WORKING PAPER 55/2010

Valuing the Environment in Developing Countries: Modeling the Impact of Distrust in Public Authorities' Ability to Deliver on the Citizens' Willingness to Pay for Improved Environmental Quality

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Price : Rs. 35

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VALUING THE ENVIRONMENT IN DEVELOPING COUNTRIES: MODELING THE IMPACT OF DISTRUST IN PUBLIC **AUTHORITIES' ABILITY TO DELIVER ON THE CITIZENS' WILLINGNESS TO PAY** FOR IMPROVED ENVIRONMENTAL QUALITY

Ekin Birol and Sukanya Das

Abstract

In this paper we employ the choice experiment method to estimate local citizens' valuation of a public intervention which proposes to improve the quality of an important environmental resource, namely the river Ganga in India. 150 randomly selected citizens of the municipality of Chandernagore located on the banks of the river Ganga in West Bengal are interviewed to elicit their willingness to pay (WTP) in higher municipality taxes for an intervention that proposes to improve the quantity and quality of wastewater treated by the local sewage treatment plant (STP). The findings reveal that almost all (98%) of the citizens value of the quality of the water and the environment in the river Ganga, though a great majority (90%) protested the intervention, by not choosing the improved STP scenario in at least one of the eight hypothetical markets they were asked to participate. When asked their reasons for not preferring the improved scenarios, 92% of them stated that they do not trust the authorities to manage the funds generated through additional taxes efficiently and effectively. The protest responses were controlled for with the use of the nested logit model. The results reveal that the citizens are willing to pay significant amounts to ensure that the intervention takes place, and an improved STP treats larger amounts of wastewater to a higher quality before discharging it to the Ganga. Therefore in order to improve the wastewater management

services and the related environmental quality in the water bodies in which treated wastewater is deposited into, the municipalities could rely – at least to some extent - on their citizens' WTP higher taxes for provision of improved services. In order to be able to capture this WTP however, municipalities' performance, trustworthiness and accountability, as well as the citizens' perceptions of these should be improved.

Keywords: *choice experiment method, nested logit model, willingness to pay, sewage treatment plant, distrust in public authorities*

JEL Codes: *C25, C83,C87,Q5,Q53*

Acknowledgements

Earlier version of this paper was presented at MSE Seminar Series held on 21-22nd August, 2010. We thank the MSE faculty for their useful comments.

INTRODUCTION

Stated preference methods (SPM), such as the contingent valuation method (CVM) and the choice experiment method (CEM), have traditionally been applied in developed countries to estimate these countries' citizens' willingness to pay (WTP) for various interventions (such as, policies, programs or projects) for environmental conservation and sustainable management of natural resources (see for example chapters in Bateman and Willis 1999 and Brien 2009, among others). Economic benefits estimated from such studies (captured as WTP) are weighed against the economic costs of interventions targeted at environmental conservation and sustainable management of natural resources, in order to understand whether such interventions would be efficient, or in economic terms, a Pareto improvement. Environmental goods (such as biodiversity) and natural resources (such as water, clean air or forests) are public goods which are not traded in markets, and hence do not possess readily available prices (or economic values) which can be used for such cost-benefit analysis. Therefore SPM which rely on constructed, hypothetical markets in which respondents participate to state their WTP for different interventions are used to capture their value.

Such studies are not so often conducted in developing country contexts since it is assumed that due to their tight budgets constraints and high discount rates, developing country citizens may not have the ability to pay for "luxury" goods, such as interventions for environmental conservation or sustainable natural resources management. In recent studies, however, middle-income citizens in developing countries with low-incomes, as well as citizens of developing countries with rising incomes have stated to have positive and significant WTP for the conservation of the environment or for the sustainable management of natural resources (see for example chapters in Bennett and Birol 2010, among others). These studies reveal that when framed in a manner

relevant to the environmental conservation or natural resource management question at hand, and when designed with cultural and institutional setting in mind, such studies can yield valuable information as they have done in developed countries for decades. There is however a need to investigate further how SPM can be implemented effectively in developing country contexts to be able to capture and model developing country citizens' valuation of environmental conservation or sustainable natural resources management.

In this paper we endeavor to contribute to this growing literature on the developing country citizens' valuation of interventions that propose environmental conservation or sustainable natural resources management in developing countries, by presenting the results of a choice experiment study conducted in India. In this study we investigate whether citizens of West Bengal municipalities located along the banks of the river Ganga are willing to pay higher municipality taxes for an intervention, namely an improvement in the capacity and technology of a sewage treatment plant (STP). This improved STP proposes to reduce the water pollution in this great river, which is not only a major input to various economic activities (such as agriculture, aquaculture, hydro-power generation, industry, and water supply for household consumption) but also an important source of religious, cultural and historical values (Alley, 2002; Markandya and Murty, 2004; Birol and Das, 2010).

Our findings reveal that even though almost all (98%) of the randomly selected 150 local citizens stated that they cared about the quality of the water in particular, and the ecological status of the Ganga in general; a great majority (90%) protested the intervention, by not choosing the improved water quality scenario in at least one of the eight hypothetical markets they were asked to participate. When asked their reasons for not preferring the improved scenarios, 92% of them stated that they do not believe the additional taxes they would pay for the

provision of this intervention would be used for this purpose due to the inefficacy of the local authorities. These findings are in line with previous research which have shown that corruption tends to occur more frequently at the local government levels (see for example Triestman, 1998) and that urban citizens in India are not willing to pay for improvements in publically provided goods (such as water supply) possibly due to their lack of trust in the efficacy of the local governments in their provision (Anand 2002).

Following the finding that citizens protest the intervention not because they do not care about the quality of the water and associated environmental problems in the Ganga, but rather because of their perceived ineffectiveness of the system; a nested logit model was used to model the citizens' decision-making process as a two stage process. In this model respondents first decide whether or not to 'participate' in this intervention by paying increased taxes for its implementation and then those who decide to participate in this endeavor decide which attributes of the intervention they would be willing to pay for and how much.

Our preliminary results reveal that the nested model explains the data better than more conventional models, such as the conditional logit model. Moreover, similarly to their developed country counterparts, citizens from households with higher income levels (measured as spending lower shares of their expenditure, as a proxy for income, on food); larger households (which is correlated with having children and higher number of children) and households with heads that have university degree or above, are more likely to participate in the STP improvement intervention. Households are willing to pay on average Rs 8.6 additional monthly taxes to improve the quality of the water treated and Rs 5.5 to increase the quantity of treated water. Citizens however are not willing to pay, rather they are willing to accept compensation, for improvements in the Wonderland park around the current STP, which is mainly used for recreational activities. These findings have implications

in terms of designing interventions for improving the STP in the study site, as well as in terms of improving the credibility and accountability of the public institutions which are responsible for providing these interventions.

The rest of the paper unfolds as follow. Next section explains the choice experiment method and decision modelling approaches used in this paper. Then, we describe the survey design and administration, and present the descriptive statistics. Then, we present results followed by concluding remarks of the paper with policy implications.

METHODOLOGY

The choice experiment method has its theoretical grounding in Lancaster's model of consumer choice (Lancaster, 1966), and its econometric basis in random utility theory (Luce, 1959; McFadden, 1974). Lancaster proposed that consumers derive satisfaction not from goods themselves but from the attributes they provide. According to the random utility theory, the utility of a choice is comprised of a deterministic component (V) and an error component (e), which is independent of the deterministic part and follows a predetermined distribution. This error component implies that predictions cannot be made with certainty. Choices made between alternatives will be a function of the probability that the utility associated with a particular alternative j (e.g., wastewater treatment program option) is higher than those for other alternatives.

$$U_{ij} = V(Z_{ij}) + e(Z_{ij}) \quad \textbf{(1)}$$

Where, for example in the case of the experiment presented here, for any citizen i, a given level of utility will be associated with any wastewater treatment program alternative j. Following Lancaster's theory of consumer choice, the utility derived from any of the wastewater treatment alternatives depends on its attributes (Z), such as the quantity

and quality of wastewater treated in the STP and the regeneration of the Wonderland Park.

Assuming that the relationship between utility and attributes is linear in the parameters and variables function, and that the error terms are identically and independently distributed with a Weibull distribution, the probability of any particular wastewater treatment programme alternative j being chosen can be expressed in terms of a logistic distribution. Equation (1) can be estimated with a conditional logit model (CLM) (McFadden, 1974; Greene, 1997 pp. 913-914; Maddala, 1999, pp. 42), which takes the general form:

$$P_{ij} = \frac{\exp(V(Z_{ij}))}{\sum_{h=1}^{C} \exp(V(Z_{ih}))} \quad \textbf{(2)}$$

where the conditional indirect utility function generally estimated is:

$$V_{ij} = \alpha + \beta_1 Z_1 + \beta_2 Z_2 + ... + \beta_n Z_n \quad \textbf{(3)}$$

Where α is the alternative specific constant (ASC) which captures the effects on utility of any attributes not included in choice specific wastewater treatment programme attributes, n is the number of wastewater treatment programme attributes considered, and the vectors of coefficients β_1 to β_n are attached to the vector of attributes (Z).

The assumptions about the distribution of error terms implicit in the use of the CLM impose a particular condition known as the independence of irrelevant alternatives (IIA) property, which states that the ratio of the probabilities of choosing one alternative over another (given that both alternatives have a non-zero probability of choice) is unaffected by the presence or absence of any additional alternatives in the choice set. Another limitation of the CLM is the independent and identically distributed (IID) assumption of the error terms. This assumption implies that cross-substitutions between pairs of alternatives

are equal and unaffected by the presence/absence of other alternatives. If the IIA property is violated then CLM results will be biased and hence a discrete choice model that does not require the IIA property, such as such as random parameter logit model (RPLM), should be used. Birol and Das (2010) showed that according to the Hausman and McFadden (1984) test the IIA property is rejected and therefore used RLPM, which relaxes the IIA assumption.

In this paper we use the nested logit model (NLM) which relaxes the IIA and IID assumptions (McFadden, 1981; Louviere et al., 2000). In this model the alternatives are grouped based on similarity of the unobserved error terms of the indirect utility. Here we model the citizen's decision as a two level NLM, where they make the decision on whether to choose an improved wastewater treatment program or stay with the current program (status-quo), and if they choose improved program, they make a choice between the two different improved programs: A and B.

In the NLM, the random error terms (e in equation 1) are assumed to have an extreme value distribution and are correlated within each nest (i.e. the random error terms of Programs A and B are correlated). However the random error terms of programs A and B are not correlated with that of the status-quo alternative, opt out program. The probability of choosing program A, is the product of participating in a new program, and the probability of choosing program A given that the citizen chose the improvement.

Prob(Program A)=Prob(New Program) x Prob(Program A|New Program) =P(NP) x P(A|NP) **(4)**

$$P(A \mid NP) = \frac{e^{V_A|\tau}}{e^{V_A|\tau} + e^{V_B|\tau}} . \quad \textbf{(5)}$$

$$P(NP) = \frac{e^{\tau IV}}{e^{\tau IV} + e^{V_{SQ}}} \quad \textbf{(6)}$$

where NP is a new p, A and B are the two new service alternatives, SQ is the status quo, IV is the inclusive value on the new program group, and τ is the coefficient of the IV.

$$IV = \ln(e^{V_A|\tau} + e^{V_B|\tau}) \quad \textbf{(7)}$$

Utility maximization requires the IV coefficient τ to be in the 0-1 interval. Values of τ closer to 0 indicate higher correlation. If τ is 1, the correlation is 0 which is the case of CLM i.e. the random components of the alternatives are not similar. Finally, the probability of choosing the status-quo option is:

$$P(C) = \frac{e^{V_{SQ}}}{e^{\tau IV} + e^{V_{SQ}}} \quad \textbf{(8)}$$

DATA

a. *Case Study*

The details of the case study site and proposed intervention to improve the water and hence environmental quality in the Ganga are explained in greater detail in Birol and Das (2010). Here we present a summary of the background of the case study. The case study site is the Chandernagore municipality in West Bengal, which is situated along the banks of the river Ganga. Currently this municipality hosts a conventional sewage treatment plant (STP) built in 1991. The total volume of wastewater generated by the Chandernagore municipality is estimated at 11,700 M3 of raw sewage per day while the capacity of the local STP far surpasses this figure, at 22,500 M3 of raw sewage which can be treated with primary treatment methods. Due to major financial constraints, the STP utilizes only a small fraction of its capacity, conducting primary treatment on only 2,800 M3 of raw sewage per day, i.e., 24 percent of the sewage generated by the municipality.

The 2,800 M^3 of raw sewage treated daily is treated to permissible limit standards, which are 30mgl for biochemical oxygen demand (BOD) and 250mgl for chemical oxygen demand (COD), as set by the West Bengal Pollution Control Board in 1999. The current permissible limit standards, however, are not high enough to remove all the pathogens and hence after this primary treatment, significant health and environmental risks remain. The remaining wastewater generated by the municipality (i.e., the 8,830M^3 of raw sewage per day) is untreated by the STP due to the budget constraints. Less than half of the untreated water is used for the replenishment of the lake in the Wonderland Park, in which the STP is located, and for local agriculture (specifically vegetable farming) and aquaculture activities conducted in the surrounding areas. The use of the untreated wastewater for these purposes poses serious health risks to visitors of the park, as well as for the consumers and producers of fish and vegetables produced with this water. The remaining untreated wastewater is discharged to the Ganga, creating environmental pollution and negatively affecting the sustainability of the ecosystem functions of the river. There is therefore an urgent need to invest in the improvement of the STP of the Chandernagore municipality to ensure that it functions at its maximum capacity for primary treatment and treats higher quantities of wastewater and also to upgrade its technology to treat wastewater at a higher quality, i.e., secondary treatment.

b. Survey Design and Administration

The details of the experimental design and the process that enabled the selection of the attributes and attribute levels used in this choice experiment are reported in great detail in Birol and Das (2010). In a nutshell, following extensive background work (which included detailed review of the published and gray literature on wastewater treatment in general and on River Ganga in particular; two focus group discussions with local citizens; consultations with civil and chemical engineers and hydrologists employed by the Kolkata Metropolitan Development

Authority and Public Health Engineering Directorate, as well as a pilot open-ended contingent valuation study), the attributes and levels reported in Table 1 were identified to describe the current (status quo) and improved situations pertaining to the wastewater management program.

Table 1: Wastewater Treatment Program Attributes and Attribute Levels used in the Choice Experiment

Attributes	Definition	Levels
Quantity of treated wastewater	Total volume of wastewater treated with primary treatment by the STP. At the moment the STP is working below its capacity, treating only a quarter of wastewater generated in the municipality. The capacity of the STP can however be increased to treat ALL the wastewater generated by the municipality with primary treatment. This would significantly reduce the discharge of untreated wastewater in the Ganga.	*Low**, High
Quality treated wastewater	Current capacity of the STP can only treat wastewater with primary treatment technology. The quality of wastewater treated with primary treatment is low, and when used for agri/aquaculture or discharged to the Ganga it would still create health and environmental hazards. Secondary treatment technology could be used to increase the quality of the treated wastewater to a higher level so as to minimize the health and environmental risks.	*Low*, High
Regeneration of the Park	Investment in the Wonderland Park to improve its use as a recreational site. At the moment there are no investments to sustain or improve the recreational services provided by the park, such as walking and picnicking.	*No*, Yes
A monthly increase in the municipal tax	Payment vehicle in Indian Rupees identified through the pilot open-ended contingent valuation survey (1 Euro = 59.85 Indian Rupees)	Rs. 1.5, Rs. 4.5, Rs. 12.5 and Rs. 20

* Levels in italics indicate the status quo level.

Experimental design techniques (Louviere et al., 2000) and SPSS Conjoint software were used to obtain an orthogonal design, which consisted of only the main effects, and resulted in 32 pair wise comparisons of alternative wastewater treatment programs. These were randomly blocked to four different versions, each with eight choice sets. Each set contained two wastewater treatment scenario and an 'opt out' option which is considered as a status quo or baseline alternative whose inclusion in the choice set is instrumental to achieving welfare measures that are consistent with demand theory (Louviere et al., 2000; Bateman et al., 2003).

The pilot choice experiment survey was implemented in November and December 2007 with face-to-face interviews with a total of 150 randomly selected households located in Chandernagore municipality. The municipality population is 32,939 households according to the latest census conducted in 2001. Due to budget and time constraints a sample of 200 households (i.e., 0.6% of the population) was envisaged. Even though due to its small size the sample could not be representative of the population it is drawn from, it would generate some indication of the public's preferences with respect to improvements to the STPs and hence to the quality of the water in the Ganga.

The choice experiment survey was administered to be representative of the sample population in terms of income, social status, proximity to the River Ganga and the Wonderland Park. Households were sampled from four randomly selected wards (neighborhoods in the municipality), chosen randomly from four lists of wards, which were stratified according to proximity to the park and income level. Each ward hosts about one thousand households and 50 households (i.e. 5 percent of all households in each ward) was within the project budget and timeline of this pilot study. To select households a cross sampling method was used. That is, a cross "X" was drawn on the ward map and every nth

household was asked to partake in the survey. Overall response rate was 75 percent with 150 households taking part in the survey.

In each household the household heads were interviewed. An introductory section explained to the respondents the context in which the choices were to be made and described each attribute, their present status and implications on public and environmental health. Respondents were reminded that there were no right or wrong answers and that we were only interested in their opinions. They were also told that the municipality did not have sufficient funds to improve the wastewater treatment facilities of the STP, and therefore it would be necessary to increase the monthly municipal taxes paid by the households. The respondents were also reminded of their budget constraints as well as other local public goods which could be funded through their taxes.

In addition to the choice experiment questions, data on the households' social, economic and demographic characteristics were collected. Descriptive statistics of the sample are reported in Table 2 below.

Table 2: Social, Economic and Demographic Characteristics of the Sampled Households

Characteristic	Sample mean (std.dev.)
Household size	5.1 (2.4)
Household head age	58.8(13.1)
Monthly food expenditure (in Rs)	3498.3(1618.4)
Monthly expenditure (in Rs)	5839.6 (2397.5)
Share of income spent on food	60.1(12.3)
Number of years resident in the area	26(16.1)
Distance to the park (in minutes)	11.4 (3.7)
	Percentage
Household has a child < 18 years of age = 1, 0 otherwise	60
Household head female =1, 0 otherwise	8.7
Household head completed primary school or less =1, 0 otherwise	15.3
Household head has a university degree or above=1, 0 otherwise	33.3
Employment in service sector =1, 0 otherwise	26
Self-employed =1, 0 otherwise	40
Pensioner =1, 0 otherwise	22.7
Housewife =1, 0 otherwise	8.7
Manual worker =1, 0 otherwise	2.7
Visited the park =1, 0 otherwise	80

These statistics reveal that on average the households interviewed in this survey have been residents in the Chandernagore municipality for 26 years and they are located very near the Wonderland Park (a little over ten minutes walking distance). Average number of household members is 5 persons, which is similar to the West Bengal average of 4.7 members per household (Indiastat). Over half (60 percent) of the households have at least one child younger than 18 years of age. A great majority (91 percent) of the household heads are male and their average age is 59 years. About 15 percent of the household heads have completed (or dropped out of) primary school education,

whereas 33 percent have technical school or university degrees and above. The average household monthly expenditure (proxy for disposable income in developing countries) is Rs 5840 (97.8 Euro) and a great majority of the household expenditure is spent on food, followed by health and personal care, and transport. The average per capita expenditure (Rs 1145) is similar to the average monthly per capita income for Hugli District (under which the Chandernagore municipality falls) which was estimated to be Rs 1127 in 2005 (Bureau of Applied Economics & Statistics, Government of West Bengal, 2005).

RESULTS

a. Conditional Logit Model

The choice experiment was designed with the assumption that the observable utility function would follow a strictly additive form. The model was specified so that the probability of choosing a particular wastewater treatment programme was a function of the attributes and the ASC (equation (3) above). Using the 1500 choices elicited from 150 households the CLM was estimated with LIMDEP 9.0 NLOGIT 4.0. The results for the CLM are reported in Table 3.

The McFadden's ρ^2 value in CLM is similar to the R^2 in conventional analysis except that significance occurs at lower levels. According to Hensher et al. (2005, p. 338) values of ρ^2 between 0.2 and 0.4 are considered to be extremely good fits. According to this criterion the overall fit of the CLM (0.219) indicates an extremely good fit, and all the coefficients are statistically significant. Treated wastewater quantity and quality are significant factors in the choice of a wastewater treatment program, and ceteris paribus, these two attributes increase the probability that a wastewater treatment program is selected. In other words, households value those wastewater treatment programs that result in higher quality and quantity of wastewater treated.

The coefficient on the wastewater quality is about one and a half times the magnitude of the coefficient on wastewater quantity. This result can be explained by the fact that even though residents recognize the need to increase the capacity of the current STP so that all of the wastewater generated by the residents of the Municipality can be treated with primary treatment, they are especially concerned about treating wastewater to a higher quality (secondary treatment) level before discharging in the River Ganga and/or before using it for irrigation or aquaculture.

This result reveals that residents acknowledge that the quality of treated wastewater has implications for health and environmental risks. Therefore plans for improvements to the STP should not only include expansion (or full use of its current) capacity for primary treatment, but also upgrading of the current technology, from primary to secondary treatment, so that wastewater can be treated to a higher quality to minimize risks to public and environmental health.

Table 3: CLM Estimates for Wastewater Treatment Program Attributes

Variables	CLM
Attributes	Coeff. (s.e.)
ASC	-1.1***(0.174)
Quality of treated wastewater	0.665*** (0.071)
Quantity of treated wastewater	0.407*** (0.069)
Regeneration of the park	-0.421*** (0.064)
Monthly increase in municipality tax	-0.147*** (0.012)
Pseudo ρ^2	0.219
Log-likelihood	-867.133
Sample size	1200

Source: River Ganga Wastewater Treatment Choice Experiment Survey, 2008.

*** 1% significance; **5% significance and *10% significance level with two-tailed tests.

Local households prefer those wastewater treatment programs which do not propose additional investments in the regeneration of the Wonderland Park around the STP in order to improve its use as a recreational Park. This result is also not surprising given that 98.7 percent of the households interviewed agree that the Park is already an attractive recreational site and since its opening in 1999. In fact 80 percent of the respondents have visited the park for recreational purposes, an average of 6.8 times. The coefficient on ASC is negative and significant implying that there is some degree of status quo bias – all else held constant, respondents would prefer to move away from the status quo situation (Hanley et al., 2005) and towards improved wastewater treatment program even if they would have to pay higher monthly taxes for these. Finally, the sign of the payment coefficient indicates that the effect on utility of choosing a choice set with a higher payment level is negative, as expected.

b. Protest Responses

One feature of the data which needs further investigation is the high number of citizens who chose the status quo alternative in at least one of the eight choice sets offered to them. In fact 90% of citizens chose to opt out in at least one choice set, 89% in two, 82% in three, 77% in four, 71% in five, 64% in six, 39% in seven and finally 21% chose to opt out in all eight choice sets. In order to differentiate true zero WTP values from protest responses, five follow-up questions (Haab, 1999) were asked in Likert scale format (strongly disagree, disagree, neither agree nor disagree, agree, strongly agree):

i. I should not be asked to pay higher taxes for improvement of the STP
ii. I do not believe that the investments to improve the conditions of the STP will be made successfully
iii. I do not have the financial capability to pay higher taxes

iv. I do not care about the quality of water and environmental problems in the Ganga
v. I do not care about the Wonderland Park

Those citizens that have agreed or strongly agreed with the statements (i) and (ii) were classified as protesters of the STP improvement intervention, whereas those that agreed or strongly agreed with the statements (iii), (iv) and (v) were classified as true zeros. Of the 31 respondents that chose the status quo in all of the eight choice sets, 94% agreed or strongly agreed with statements (i) and (ii) each; whereas 55% agreed or strongly agreed with statement (ii) and only two respondents (6.5%) agreed or strongly agreed with statements (iv) and (v) each. Therefore a significantly greater proportion of respondents who chose to opt out in all eight choice scenarios are protestors, rather than true zeros.

Similarly, of all the respondents that chose to opt out in at least one choice set, 71% agreed or strongly agreed with statement (i); 92% agreed or strongly agreed with statement (ii); whereas 38% agreed or strongly agreed with statement (ii); only 1.5% agreed or strongly agreed with statement (iv) and 11% agreed or strongly agreed with statement (v). Therefore, overall, citizens' main reasons for not choosing the improvement scenarios were not related to their inability to pay nor because they do not value to water quality and the environmental conditions in the Ganga. Almost all (90%) of the citizens opted out at least in one scenario mainly because they did not think the program will work because investments would not be made successfully or because they did not think they should be providing the financial resources for this investment, or both.

c. Nested Logit Model

In order to account for the high percentage of opt out (status quo) responses and to relax the IIA and IID assumption, the nested logit

model (NLM) was used to analyse the data. In this model the citizens' decision-making process was modeled as explained in section 2 above. That is, the citizens first make the decision on whether to choose an improved wastewater treatment program or stay with the current program (status-quo), and if they choose improved program, they make a choice between the two different improved programs: A and B. The NLM was estimated using LIMDEP 9.0 NLOGIT 4.0 and the full data set of 1200 observations from 150 respondents. The results are reported in Table 4 below.

Table 4: NLM Estimates for Wastewater Treatment Program Attributes

Attributes	Coeff. (s.e.)
Attributes in the Utility Functions	
ASC	0.086 (0.248)
Quality of treated wastewater	0.784***(0.098)
Quantity of treated wastewater	0.504***(0.094)
Regeneration of the park	-0.498***(0.083)
Monthly increase in municipality tax	-0.182***(0.022)
Attributes of Branch Choice Equations	
ASC	0.086 (0.248)
Share of food expenditure in total household expenditure	-3.377***(0.556)
Household size	0.111***(0.028)
Household head has a university degree or above	0.374*** (0.147)
IV parameters	
IMPROVEMENT	0.724*** (0.115)
STATUS QUO	1*** Fixed Parameter
Pseudo ρ^2	0.249
Log-likelihood	-833.013
Sample size	1200

Source: River Ganga Wastewater Treatment Choice Experiment Survey, 2008.
*** 1% significance; **5% significance and *10% significance level with two-tailed tests.

The Swait-Louviere log likelihood ratio test rejects the null hypothesis that the regression parameters of CLM and NLM are equal at 0.5% significance level. There are other statistical tests that point to the superiority of the NLM to CLM in explanation of the citizens' valuation

process. First, the scale parameter must be different than unity to indicate a nested structure (Li et al., 2004). Since the choice model in each branch is conditional logit model this implies that the scale of the utilities of one branch is equal to the inverse of the branch inclusive value (Louviere et al., 2000). Therefore the scale parameter for the CHANGE branch is 1/0.69=1.45, which is greater than unity, and hence NLM should be employed to explain the decision-making process. Second, the he inclusive value estimate in the nested logit model is in the (0,1) interval and hence is consistent with utility maximisation (Scarpa et al., 2004).

Second, a significant IV parameter estimate suggests that the parameter is not equal to zero, but does not indicate whether the parameter lies outside the upper bound of the (0,1) range. Thus for significant IV parameters a second test is required to determine whether the upper bound has been exceeded. This test is Wald test which is measured as (IV parameter-1)/standard error, which in this case yields (0.69-1)/0.11=-2.82 for the IMPROVEMENT branch. Comparing the test statistics of –2.82 to the critical value of +-1.96 we cannot accept the hypothesis that the IMPROVEMENT IV parameter is statistically equal to one. This finding implies that the two branches should not collapse into a single branch. Thus for our example the NLM model would be preferable (Hensher et al., 2005).

The results of the NLM reveal that the citizens prefer those wastewater treatment program alternatives which provide higher water quality to be discharged in river Ganga and higher water quantity to be treated by the STP. The citizens, however, do not prefer programs that propose to invest in the regeneration of the Wonderland Park. Consistent with economic theory, the citizens prefer those programs that cost less in terms of increased municipality taxes.

In order to better understand the citizens' choice of participation, we included some household level characteristics in the branch choice equation. These characteristics were household size, share of food expenditure in total expenditure and whether or not the household head has a university degree. The results reveal that those households who spend greater proportions of their total expenditure (as a proxy for income) on food, which tend to be poorer households, are less likely to choose the improvement programs. On the other hand, citizens from larger households, which are likely to include children, as well as those from households with educated heads with university degrees and above are more likely to choose the improvement programs. These findings are in line with those from developed countries, where more educated citizens; those with higher incomes and those with children (due to 'bequest motives', Krutilla, 1967) are more likely to participate in and willing to pay higher values for interventions for environmental conservation and sustainable natural resources management (see for example Kosz, 1996; Birol et al., 2006, among others).

d. Willingness to Pay Estimations

The choice experiment method is consistent with utility maximisation and demand theory (Hanemann, 1984; Bateman et al., 2003), therefore the marginal value of change in wastewater treatment program attribute can be calculated as

$$WTP = -2\left(\frac{\beta_{attribute}}{\beta_{localtax}}\right) \qquad \textbf{(9)}$$

This part-worth (or implicit price) formula represents the marginal rate of substitution between payment (increase in monthly tax) and the wastewater treatment program attribute in question, or the marginal welfare measure (i.e., WTP) for a change in any of the attributes. Since all three of the wastewater treatment program have two levels, i.e., are binary, the WTP is multiplied by two (see, Hu et al., 2004).

Using Wald Procedure (Delta method) in LIMDEP 9.0 NLOGIT 4.0., citizens' valuation of wastewater treatment program attributes are calculated for the CLM and NLM, for comparison purposes, and reported in Table 5.

Table 5: Marginal WTP for Wastewater Treatment Program Attributes from CLM and NLM (Rs/household/month) and 95% C.I.

Attributes	CLM	NLM
Quality of treated wastewater	9.1 (8.1-10.1)	8.6 (7.6 - 9.6)
Quantity of treated wastewater	5.6 (4.7-6.5)	5.5 (4.6 - 6.4)
Regeneration of the Park	-5.8 (-6.7- - 4.9)	-5.5 (-6.5- -4.6)

Source: River Ganga Wastewater Treatment Choice Experiment Survey, 2008.

According to the t-tests, compared to the better fitting NLM, the CLM overestimates citizens' WTP for all three attributes at 1% significance level. The estimated WTP values for the NLM indicate that an average household values the improvement in water quality the most, as they are willing to pay Rs 8.6 more in monthly municipal taxes to ensure that the wastewater is treated with secondary treatment and the quality of the water discharged to the river is high. They are willing to pay about 40% less to increase the treatment capacity of the STP to treat all the wastewater generated by the municipality with primary treatment. The households, however, derive negative values from investment in the regeneration of the park, given that they are already satisfied with the present facilities (status quo) provided. The significant discrepancy of WTP values across the two models reveals the capture the two stage decision making process that is modeled in the NLM.

DISCUSSIONS, CONCLUSIONS AND POLICY IMPLICATION

Water supply and sanitation hold a very important place in urban services. India's urban water supply and sanitation sector face several

resource and management related problems and require a huge investment for revamping (Singh 2006). Several municipalities in India cannot deliver these services to the full population of their municipalities; the services they deliver are often of low quality and they are unable to maintain available services without extensive subsidies (Singh 2006).

One of the reasons for low quality or unreliable service delivery is no doubt corruption. The corruption study conducted by Transparency International India (2005) was the largest corruption survey ever undertaken in the country with a sample of 14,405 respondents spread across 20 states. The results of this study showed that (i) about 17% households they interviewed stated to have interacted with municipalities to get water supply or sanitation or both services during 2004-05; (ii) nearly one-fourth of those interacted with the municipalities had actually paid bribes; (iii) more than one third had visited municipality more than four times in 2004-05; (iv) nearly three fourths opined that there was corruption in the municipality, and (v) two fifths had taken recourse to alternate methods such as paying bribe or using influence to get their work done. As also put forward by Alley (2002), the cycle of allegations about corruption and admissions about public alienation runs through wastewater management issues. Citizens and in some cases industrialists allege that they do not trust government institutions to provide services without bribes, and civic institutions do not get the public support they need to improve services legitimately (Alley 2002).

In this paper we conducted a choice experiment study to understand whether or not the citizens of the Chandernagore municipality located on the banks of the river Ganga in West Bengal are willing to pay higher municipality taxes for an intervention that proposes to improve the quantity and quality of wastewater treated by the local sewage treatment plant (STP) and to invest in the management of the Wonderland park, a recreational site around the STP. The findings reveal that, even though almost all (98%) of the citizens value of the quality of

the water and the environment in the river Ganga, a great majority (90%) protested the intervention, by not choosing the improved STP scenario in at least one of the eight hypothetical markets they were asked to participate. When asked their reasons for not preferring the improved scenarios, 92% of them agreed with the statement that they do not trust the authorities to manage the funds generated through additional taxes efficiently and effectively. Even though this statement cannot be translated into citizens concerns about corruption in their local authorities; nor measures the level of distrust or perceived corruption explicitly, it points to the citizen's lack of trust in local authorities' ability and willingness to deliver the service. When the protest responses are accounted for with the use of the nested logit model however, the results reveal that the citizens are willing to pay significant amounts to ensure that the intervention takes place, and improved STP treats larger amounts of wastewater to a higher quality before discharging it to the Ganga.

These finding are in line with the findings of Alley (2002) and Transparency India International (2005), as well as previous water supply provision studies conducted by Anand (2002). Even though in this study we did not measure the impact of distrust on citizens' WTP, we showed that this distrust affects citizen's valuation. Therefore in order to improve the wastewater management services, which are directly related to the water and environmental quality in the water bodies in which treated wastewater is deposited into, the municipalities could rely on their citizens' WTP for provision of such improved services. In order to be able to capture this WTP however, municipalities' performance, trustworthiness and accountability, as well as the citizens' perceptions of these should be improved.

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