The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines

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The Economic Benefits of Surface Water Quality Improvements in Developing Countries: A Case Study of Davao, Philippines

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ABSTRACT. *Two nonmarket valuation techniques—the contingent valuation method and travel cost model—are used to estimate the economic value that people in Davao, Philippines, place on improving the water quality of the rivers and sea near their community. The contingent valuation and travel cost estimates are very close to each other and are quite low, both in absolute terms and as a percentage of household income. These findings suggest that water pollution control is simply not a high priority for Davao's residents, and support the argument that households' willingness to pay for environmental amenities such as improved water quality is low.* (JEL Q25)

I. INTRODUCTION

Until quite recently, the conventional wisdom among development economists and policymakers has been that improved environmental quality is a luxury for the world's poor. It had been widely assumed that most people in developing countries do not place much value on many types of improvements in environmental quality, largely because they simply cannot afford to pay for it. Solow (1992) summarized the problem in the following way:

> The poor countries seem to have a choice between cooperating in the degradation of their own environment or acquiescing in their own poverty. At least when pollution is localized, the resolution of the dilemma appears to be a controlled tradeoff between an immediate loss of environmental amenity and a gain in future economic well-being. (Solow 1992)

The policy message for developing countries could be stated as "wait until your economy has grown more before spending much effort trying to take care of the environment."

However, over the last few years environmentalists and many members of the development community have argued for just the opposite policy: that investments in environmental quality improvements should not wait until incomes rise. The new conventional wisdom is that economic development and environmental improvement are in fact complementary, not competing, objectives. This argument, that environmental quality should not be sacrificed for economic growth, was the principal message of the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 (World Bank 1992). One important strand of this argument is that environmental resources are not properly valued in either national accounts or development project appraisals, and that if they were assigned their "true economic value," a proper accounting of many existing development strategies would show a much reduced or even negative economic rate of return (Dasgupta and Mäler 1990; Munasinghe and Lutz 1993). The policy message of this new conventional wisdom is thus "act now to protect the environment before it is too late"—just the opposite of the old conventional wisdom.

Proponents of both positions have not been overly concerned with the question of whether their policy prescriptions are supported by empirical evidence. In fact, there are relatively few careful studies of how

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much people in developing countries actually value different types of environmental goods and services, although this literature is growing rapidly (Pearce et al. 1996). The objective of this paper is to estimate the economic value that people in one urban area in a developing country (Davao, Philippines) place on improving the water quality of the rivers and sea near their community, and then to reflect upon what these estimates may mean for this broader debate about the relationship between environmental protection and development.

Two different nonmarket valuation techniques are used to estimate the economic benefits of water quality improvements in the rivers and sea near Davao: the contingent valuation method and the travel cost method. These two techniques were selected because (1) they are two of the most widely used nonmarket valuation methods, and (2) we wanted to see how the results from stated and revealed preferences approaches compared. The estimates from (1) the analyses of the responses to the contingent valuation questions and (2) the recreation patterns and travel costs of residents of Davao, are very close to each other and are quite low, both in absolute terms (about US$1.00–2.00 per month per household) and as a percentage of household income (less than 1 percent). Household income was, however, a statistically significant determinant of households' willingness to pay for water quality improvements. These findings suggest that water pollution control is simply not a high priority for residents of Davao. This lends support to the old conventional wisdom that households' willingness to pay for environmental amenities such as improved water quality is low and that investments in surface water pollution control should wait until incomes in Davao have increased. We do not contend that these results are generalizable to other environmental problems or to other locations, although we doubt that the situation in Davao with respect to water-based recreation benefits is in any important way unique. We do believe, however, that the relatively successful application of both the contingent valuation method and the travel cost method in Davao suggests that these techniques can be more widely applied in developing countries.

In the second section of the paper we present an overview of the water and sanitation situation in Davao, and briefly summarize the transition in sanitation services urban areas often experience as incomes rise in order to show where Davao is in this transition process. In the third section we describe the research design and survey instrument. The fourth section presents the results of our analysis. Finally, in the fifth section we summarize our conclusions and discuss some of the policy implications of the research.

II. DESCRIPTION OF DAVAO CITY: THE TRANSITION TO IMPROVED SANITATION

Davao, the second largest urban area in the Philippines, is located on the island of Mindanao. The urbanized portion of the city is primarily in a strip of coastal plain alongside the Gulf of Davao. The 1990 population within the official municipal boundaries was estimated to be 850,000; the population within the urbanized portion of the municipality was approximately 600,000 (about 100,000 households). Mean monthly household income in Davao was about 5100 pesos (US$204) in 1992. The average head of household had ten years of education. Most housing units in Davao are single-family, single-story buildings. About 62 percent of the urban housing units are classified as "owned by occupant"; more than 30 percent of the households in Davao are classified as squatters. The majority of the households in Davao (about 70 percent) have a private, metered water connection provided by the Davao Water District Authority. Average per capita water use is about 170 liters per day. The average water bill is about US$5 per month.

Households and communities typically go through three stages in their efforts to obtain (1) safe, hygienic conditions in their houses, (2) clean, sanitary neighborhoods, and (3) improved quality of surface waters.

Stage 1 involves the removal of excreta and wastewater from the household's living space. In the course of solving their own individual sanitation problems, households often impose costs on their neighbors by discharging untreated human wastes and wastewater from their property onto streets and other public property. This creates the setting for Stage 2: neighborhood collection of household wastewater. Collecting and removing wastewater from neighborhoods improves neighborhood public health conditions, but the quality of the surface water receiving the wastes will likely deteriorate. Stage 3 is the improvement of the quality of surface waters.

In most industrialized countries, cities built their sewer lines first and then later, when they could afford it, they built wastewater treatment plants. This staged approach improved public health conditions in cities because it removed the human waste from town. However, the rivers and lakes were often badly polluted by the discharge of untreated wastewater. In industrialized countries, the transition from Stage 2 to Stage 3 has typically taken decades; indeed, many cities in high-income countries are still not treating all their municipal wastewater to secondary standards. In this paper we focus on the economic value to households of investments that lead to surface water quality improvements (both the value of moving from Stage 1 to 3 and from Stage 2 to 3).[1]

Over the last decade, most households in Davao have completed the first stage of sanitation improvement without public sector involvement or other subsidies. Over 80 percent of households have solved their immediate excreta disposal problems by constructing flush or pour-flush toilets for their exclusive use. Most of these water-sealed toilets empty into large holding or septic tanks. Little progress has been made on the transition from Stage 1 to Stage 2. The effluent from these septic tanks (and often bath and kitchen wastewater) seeps into the ground or overflows into open street drains or neighborhood ditches and quickly reaches the Davao River and Davao Bay, where some of it washes ashore on the beaches. Less than 1 percent of the households in Davao are connected to a sewage collection system; the few small, scattered existing sewer lines service only a handful of upper income subdivisions.

The untreated discharge of household and industrial wastewater poses a threat to the development of both domestic and foreign tourism in and around Davao. Until 1992 most of the residents of Davao who used local beaches for recreation went to beaches very near the urban area, the most popular of which was Times Beach. Travel time to Times Beach is approximately fifteen minutes by bus or taxi from most parts of Davao. Literally thousands of residents of Davao would use it for picnicking and swimming on weekends. However, in early 1992 the city health department found very high levels of fecal coliforms and pathogens in the water and issued a series of warnings to the public about the health risks of swimming at Times Beach. The sea at the beach is polluted by the nearby discharge of the Davao River, which carries silt, stormwater drainage, and household and industrial wastewater from Davao.

Much was written in the local media about this problem, and warning signs were posted on the beach. As a result, most people stopped using Times Beach. As described in the next section of the paper, this situation provided us an opportunity to determine the economic losses households incurred from the loss of this recreation opportunity due to the public's realization that the water quality posed a health risk.

III. RESEARCH DESIGN

We used a two-stage stratified random sampling procedure to select 1,200 households from the general population of Davao. The overall response rate was 65 percent. About 32 percent of the households in the sample could not be located by our enumer-

[1] In another publication we examine in detail the economic benefits to residents of Davao of the transition from Stage 1 to Stage 2 (see Whittington, Lauria, and Choe 1993).

ators. Only 3 percent of the total number of households in the sample refused to be interviewed. The 777 completed interviews included three groups of households: (1) *Group 1*: households that owned their homes and had a water-sealed toilet for their exclusive use ($n = 364$); (2) *Group 2*: households that were renting their dwelling ($n = 87$); and (3) *Group 3*: all other households (e.g., households that own their home but do not have a water-sealed toilet for their exclusive use; households that own their home but do not have title to the land; households that are occupying a house with the owner's consent but do not pay rent; $n = 326$). Eighty-six percent of the households in Group 2 had a water-sealed toilet for the exclusive use of household members.[2]

In the contingent valuation section of the household questionnaire, all households in *Groups 2 and 3* and approximately half of the households in *Group 1* ($n = 168$) were asked to assume that there was a city-wide plan to clean up the rivers and sea and make Times Beach safe again for swimming and other recreational activities. They were not told specifically what this plan would entail. We refer to this as the Water Quality Improvement Plan and call it Scenario 1 (an improvement from Stage 2 to 3). Households were told that if this hypothetical plan were adopted, each household would be required to pay a monthly fee, and that industries would also do their fair share to reduce wastewater discharges to the river. Respondents were then asked to vote on whether their household would support such a plan at a specified monthly price. Five different monthly fees (25, 50, 100, 150, and 200 pesos, i.e., US$1, 2, 4, 6, and 8)[3] were randomly assigned to different sample households. After the respondent answered the first referendum question, a series of follow-up yes/no questions were asked with different prices. If the respondent answered "no" to all of the subsequent yes/no questions, he or she was asked a final, open-ended question about the maximum their household would be willing to pay for the Water Quality Improvement Plan.[4]

The remaining households in *Group 1* ($n = 196$) were asked how they would vote on a different plan that constituted an improvement from Stage 1 to 3. These households were offered a more comprehensive plan that included not only the cleanup of surface water, but also the construction of sewer lines in their neighborhood and the treatment of the wastewater collected. We refer to this as the Sewer plus Treatment Plan and call it Scenario 2. Respondents were told that this sewage collection and treatment project was part of a city-wide plan to improve the water quality of the rivers and sea and make Times Beach safe again for swimming and other recreational activities, as well as to enhance the public health conditions in residential neighborhoods. The description of this second scenario was necessarily longer and more detailed than that for Scenario 1 because the enumerator had to explain to the respondent what a sewage collection system and wastewater treatment plant were.

Households voting for Scenario 2 would thus receive the neighborhood public health benefits associated with Stage 2 improvements *and* the recreation and other benefits associated with Stage 3 surface water quality improvements. Our hypothesis was that a higher percentage of households would agree to the Sewer plus Treatment Plan (Scenario 2) at a specified monthly price than to the Water Quality Improvement Plan without sewage collection and treatment (Scenario 1). The use of this split-sample experiment provided us an opportunity to test whether respondents' answers to the willingness-to-pay questions were sensitive to the "scope" of the environmental services described (Kahneman and Knetsch 1992; Boyle et al. 1994; Carson and Mitchell

[2] The distinction among these three groups of households is important for the design of the contingent valuation scenarios because owners with water-sealed toilets for the exclusive use of their household members who have already completed Stage 1 of the sanitation transition are best able to make a reasoned decision about connecting their house to a sewer line.

[3] In November 1992, the exchange rate was US$1 = 25 pesos.

[4] The precise wording of the scenario descriptions and contingent valuation questions is reported in Whittington, Lauria, and Choe (1993).

1995). If a higher proportion of respondents in Group 1 agreed to the Sewer plus Treatment Plan at a given monthly fee than to the Water Quality Improvement Plan, this would be evidence that respondents had listened carefully to the information provided by the enumerators and had offered answers that depended on the commodity described.[5] Only the *Group 1* households (i.e., households that already had a water-sealed toilet and owned their homes) were used to test for "scope" or "embedding" effects because this was the only subsample of respondents who had completed Stage 1 improvements and could realistically be asked about both Scenario 1 and Scenario 2. Households in *Groups 2 and 3* could not be asked questions associated with Scenario 2 because they were not in a position to consider connecting their house to a sewer line.

IV. ANALYSIS AND RESULTS

The Public's Knowledge of Water Pollution Problems and Use of Times Beach

Respondents' answers to several questions in the household survey demonstrate that residents of Davao are well aware of local surface water quality problems in general and the health risks of swimming at Times Beach in particular. Residents have also made substantial changes in their behavior as a result of this knowledge and awareness. For example, we asked respondents their perception of how the water quality of the sea near Davao had changed over the last twenty years; almost 90 percent indicated that it was "much worse." Eighty percent of the sample respondents said the suitability of the sea near Davao for swimming was "much worse"; almost half of the respondents said the quality of the type and size of fish caught was "much worse."

Almost everyone in our sample indicated that they had heard about the pollution problems at Times Beach (91 percent). Almost everyone also knew that the number of people using Times Beach had declined since the public health warnings. Our survey results also confirmed that the public health warnings had a significant effect on the use of Times Beach by our sample respondents. Before the pollution warnings, 31 percent of our respondents indicated that they used to go to Times Beach; after the announcements, only 8 percent of the sample still visited Times Beach. Before the public health advisory, the 31 percent of households that used Times Beach averaged 12 visits per year. After the advisory, the average number of visits declined from 17 to 10 visits per year for those 8 percent of households that still used Times Beach.[6]

We also asked respondents who had not visited Times Beach during the previous year why they had not done so. About 40 percent indicated that Times Beach was "too dirty." About 20 percent said that they went to other beaches. The remaining 40 percent gave a variety of reasons, such as that Times Beach was too expensive or too far away, they had no time to go to the beach, or they simply were not interested in going to the beach.

Estimates of Economic Benefits Based on the Contingent Valuation Questions

Respondents' answers to the contingent valuation questions associated with Scenario 1 were used in three different ways to estimate households' willingness to pay for surface water quality improvements: (1) a simple average of respondents' answers to the last valuation question asked, (2) estimated means from the analysis of parametric distributions using respondents' answers to the referendum and first yes/no follow-up valu-

[5] The National Oceanic and Atmospheric Administration (NOAA), United States Department of Commerce, has recently proposed guidelines for conducting contingent valuation studies that are to be used in natural resources damage assessments. These guidelines suggest that two independent tests of "scope" be conducted using split-samples to test for the internal validity of the CV estimates. These tests are intended to check whether respondents' willingness to pay is sensitive to the description of the commodity offered in the CV scenario. Our test of scope in this study is consistent with the intent of NOAA's proposed rule.

[6] No one who did *not* use Times Beach before the public health advisory started using the beach after the warnings.

ation questions, and (3) estimated means from a random utility model analysis of each respondent's answer to only the first referendum question. These three approaches sequentially reduce the amount of information that we assume can be obtained from respondents' answers to the contingent valuation questions.

The first approach treats a respondent's final answer as a point estimate; in other words, we take the last price to which each respondent answered "yes," and consider these as continuous values.[7] The mean willingness to pay of households in our sample for the city-wide water quality improvement plan (Scenario 1) was 29 pesos per month (US$1.16). About 15 percent of the respondents were not willing to pay anything at all.

The second approach takes answers from the referendum and first follow-up questions in the elicitation procedure. Depending on a respondent's answers to the first two yes/no questions, the bids could be either left or right censored, or both (interval censored). Thus, we consider them as interval data. Since we do not know the true shape of the distribution of households' willingness to pay, we assumed four different distributions (exponential, Weibull, log-normal, and log-logistic functions) and used survival (i.e., hazard) analysis to estimate mean and median household willingness to pay for each (Nelson 1982). The results of the parametric estimations are summarized in Table 1. The Weibull, log-normal, and log-logistic distributions each fit the data well; the exponential distribution does not.

The estimated means and medians for the Weibull, log-normal, and log-logistic distributions are similar (i.e., close to each other), and the means are moderately higher than the simple average willingness to pay estimated using the first approach. Since there is no upper bound on these distributions, the estimated WTP values from the left-censored responses increase the estimated means for the assumed distribution. Estimated median household willingness to pay ranges from 21 to 28 pesos per month (US$0.84–1.12); mean willingness to pay ranges from 39 to 49 pesos per month (US$1.56–1.96). The estimated median values of the Weibull, log-normal, and log-logistic distributions are very close and mostly overlap within the range of 18 to 25 pesos (US$0.72–1.00). The 95 percent confidence intervals for the estimated mean values fall within the range of 37 to 45 pesos per month (US$1.48–1.56) for the Weibull, log-normal, and exponential distributions. Because the log-logistic distribution is sensitive to left-censored data, it shows higher mean values than the estimated means from the Weibull and log-normal distributions. These results show that the estimates of household willingness to pay are quite stable for these three assumed distributions

[7] If a respondent's answer to the last question in the iterative bidding sequence was "No," then the enumerator asked an open-ended question, and the respondent's answer to this open-ended question was used for the analysis.

TABLE 1
ESTIMATED SCALE, MEDIAN, AND MEAN HOUSEHOLD WILLINGNESS TO PAY FOR "WATER QUALITY IMPROVEMENT PLAN" FROM FOUR DISTRIBUTIONS (WITHOUT COVARIATES; SCENARIO 1)

Distribution	Scale	Median (pesos per month)	95% Confidence Interval (pesos per month)	Mean (pesos per month)	95% Confidence Interval (pesos per month)	Log-likelihood
Exponential	1.00	27.7	25.5–30.0	40.0	37.3–42.7	−436
Weibull	1.28	20.8	17.4–24.2	38.5	38.5–38.5	−427
Log-normal	1.12	21.9	19.1–24.6	40.9	36.5–45.3	−428
Log-logistic	0.63	22.4	19.8–25.0	48.9	—	−431

and are low, both in absolute terms and as a percentage of income.[8]

The predicted probability of respondents' supporting the Water Quality Improvement Plan (Scenario 1) from the Weibull and log-normal distributions suggest that at a price of 25 pesos per month (US$1), approximately one-half of the sample households would support the plan. At a price of 50 pesos per month, 25 percent would vote for the Water Quality Improvement Plan.

The third approach uses the answers from the initial referendum question only, in which answers were either "yes" or "no" to the suggested price. Table 2 presents a tabulation of the percentages of respondents who agreed to support the two plans (both Scenarios 1 and 2) when different initial referendum prices were offered. As shown, for all groups of households, as the price increased, the percentage of respondents supporting the two plans generally decreased. Almost no one who was offered a plan for 200 pesos per month voted for it.

To model the determinants of these responses to the initial referendum question, an individual is assumed to compare his or her current utility level to the utility level that would be obtained after receiving the water quality improvements described in the citywide plan (Scenario 1) and paying the specified monthly price. A probit model was used to explain these initial votes for and against the plan. Descriptions of the independent variables used in the multivariate analyses are reported in Table 3. Table 4 summarizes the results of the multivariate analyses from all three modeling approaches (i.e., OLS, probit, and hazard models). A hazard model is presented for only one assumed Weibull error distribution because the results for other distribution assumptions are similar.

The probit model results in Table 4 clearly show that the higher the monthly price offered to respondents, the less likely they were to vote for the Water Quality Improvement Plan.[9] The results from all three modeling approaches consistently

[8] Such parametric methods unrealistically assume that observations are homogeneous in the probability distribution over survival times. In order to take account of the effects of individual and household characteristics, the mean values from the Weibull distribution function were reestimated by taking the average value of the estimated mean of each household in the sample. The resulting mean value is about 40 pesos per month, relatively close to the estimates without covariates.

[9] The price variable in hazard models must be interpreted carefully. Here the magnitude of the estimated coefficient indicates the relative effect of the price variable on the probability of "exiting" the elicitation process.

TABLE 2

PERCENTAGE OF RESPONDENTS WHO GAVE POSITIVE ANSWERS TO REFERENDUM QUESTIONS (DAVAO)

	Sewer and Wastewater Treatment (Scenario 2)	Water Quality Improvements and Beach Clean-up (Scenario 1)			
Referendum Prices (pesos per month)	Households with Water-Sealed Toilets for Their Exclusive Use (%)[a]	Households with Water-Sealed Toilets for Their Exclusive Use (%)	Households Renting Their Dwelling Unit (%)	Other Households (e.g., squatters) (%)	Total (%)
25	63	53	53	41	46
50	32	42	50	21	31
100	16	10	11	16	13
150	25	15	0	4	7
200	14	9	0	0	3

Note: US$1 = 25 pesos.

[a] The percentages refer to the proportion of the respondents *in each cell* that agreed to pay the referendum price, and thus the columns do not sum to 100 percent.

TABLE 3
DESCRIPTION OF VARIABLES USED IN THE MUTLIVARIATE ANALYSIS OF CV RESPONSES (DAVAO)

Variable Name	Description	Mean & Standard Deviations of Variables
Dependent Variables		
LOWBID, UPBID,	Defining the lower and upper bound of willingness to pay responses from the bidding game (for Hazard model)	—
VOTE	Yes and no responses taken from the first referendum question: 1 = respondent is willing to pay monthly price for specified service; 0 = respondent is not willing to pay referendum price for specified service (for Probit model)	0.21 (0.41)
Independent Variables		
INITIAL PRICE	Starting value of the elicitation procedure; 25, 50, 100, 150, and 200 pesos	100.4 (63.51)
FEMALE	1 = if gender of respondent is female; 0 = otherwise	0.56 (0.50)
INCOME	Total monthly income for all wage earners of a household (000s pesos/month)	4.56 (3.58)
EDUCATION	Years of education of respondent	9.47 (3.49)
RENTERS	1 = if respondent is a renter; 0 = otherwise	0.20 (0.40)
SQUATTER	1 = if respondent is in squatter; 0 = otherwise	0.49 (0.50)
FLOOD	1 = if house is located in flood zone; 0 = otherwise	0.33 (0.47)
URBAN	1 = if respondent lives in *poblacion* (i.e., city center); 0 = otherwise	0.30 (0.46)
COAST	1 = if respondent lives in a barangay that is adjacent to the coast; 0 = otherwise	0.47 (0.50)
KNOWLEDGE	1 = if respondent is somewhat (or very) familiar with sewer system; 0 = otherwise	0.07 (0.25)
QUALITY	1 = if respondent believes water quality of sea over last 20 years has gotten worse (or much worse) and is also very concerned about contaminated fish; 0 = otherwise	0.07 (0.25)
WORRY	1 = if respondent is somewhat or very worried about the pollution problem at Times Beach; 0 = otherwise	0.89 (0.32)
USE	1 = if respondent has used Times Beach; 0 = if respondent has not used Times Beach at all	0.31 (0.46)
NEWS	Difference between the number of visits the household made per month to Times Beach before and after the public health advisory	0.30 (0.86)

show that four independent variables are positively related to, and statistically significant determinants of, household responses to the referendum questions: (1) household income, (2) the respondent's education, (3) whether the household lives in a flood zone, and (4) whether the household used Times Beach before the public health advisory. The higher the household's income and the higher the education level of the respondent, the more likely the respondent was to support the Water Quality Improvement Plan. The marginal effect of a 1000-peso increase in monthly income on the probability of accepting the suggested price is, however, small (0.02). The marginal effect of a year increase in education on a respondent's accepting the suggested price is about 0.14.

Households that lived in a flood zone and households that used Times Beach before the public health advisory were also found to be more likely to support the Water

TABLE 4
MULTIVARIATE MODELS OF THE DETERMINANTS OF HOUSEHOLDS' WILLINGNESS TO PAY FOR WATER QUALITY IMPROVEMENT AND TIMES BEACH CLEANUP BASED ON RESPONSES TO CONTINGENT VALUATION QUESTIONS (DAVAO)

	Probit	Hazard; Weibull	OLS
Dependent Variable	*VOTE*	*LOW/UP*	*FINALBID*
Independent Variable			
INTERCEPT	−1.017	2.314	−13.554*
	(−2.823)	(44.631)	(−1.770)
INITIAL PRICE	−0.012*	−0.002+	0.021
	(−8.598)	(1.689)	(0.911)
FEMALE	0.065	0.018	0.220
	(0.470)	(0.020)	(0.072)
INCOME	0.067*	0.055*	2.304*
	(3.382)	(7.477)	(4.980)
EDUCATION	0.064*	0.073*	1.757*
	(2.952)	(13.705)	(3.792)
RENTERS	−0.218	−0.245	−1.270
	(−1.043)	(1.592)	(−0.280)
SQUATTER	−0.098	0.029	1.028
	(−0.590)	(0.037)	(0.278)
FLOOD	0.218+	0.296*	8.963*
	(1.479)	(4.674)	(2.757)
URBAN	0.005	0.081	7.271#
	(0.036)	(0.319)	(2.077)
COAST	−0.080	−0.046	1.581
	(−0.544)	(0.119)	(0.489)
KNOWLEDGE	−0.207	0.074	0.070
	(−0.735)	(0.091)	(0.011)
QUALITY	0.255	0.275	−0.204
	(0.925)	(1.216)	(−0.034)
WORRY	0.180	0.189	5.717
	(0.795)	(0.807)	(1.212)
USE	0.280+	0.253+	6.000+
	(1.658)	(2.676)	(1.683)
NEWS	0.001	0.047	1.451
	(0.017)	(0.345)	(0.706)
SCALE	—	1.211	
log(*L*)	−222.49	−393.12	
X^2	135.78	—	—
N	563	563	563
% of Correct Predictions, Total	82.9	—	—
% of Correct Predictions, Yes Only	30		
(pseudo) *R*-squared value	0.234		0.14

Note: The numbers in parentheses below the estimated coefficients are the ratio of these coefficients to the estimates of their asymptotic standard errors. Probit model shows *t*-statistics and Hazard models show Chi-square statistics.

* indicates null hypothesis of $b = 0$ is rejected at 1 percent of one-tailed significance level.

\# indicates null hypothesis of $b = 0$ is rejected at 5 percent of one-tailed significance level.

\+ indicates null hypothesis of $b = 0$ is rejected at 10 percent of one-tailed significance level.

Quality Improvement Plan. If these variables were exogenously determined, these results would be consistent with prior expectations. However, it is reasonable to question whether these variables (*FLOOD* and *USE*) might, in fact, be endogenous.[10] In fact, we consider it unlikely that households moving to Davao conduct the kind of systematic housing search that economists often hypothesize for people in industrialized countries. Household location decisions in a city in a developing country such as Davao would often be largely determined by the location of other family members or friends from their village. We doubt whether preferences for water-based recreational activities were a significant determinant of housing choices for the majority of respondents in our sample. However, to test whether the inclusion of these variables (*FLOOD* and *USE*) biased our estimates, we reestimated the models without them. The estimated coefficients and standard errors for the other independent variables were essentially unchanged.

We carried out a separate set of multivariate analyses to test whether the subsample of households that owned their home and had a water-sealed toilet for their exclusive use ($n = 364$) responded differently to the valuation questions if they received Scenario 1 or Scenario 2 (i.e., whether they were voting for the Water Quality Improvement Plan or the Sewer plus Treatment Plan). These results are presented in Table 5. All the variables are defined as before except that one new dummy variable is used to denote whether a respondent received Scenario 2 or Scenario 1.[11]

This split-sample experiment designed to test for "scope" or "embedding" effects provides some evidence that respondents' answers were sensitive to variations in the commodity described in the direction hypothesized. The coefficient for the dummy variable indicating which scenario a respondent received is positive in all three models, and statistically significant in the hazard and OLS models at the 10 percent and 1 percent levels, respectively. The results of the OLS model indicate that a typical household that received Scenario 2 was willing to pay about fourteen pesos a month *higher* than a similar household that received Scenario 1.

However, the dummy variable indicating which scenario a respondent received was not statistically significant in the probit model (which used only respondents' answers to the first yes/no question). One possible explanation of this result is that a single referendum question simply provides less information on a respondent's values than a double-bounded dichotomous choice elicitation format, and thus the probit model cannot as readily discriminate between respondents who received the two scenarios (Hanemann, Loomis, and Kanninen 1991). Another possibility is that the schedule of prices was not appropriate for this scope test. There is only a minimal decline in the proportion of "yes" votes as the price increases from 100 pesos per month to 200 pesos per month (Table 2).

The estimated coefficients of the statistically significant variables in the probit model presented in Table 5 were used to calculate the Hicksian welfare benefits from the implementation of the Water Quality Improvement Plan (Scenario 1):

$$\text{Prob(yes)} = a - b^*\mathit{INITIAL\ PRICE} + c^*\mathit{INCOME} + d^*\mathit{EDUCATION} + e^*\mathit{FLOOD} + f^*\mathit{USE} + \varepsilon. \quad [1]$$

The general expression for recovering the Hicksian welfare benefits from [1] is:

$$E[\mathit{WTP}] = (a + c^*\mathit{INCOME} + d^*\mathit{EDUCATION} + e^*\mathit{FLOOD} + f^*\mathit{USE})/b. \quad [2]$$

[10] For example, people may self-select to live in the flood zone. If people who choose to live in the flood zone are relatively unconcerned about the dangers of poor surface water quality, then they may be unwilling to pay very much to improve water quality. People who value improved surface water quality highly may choose to live outside the flood zone, but still be willing to pay a great deal for water quality improvements. This would bias the coefficient on the variable *FLOOD* downward.

[11] This dummy variable (Scenario 2) takes the value of one if the respondent received Scenario 2, and zero if the respondent received Scenario 1.

TABLE 5
MULTIVARIATE MODELS TESTING THE SIGNIFICANCE OF THE SCOPE OF CV SCENARIOS USING SUBSAMPLE OF OWNERS WITH WATER-SEALED TOILETS FOR THEIR EXCLUSIVE USE (DAVAO)

	Probit	Hazard; Weibull	OLS
Dependent Variable	*VOTE*	*LOW/UP*	*FINALBID*
Independent Variable			
INTERCEPT	−1.174*	2.279*	−25.062#
	(−2.800)	(45.392)	(−2.104)
INITIAL PRICE	−0.009*	0.002#	0.134*
	(−6.562)	(5.025)	(3.569)
FEMALE	−0.193	−0.039	−5.730
	(−1.194)	(0.096)	(−1.175)
INCOME	0.068*	0.061*	2.564*
	(3.347)	(13.210)	(4.406)
EDUCATION	0.045	0.030	1.414+
	(1.604)	(2.085)	(1.760)
FLOOD	−0.308	−0.050	5.653
	(−1.517)	(0.115)	(0.951)
URBAN	0.112	0.037	−0.583
	(0.564)	(0.057)	(−0.098)
COAST	0.203	0.176	6.697
	(1.192)	(1.828)	(1.325)
KNOWLEDGE	−0.094	0.032	2.387
	(−0.459)	(0.041)	(0.377)
QUALITY	−0.030	0.056	−0.385
	(−0.108)	(0.064)	(−0.044)
WORRY	0.528#	0.528*	11.713+
	(2.046)	(6.971)	(1.651)
USE	0.141	0.284+	11.572#
	(0.739)	(3.723)	(1.962)
NEWS	0.066	0.032	−3.526
	(0.564)	(0.146)	(−0.971)
SCENARIO2	0.112	0.232+	14.059*
	(0.703)	(3.602)	(2.952)
SCALE	—	0.946	—
(pseudo) R-square	0.19	—	0.19
F-value	—	—	6.172
log (L)	−169.48	−298.83	—
X^2	80.28	—	—
N	348	348	348

Note: The numbers in parentheses below the estimated coefficients are the ratio of these coefficients to the estimates of their asymptotic standard errors. Probit model shows t-statistics and Hazard models show Chi-square statistics.
* indicates null hypothesis of $b = 0$ is rejected at 1 percent of one-tailed significance level.
# indicates null hypothesis of $b = 0$ is rejected at 5 percent of one-tailed significance level.
+ indicates null hypothesis of $b = 0$ is rejected at 10 percent of one-tailed significance level.

The economic benefit of Scenario 1 was calculated for each household in the sample, and these values were averaged to determine a mean household willingness to pay of 27 pesos per month (US$1.08). Households that used Times Beach before the public health advisory were willing to pay about 40 pesos per month (US$1.60); nonusers were only willing to pay about half as much (20 pesos per month; US$0.80).

Estimates of Economic Benefits Based on the Travel Cost Method

A simple, single-site travel cost model was estimated to measure the difference in the economic benefits recreational users obtained from activities before and after the public health advisory regarding pollution at Times Beach.[12] We specified the household's demand for visits to the site (Times Beach) as an additive function of travel cost, household income, preferences, the availability of substitute sites, and the water quality at Times Beach:

$$V_i = V(p_i, q, y_i, h_i, s_{ij}) + \varepsilon_i \qquad [3]$$

where

V_i = number of annual visits to Time Beach by household i;
p_i = round-trip travel costs of household i (including the opportunity cost of travel time) to Times Beach;
q = a dummy variable associated with the perceived water quality at Times Beach before ($q = 0$) and after ($q = 1$) the public health advisory;
y_i = annual income of household i;
h_i = preferences and tastes of household i (represented by household socioeconomic characteristics);
s_{ij} = round-trip travel costs of household i (including the opportunity cost of travel time) to substitute site j;
ε_i = random error term.

We included both round-trip transportation costs for a household to a site and the opportunity cost of travel time in the calculation of a household's travel costs (i.e., p and s). The opportunity cost of travel time was assumed to be equal to one-half the household's hourly wage rate.[13] The distance from each barangay (the smallest administrative unit) to Times Beach was measured from a topographic map and assigned to each sample household in that barangay. Similarly, we estimated travel times and costs to other beach recreation sites near Davao (most of the alternative sites were a couple of hours away from Times Beach). We assumed that all of the trips to these substitute sites were one-day excursions.

The estimation of the visitation function in equation [3] is often difficult, because there is typically little variation in the water quality variable q. In this study, however, we can relate changes in observable behavior (in terms of visitation to Times Beach) to water quality perceptions before and after the public health advisory. Because we have self-reported visitation rates before (V_i^o) and after the advisory (V_i^*), we can estimate the visitation rate equations separately for the two situations. Thus, equation [3] becomes

$$V_i^o, \quad \text{if } q = 0$$

$$V_i^*, \quad \text{if } q = 1.$$

We can thus drop the quality variable q from the set of independent variables. The welfare loss W of the ith household due to the pollution at Times Beach is:

$$W = \int_{\bar{p}}^{\tilde{p}} [V^o(p, y, h, s) - V^*(p, y, h, s)]\, dp \qquad [4]$$

where $\tilde{p}$ is the choke price (in this case, the travel cost predicted to result in zero visits), and $\bar{p}$ is the actual travel cost of each household in the sample. Since two-thirds of the recreational users stopped using Times Beach after the public health advisory, we used a tobit model to estimate the visitation rate equation.

[12] Households in Davao changed their recreation use of Times Beach as a result of the public health advisory. The travel cost model presented in this section of the paper estimates the welfare loss associated with these behavioral changes. However, the changes in water quality that have occurred at Times Beach over the last couple of decades are obviously not the result of the public health advisory per se. Rather, the public health advisory changed people's perception of the risks associated with using the degraded water resource.

[13] The assumed hourly wage rate is based on the income of all the wage earners in the household. If the income variable is excluded from the models, the estimated coefficients and standard errors of the travel cost variable remain essentially unchanged. The R-squared value decreases by approximately 50 percent.

In order to take account of the potential measurement errors in the data,[14] the expected value of $V(\cdot)$ for the tobit estimation is estimated by the following function:[15]

$$E[V_i \mid x_i] = \Phi\left(\frac{\beta' x_i}{\sigma}\right)\left(\beta' x_i + \sigma\frac{\Phi(\beta' x_i/\sigma)}{\Phi(\beta' x_i/\sigma)}\right) \quad [5]$$

where x is the vector of the explanatory variables in equation [3], β is the vector of the estimated coefficients of the model, and σ is the standard deviation of the error term in the tobit model.

Table 6 reports the results from the estimation of the tobit models for visitation rates to Times Beach before and after the public health advisory. The results of ordinary least squares (OLS) models are also reported for purposes of comparison. The model results are consistent with both economic theory and common sense. Household income is positively related to the quantity of visits to Times Beach and is statistically significant in all of the models. Before the public health advisory, for the typical household, a 50 percent increase in income would result in a 8 percent increase in visits to Times Beach (from 13 visits to 14 visits per year). These results indicate that higher income groups suffer proportionately greater welfare losses as a result of the deterioration in water quality.

In both the tobit and OLS models for visitation rates before the public health advisory, the estimated coefficients of the household's own travel costs to Times Beach are negative as hypothesized and statistically significant at the 1 percent level. For the typical household, a 50 percent increase in travel costs would result in a 10 percent decrease in the visitation rate. The models of visitation rates after the public health advisory also indicate that the household's travel costs are a negative and statistically significant determinate of the number of visits to Times Beach. In all four visitation rate equations presented in Table 6, the estimated coefficients for travel costs to substitute sites are positive, as expected, which implies substitutability between recreational sites.

The overall explanatory power of all the models is low; however, the F-values suggest that the overall models are significant at the 5 percent level. Two factors may account for the low explanatory power of these travel cost models. First, our models use data from individual households rather than household averages for zones of different distances from Times Beach (as is done in the standard zonal travel cost model). Second, the distance to Times Beach is relatively short for all households in the sample, and there is thus not much variation in travel distance (all of the sample households can reach the beach within thirty minutes).

The consumer surplus (CS) was calculated for each household in the sample using the following equation:

$$CS = \int_{\bar{p}}^{\tilde{p}} V(\cdot)\, dp = \left.\frac{\{E[V \mid x]\}^2}{2\beta_p}\right|_{\bar{p}}^{\tilde{p}} \quad [6]$$

where β_p in equation [6] indicates the estimated coefficient for the travel cost variable from equation [5]. The estimated mean monthly consumer's surplus of the households that went to Times Beach before the public health advisory was 22 pesos (US$0.88); after the advisory, the estimated consumer surplus was 12 pesos (US$0.48). Thus, the average welfare benefit lost due to the pollution in Times Beach was about 10 pesos a month (US$0.40).

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[14] Such measurement errors might arise, for example, from respondents' inability to remember precisely how many times their households went to Times Beach before the public health advisory.

[15] Kling (1992) has shown that the difference between the Hicksian (from CVM) and Marshallian (from TCM) welfare measures depends in part on how a researcher treats the error terms in estimating consumers surplus. For this case, we believe that it is reasonable to assume that errors arise from respondents' inability to recall precisely how many times their household went to the beach and data aggregation errors. Households' visitation rates to Times Beach were originally recorded as categorical data (i.e., once a month or once a week). These data were then converted to an estimate of visits per year per household.

TABLE 6
RESULTS OF THE ESTIMATION OF THE TRAVEL COST MODELS (DAVAO)

Variable Descriptions	Mean (S.D.)	Before the Public Health Advisory: OLS Model I	Before the Public Health Advisory: Tobit Model II	After the Public Health Advisory: OLS Model III	After the Public Health Advisory: Tobit Model IV
Dependent Variable					
No. of visits made to Times Beach each year by an individual household before the public health advisory	5.83 (11.54)	—	—	(n/a)	(n/a)
Avg. no. of visits made to Times Beach a year by an individual household after the public health advisory	1.22 (5.98)	(n/a)	(n/a)	—	—
Independent Variable					
Intercept	—	9.762 (3.37)***	1.817 (0.35)	4.892 (3.23)***	−9.982 (−1.09)
Annual household income in 1000 pesos	62.14 (50.44)	0.026 (1.96)**	0.049 (2.15)**	0.019 (2.86)***	0.081 (2.21)**
Head of household's education level (years)	9.95 (3.38)	−0.163 (−0.93)	−0.150 (−0.47)	−0.276 (−2.92)***	−0.805 (−1.43)
Respondent's age (years)	42.16 (11.82)	−0.027 (−0.58)	−0.024 (−0.30)	−0.029 (−1.19)	−0.247 (−1.63)
Dummy identifying the location of households: 1 if located in *poblacion*, 0 otherwise	0.26 (0.44)	−0.044 (−0.03)	−0.177 (−0.08)	−0.579 (−0.90)	−4.790 (−1.17)
Total travel cost to Times Beach by the household (pesos per visit)	50.09 (27.08)	−0.104 (−4.11)***	−0.201 (−4.33)***	−0.029 (−2.23)**	−0.144 (−1.79)**
Total travel cost to a substitute site by the household (pesos per visit)	94.46 (86.92)	0.019 (2.92)**	0.048 (4.19)***	0.005 (1.57)	0.047 (2.50)**
No. of observations	447	447	447	447	447
R-squared	—	0.06	—	0.04	—
F-value	—	5.434	—	3.247	—
Log-likelihood	—	—	−1,113.4	—	−359.61
σ	—	—	17.77	—	21.95

Note: The values in parentheses under each coefficient estimate are t-ratios. The symbols ***, **, and * indicate the significance level at 1, 5, and 10 percent, respectively, for a two-tailed test.

A Comparison of the Estimates of Economic Benefits from the CV and Travel Cost Methods

Table 7 summarizes the estimates of mean household willingness to pay for water quality improvements from both the contingent valuation (Scenario 1 only) and travel cost methods. Mean values are reported for both users and nonusers of Times Beach. The estimates of household willingness to pay obtained from the analyses of the contingent valuation and travel cost data appear quite close. For example, our estimates of the willingness to pay of households that use Times Beach from the probit and hazard models were 30 pesos (US$1.20) and 51 pesos (US$2.04), respectively. Our estimate of the loss of consumer surplus of households that use Times Beach from the travel cost model was 51 and 36 pesos from tobit and OLS models, respectively (US$2.04; US$1.44). These results from two different nonmarket valuation techniques increase our confidence that the general magnitude of our estimates of household willingness to pay for water quality improvements in Davao is correct.

Such comparisons must, however, be interpreted carefully, because the estimates of willingness to pay from the two valuation approaches are not measuring precisely the

TABLE 7
ESTIMATED MEAN WILLINGNESS TO PAY FOR WATER QUALITY IMPROVEMENT FROM CONTINGENT VALUATION AND TRAVEL COST METHODS FOR USERS AND NONUSERS (PESOS PER MONTH)

	WTP from the Users of Times Beach	WTP from the Nonusers of Times Beach	WTP from Both Users and Nonusers of Times Beach
1. Final bids taken as continuous variable			
Mean	37 pesos	26 pesos	29 pesos
Std. Dev.	41	35	37
Median	25	15	20
N	174	389	563
t-stat. (*Ho*: $\mu = 0$)	11.90	14.65	18.59
2. Estimates from Probit models			
(a) All respondents			
Mean	30 pesos	1 peso	10 pesos
Std. Dev.	36	31	35
Median	21	−8	2
N	174	389	563
t-stat. (*Ho*: $\mu = 0$)	10.99	0.64*	6.78
(b) Respondents who voted for Water Quality Improvement Plan (Scenario 1)			
Mean	40 pesos	20 pesos	27 pesos
Std. Dev.	40	39	40
Median	28	7	18
N	43	76	119
t-stat. (*Ho*: $\mu = 0$)	6.56	4.47	7.36
3. Estimates from Hazard model: Weibull distribution			
Mean	51 pesos	35 pesos	40 pesos
Std. Dev.	30	16	23
Median	26	9	21
N	174	389	563
t-stat. (*Ho*: $\mu = 0$)	22.42	43.14	41.26
4. Estimates from travel cost model			
Tobit model ($n = 447$)	51 pesos	(not applicable)	(not applicable)
OLS model ($n = 447$)	36 pesos	(not applicable)	(not applicable)

Note: For each observed household, the consumer surplus was estimated according to the estimated coefficients from the reduced models (Probit model and Weibull distribution of Hazard model). The average values and the standard deviation of these estimated values are reported in the table. Except in one case (*), all the null hypothesis of zero mean are rejected at 1 percent significant level.

same thing. There are several potentially important differences. First, the travel cost method provides an estimate of the Marshallian consumers surplus, while the CV method provides the Hicksian welfare benefits. When the income effect is small, the difference between the two types of welfare measures is generally expected to be small for price changes (Willig 1976; Freeman 1993). However, in this case there is a possibility that respondents answering the contingent valuation questions may have framed the welfare change differently than that implied by the travel cost model (Kahneman and Tyversky 1979; Cameron 1992; Kahneman 1992; Mansfield 1993).

The travel cost method purports to measure the welfare loss associated with the change from the water quality conditions before the public health advisory to the conditions after the public health advisory. In fact, the objective water quality conditions did not change as a result of the advisory; what changed was people's perception of the public health risks. In contrast, when answering the contingent valuation questions, respondents may have implicitly assumed that the benefits of swimming at Times Beach had already been lost and shifted their reference point for valuing gains and losses to the degraded water quality state. Also, respondents may have understandably assumed that the implementation of the Water Quality Improvement Plan would have resulted in objective water quality conditions that would be better than those existing before the public health advisory. Our point is that the environmental services respondents expected to receive when answering the contingent valuation questions may have been somewhat different from those assumed for the travel cost calculations.

Second, the travel cost method only measures the use values lost by households due to a deterioration in water quality. The contingent valuation method captures both the use and nonuse values associated with improvements in the water quality of the rivers and sea near Davao and cleaning up Times Beach. Based on the CV data, it is not possible to clearly distinguish between the use and nonuse values of those households that used Times Beach for recreational purposes before the public health advisory and those households that did not. The contingent valuation estimates for households that used Times Beach before the advisory certainly include both use and nonuse values. The problem comes in interpreting the CV estimates of willingness to pay of nonusers. It cannot be assumed that a nonuser who indicates a positive willingness to pay is thinking only of nonuse values. Such a respondent may receive several use-related economic benefits other than enhanced recreational opportunities. For example, such a household may face a reduced risk of seafood contamination, or reduced health risks when flooding occurs. It may conceivably benefit from increased tourism at Times Beach (and other nearby beaches) in terms of increased economic activity resulting from local multiplier effects.

Third, the CV survey instruments elicit respondents' willingness to pay for cleaning up both Times Beach and other beaches near Davao. The estimates of willingness to pay based on the travel cost model are only for Times Beach.

The economic benefits from any future water quality improvements can be classified into two components:

1. w_1— removing the welfare loss associated with the reduced use of Times Beach (and other nearby beaches) and the welfare loss associated with water quality deterioration at the reduced use level;
2. w_2—the value of cleaning up the river and seas near Davao in addition to the recreational benefits from using Times Beach (and other nearby beaches), including use values, such as reduced risk of seafood contamination, and nonuse values.

Figure 1 illustrates which of these two components of economic benefits is measured by the contingent valuation method and the travel cost method for both users and nonusers. This classification yields two clear expectations. First, the CV estimates for users should be higher than the travel cost estimates. Second, the CV estimates for users should be higher than the CV estimates for nonusers. As shown in Table 7, our findings are consistent with the second hypothesis. The results with respect to the first hypothesis are less clear. The results from the OLS model are consistent with the first hypothesis, but those for the tobit model are not.

V. SUMMARY AND POLICY IMPLICATIONS

This paper makes three contributions to the literature on nonmarket valuation of environmental goods and services in developing countries. First, we present the first estimates of the economic value to households of surface water quality improvements in a low-income developing country.[16] Second, the paper presents the first rigorous comparison of welfare estimates for an improvement in environmental quality in a

[16] See McConnell and Ducci (1989) for some estimates of the economic value of water quality improvements in two medium-income developing countries.

	Times Beach	
	Users	**Non-users**
Contingent Valuation Method*	**Cell A:** **Use values and nonuse values for cleaning up rivers and sea near Davao** w_1+w_2 **(37, 30, 40, 51 pesos per month per household)***	**Cell B:** **Nonuse values for cleaning up rivers and sea near Davao** w_2 **(26, 1, 20, 35 pesos per month per household)***
Travel Cost Method	**Cell C:** **Use values** w_1 **(51, 36 pesos per month per household)**	**(not applicable)**

FIGURE 1

A COMPARISON OF THE COMPONENTS OF THE ECONOMIC BENEFITS OF WATER QUALITY IMPROVEMENTS BASED ON THE CONTINGENT VALUATION AND TRAVEL COST METHODS FOR USERS AND NONUSERS OF TIMES BEACH

Notes: w_1—removing the welfare loss associated with the reduced use of Times Beach (and other nearby beaches) and the welfare loss associated with water quality deterioration at the reduced use level; w_2—the value of cleaning up the river and seas near Davao in addition to the recreational benefits from using Times Beach (and other nearby beaches), including use values, such as reduced risk of seafood contamination, and nonuse values.

* Estimates from (1) final bids taken as a continuous variable; (2) probit model, using all respondents; (3) probit model, using respondents who voted for Water Quality Improvement Plan; (4) hazard model assuming Weibull distribution (see Table 7).

developing country obtained from the contingent valuation method and the travel cost method.[17] Third, we present the first evidence that respondents in a contingent valuation survey in a developing country are sensitive to the scope of the commodity described in a contingent valuation scenario. Our study suggests that the use of nonmarket valuation methods in developing countries can be both practical and feasible. In particular, the estimates of economic value based on the contingent valuation responses were quite close to those based on the travel cost method.

Estimates of economic benefits such as presented in this paper should not be used as the sole basis for evaluating water quality improvement projects. There are two particularly important limitations of the criterion of economic efficiency for evaluating such investments: (1) the ethical legitimacy of using households' existing preferences for improved surface water quality, and (2) distributional effects of not improving water quality conditions.

First, the criterion of economic efficiency assumes that users' existing preferences for improved surface water quality should serve as the basis for planning and investment decisions. Professionals in the water and sanitation sector often disagree with this basic assumption that underlies the kind of economic analysis presented in this paper. Health educators and community organizers typically see themselves as agents of change

[17] For a more informal comparison of the contingent valuation and travel cost methods, see Grandstaff and Dixon (1986).

and modernization. Designers of sanitation and water quality improvement projects may seek to change households' *preferences and behavior* as an explicit objective, arguing that people may not be aware of the public health and other externalities associated with poor sanitation and surface water quality. In such a case, estimates of the *ex post* health benefits of a sanitation and water quality improvement project may be much higher than *ex ante* estimates of benefits based on households' existing preferences.

Second, the consequences of not improving water quality now may have important distributional consequences that may be relevant for policy choice. For example, the risk of epidemics from poor sanitation may fall disproportionately on the poor living in squatter settlements. Delaying action on improving water quality could conceivably entail serious losses to local fishermen, both in terms of increased morbidity and lost income. Also, the full consequences of poor water quality for the tourism industry and the local economy may not be fully appreciated by respondents in our contingent valuation survey. For all these reasons, it is possible that immediate investments in water pollution control may be justified in situations such as Davao, even if estimates of economic benefits based on households' existing preferences are low.

Nevertheless, we believe this study does provide important, policy-relevant information for evaluating sanitation investments in Davao. Arguments that subsidies should be provided due to the presence of externalities and households' lack of knowledge of public health risks seem less than compelling in Davao. The externalities associated with a lack of wastewater treatment do not fall on downstream communities but largely on the residents themselves. Thus, the damages from water pollution are largely borne by the community creating the problem and are already "internalized." Moreover, the reason willingness to pay is low is not because households are unaware of the problems caused by water pollution. Indeed, many residents of Davao have already changed their behavior significantly to avoid the risks of water pollution. This finding suggests that public education campaigns or social marketing efforts designed to increase household demand for sewer connections are not likely to have a dramatic effect on willingness to pay for environmental quality improvements.

The analyses of both the contingent valuation and travel cost data collected in the household survey confirm the old conventional wisdom about household demand for environmental improvements in developing countries. People are aware of environmental problems, but water pollution control is simply not a high priority for residents of Davao. People do feel that they have lost valuable recreational opportunities as a result of water pollution, and many are concerned about possible food contamination. But these are not major problems in their lives compared to other, more pressing environmental concerns, such as deforestation and poor solid waste collection and disposal. Because households' willingness to pay for water quality improvements in Davao is much lower than the costs of providing such improvements, and because other environmental problems appear to deserve higher priority, the appropriate strategy in this case appears to be to wait until incomes are higher and willingness to pay has risen before embarking on a large investment program to control water pollution.

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