fish stock and fish species. Tourism and recreation will be affected because the lake and creek will become permanently nonswimmable and the bad smell and visual appearance of the water will reduce the number of visitors if they are unable to sail, walk, or picnic at or near the waterfront.

[63] If nothing is done, groundwater and surface water quality in the area will deteriorate further and the situation will become similar to the one in the Golden Horn (Haliç) in İstanbul and in the İzmir Gulf a few years ago. If no additional measures are taken, (1) surface water quality will further deteriorate and the lake and creek become permanently nonboatable and nonswimmable and fish species will disappear, and (2) groundwater quality will further deteriorate and well water will become nondrinkable.

A2. Description Valuation (Target) Scenario

[64] As you may know, a wastewater treatment plant has been built in the area to collect and treat your household wastewater. Some houses are already connected to the treatment plant, others will follow soon, so that all households are connected in the near future. Once the treatment plant is fully operational, that is all wastewater is treated before it is discharged into the environment and leaking septic tanks are removed, the environmental conditions in this area will improve significantly: (1) The fish stock and number of fish species will be as before. (2) Swimming in the lake and creek will be possible all year round. (3) Contact with water will be harmless, the bad smell will disappear and the visual appearance of the lake and creek improve, attracting local visitors and tourists. (4) Well water will be drinkable and polluted groundwater will not have a negative impact on water quality of the lake and creek.

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