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VALUATION OF THE IMPACTS OF SOLID WASTE DISPOSAL: A CONTINGENT VALUATION ANALYSIS

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ABSTRACT

Solid waste has become a major policy issue in recent times in view of the rapid urbanization and population pressure that has taken place especially in the case of developing countries where the world's largest urban population is located. Landfills **(**open dump sites, controlled dump sites, sanitary landfills**)** causes serious health and environmental risks in the form of externalities like formation of leachate and landfill gas leading to water and air pollution and other disamenity effects. The present study is an economic valuation of the health and disamenity effects of landfills. The analysis will take into consideration the effects of a sanitary landfill in Metro Manila on the people living nearby. The focus is on estimating the value of an environmental improvement by assessing the willingness to pay (WTP) for such an improvement and thereby finding the costs of the health and disamenity effects incurred by the community due to the presence of the landfill.

KEYWORDS: Open Dump Sites, Controlled Dump Sites, Sanitary Landfills, Contingent Valuation Method**,** WTP.

INTRODUCTION

The adoption of market-oriented policies and the active participation of the private sector has contributed immensely to the considerable economic and social development the world economy has achieved in recent years. Rising population, rapid urbanization and increased use of natural resources has given rise to a number of serious environmental problems like loss of bio diversity and habitat destruction, depletion and degradation of forest resources, marine resources, air and water pollution, waste disposal. Etc. Solid waste has become a major policy issue in recent times in view of the rapid urbanization and population pressure that has taken place especially in the case of developing countries where the world's largest urban population is located. Solid waste can be defined as the non-liquid waste materials arising from domestic, trade, commercial, industrial, agricultural and mining activities and from the public services (WHO, 1976). Solid wastes are the most visible form of pollution. It is argued that the source of most of the environmental problems lies in the inability of the economic system to take account of the valuable services the natural environment provides us. The provision of waste sinks to receive and assimilate all types of wastes from the economic system is such a service. Solid waste pollution occurs when the ecosystem functioning is hampered by an over load in the carrying capacity of the natural environment due to the sheer bulk and complexity of waste (David Pearce et al 2000).

Solid waste disposal is the final step in the solid waste management system. Solid waste management includes six functional elements like generation, storage, collection, transfer, processing and disposal (Guy Garrod et al 1997). The different types of solid wastes include food and other organic wastes, wastes like paper, cloth, plastic etc, hospital wastes like cotton, plaster, needle etc., wastes from construction sites, industrial wastes, agricultural solid wastes, mining wastes and hazardous wastes. Etc. The local bodies are entrusted with the disposal of solid wastes. The important methods of solid waste disposal include land filling, incineration, composting, refuse-derived fuel, pyrolisis and vermi composting (Ma Lourde Rebullida 2000). Of these, land filling is the most popular and commonly used method. Land fills are generally

classified into three types 1) **open dump sites(**a disposal area wherein the solid wastes are indiscriminately thrown or disposed of without due planning and consideration for environmental and health standards) 2) **controlled dump sites(** a disposal site at which solid waste is deposited in accordance with the minimum prescribed standards of site operation) and 3) **sanitary land fills(**a waste disposal site designed, constructed, operated and maintained in a manner that exerts engineering control over significant potential environmental impacts arising from the development and operation of the facility) (The Ecological Solid Waste Management Act 2000).

Land fills causes serious health and environmental risks in the form of externalities like formation of leachate and landfill gas leading to water and air pollution and other disamenity effects like increased population of pests, flies, vermin, and visual impacts. etc. (Lee and Jones-Lee 1993, UNEP 1999, CPCB 2000). The present study is an economic valuation of the health and disamenity effects of landfills. The analysis will take into consideration the effects of a sanitary landfill in Metro Manila on the people living nearby. The focus is on estimating the value of an environmental improvement by assessing the willingness to pay (WTP) for such an improvement and thereby finding the costs of the health and disamenity effects incurred by the community due to the presence of the landfill.

METHODOLOGY

Theoretical Framework

Environmental problems are considered as problems of non-optimal pricing and misallocation of resources. For many environmental goods there is either the complete absence of markets or they are incomplete. The presence of complete markets for each good is essential for the optimal distribution of resources in the economy and the lack of it will result in the inefficient distribution of resources. Environmental degradation and pollution occur when the market fails to take into account the true value of environmental quality to the society. The absence of a market has led to the unregulated use of the environment and its wide spread degradation. According to Pareto, an optimal distribution of resources is reached if it is impossible to redistribute resources in the economy in such a way that it benefits one individual without harming another. Pollution and environmental degradation are cases of market failure that results in the non-optimal distribution of resources. This is the result of externalities and incomplete markets. Externalities are one of the main causes of market failure (Arrow 1969). The presence of externalities creates marginal social costs (MSC), which even a competitive economy fails to consider during pricing. In general, economic theory, the price fixing is done by considering the marginal private cost (labour. rent. etc.). The exclusion of the externality induced social costs will result in non-optimal production of goods. (See Samuelson. P.A.1954, Bator 1958, Pearce. 1972, Akerlof.G. 1970). The market is incapable of controlling environmental degradation due to the public good character of environment (non-exclusion and non-rivalry in consumption). The presence of incomplete markets makes it difficult to fix a price for the environment that will reflect its true value. So alternative methods have to be used to find out the value of environmental quality.

An economy provides a mix of marketed and non-marketed goods. Environmental goods and services come under the category of non-marketed goods. Economic valuation means giving monetary values to the non -market goods and services and the economic valuation of the environment means giving monetary values to environmental goods and services. In a market the individual will buy a good when he finds that the WTP is greater than the price. Assigning monetary values for environmental goods means finding a measure of WTP or WTA (willingness to accept a compensation for foregoing the benefit) for an environmental good. So economic valuation is all about finding a WTP or WTA measure when market is incapable of providing that information. (See Bateman et al 1993), In order to find out the economic values

of the environment, the concept of Total Economic Value (TEV) now widely used. TEV is the sum total of the use and non-use value of the environmental good. The use value refers to the values derived from the actual use of the resource. The use value includes direct use values, indirect use values and the option values and the non-use values include existence values and bequest values. Direct use values refers to the direct use of a protected area, indirect use value means the values derived from the indirect use of a protected area and option values are values derived from using the good in the future. Non-use value refers to the values that are not associated with the actual use of the resource. The existence values is the value derived from the knowledge that a good is existing and bequest values are those which is derived by the fact that others are benefiting or will benefit from the good.

A large number of techniques have been developed over the years for the purpose of environmental valuation. The two important methods used to estimate the disamenity effects of land fills sites are the hedonic pricing method and the contingent valuation method (OECD 1995). The present study uses the contingent valuation (CV) method, which is a direct method to elicit preferences by the use of a questionnaire survey.

CONTINGENT VALUATION METHOD

CV method is used generally for the valuation of public goods especially environmental valuation (Ciriacy-Wantrup, 1947, Davis, 1963, Mitchel and Carson, 1989, among others). CV method involves directly asking people, in a survey, how much they would be willing to pay (WTP) for a specific environmental service. Although it can be used to estimate both use and non-use values it is used widely for estimating non-use values. This method involves creating a hypothetical market for a non-market good and invites the respondents to operate in that market. The willingness to pay (WTP) will reflect the value of the particular environmental quality (Ciriacy-Wantrup, 1947, Davis, 1963, Walsh et al, 1984, Brookshire et al, 1983, Mitchel and Carson, 1989, Choe et al, 1996). The main aim of the C.V. survey is to create a hypothetical market to obtain hypothetical bids that conforms to actual bids if the actual market had existed. It is essential the hypothetical market be as close to a real market. According to the contingent valuation literature, WTP should reflect the value the community is having for a better environmental quality. The WTP of an individual is found to be dependent on several factors like income, attitude towards environment, level of knowledge. Etc. (see Mitchell, R. C. et al 1989, HanemannW.M 1991, Cummings et al, 1986, among others).

CV method, which is a simple and flexible non-market valuation method, has been severely criticized mainly on two aspects, the validity and reliability of the results and the effects of biases and errors (L. Venkatachalam, 2003). Since the market created in the CV method is hypothetical it will create hypothetical bias which is defined as the difference between the real and hypothetical payments (Neill et al, 1994, Cummings et al, 1986) Strategic bias will arise due to free riding and over pledging and it is suggested that questionnaires should be designed in such a way that the respondents are unable to behave strategically (Mitchell and Carson, 1989). The initial bid bias will arise when the starting points will influence the final WTP.

AN OVER VIEW OF THE SOLID WASTE DISPOSAL SYSTEM

In Metro Manila

Metro Manila which is also known as the National Capital Region (NCR) occupies around 0.2% (636 km2) of the total land area of the Philippines. It is the most economically active region in the whole country and it contributes around 30% of the GDP. The rising economic activity has resulted in an ever-increasing population. The Metro Manila now consists of

the original four cities, thirteen municipalities and the three municipalities converted into cities under the Metro Manila Development Authority (MMDA). With ever increasing population, the solid waste generation has shown a rapid increase. It is estimated that Metro Manila generates around 6700 tones of solid waste per day i.e. around 2.5 million tones per year and the figure is expected to go up in the coming years. Quezon city itself contributes 20% to the total waste generated. Of the total solid waste generated about 5600 tones enters the municipal collection system (ADB 2003). The local governments are responsible for the collection and disposal of solid waste in Metro Manila. The method of land filling is the most widely used way of disposal. In the Philippines there are around 868 open dumpsites (National Solid Waste Commission). In Metro Manila there are now nine active landfills. Of the 6700 tones of solid waste generated daily in Metro Manila around 5700 tones (83%) reach the municipal stream. Of the rest 720 tones (11%) are recycled and 403 tones (6%) are self disposed. Of the 5700 tones entering the municipal stream 4000 tones (61%) are disposed in controlled dumps and 1500tones (22%) are dumped in an uncontrolled manner (ADB 2003).

The Disposal Crisis

The solid waste disposal crisis in Metro Manila reached its climax with the tragedy at Payatas dumpsite, which killed around 200 people. The tragedy was in the making from the early nineties when the region started facing huge problems of proper waste disposal. The closing down of the 'Smokey Mountain' dumpsite was coincided with the opening of two sanitary landfills (SLF) viz. the world financed 73-hectare San Mateo SLF in Rizal (1991) and the 65-hectare Caramona regional SLF in Cative (1992). But their operations soon started attracting public opposition due to concerns regarding the environmental risks. Apart from this there was also the subsequent commencement of the other dumpsites like the Dona Petra and the Lupang Arenda. In early 1998, Caramona landfill operations were suspended which put huge pressure on the San Mateo and other landfills. In late 1999, the intense public opposition resulted in the suspension of operation at San Mateo. With the virtual closure of the two important landfills, Metro Manila faced the garbage crisis. The Payatas landfill started receiving increased wastes and the subsequent waste mass slide, which killed around 200 people[1].

The Study Site

The Montalban Solid Waste Disposal Facility (MSWDF), Rodriguez.

The MSWDF is situated at the hills of Lukutang Munti, SanIsidro, and Montalban Rizal 10 kms from the town. The local government of montalban runs the MSWDF, Rizal contracted to the International Solid Waste Integrated Management Specialist (SWIMS) incorporated to run its daily operation. The facility operates on a 24 hour-7 day a week operation manned by 33 personnel. ISWMS is responsible for the operation and physical development of the 14-hectare facility. The facility is divided into 6 development phases of which phase 3 are completed till now. The ISWMS owns the land and facilities but the LGU gives the permission through the Environmental Clearance Certificate (ECC) given by the DENR to operate the facility. MMDA pays the contractor the tipping fee and the amount is divided 75:25. 25% goes to the LGU while the rest is remitted to the contractor. In order to avoid environmental pollution, the sanitary landfill is provided with landfill liners, leachate collection and treatment systems, landfill gas recovery system and insect and rodent control.

ANALYSIS

The variables evaluated in the questionnaire included the presence of a list of diseases that are normally associated with

[1] For a more detailed analysis of the events see Metro Manila Solid Waste Management Project (2003), ADB.

solid wastes. They are

- Water borne diseases- diarrhea, cholera, typhoid, jaundice and dysentery.
- Vector borne disease- dengue fever.
- Other diseases-parasitic diseases, skin diseases, stomach diseases, eye trouble, respiratory diseases, rat fever, head ache, persistent cold, viral fever.

The following were the indicators used for identifying the disamenities associated with the landfill

- Foul order
- Increased population of flies, vermin, pests, particulate air pollution.
- Visual impacts (dirty surroundings, litters).

The other variables Evaluated in the Questionnaire

Table 1

Variable	Notation	Concept	Characteristics
Willingness to pay	WTP	Willingness to pay for the system	Continuous and quantitative
The ownership of the House	**Hs**	Owned (1), Rented (0)	Dichotomous
Gender	**Gen**	Male (1), Female (0)	Dichotomous
Education	**Ed**	Education: No formal education (1) Primary education (2) Secondary education (3) Higher Education (4)	----
Children	**Cd**	Have (1) No (0)	Dichotomous
Per Capita Income	**PCi**	$\frac{\text{Monthly family income}}{\text{Number of family members}}$	Continuous and quantitative
Environmental Ethic	**Ea**	Consider environmental project important or environmentally active (1), No (0)	Dichotomous

From the questionnaire, the average WTP of the sample households was calculated.

The Model

The following econometric model was used

$$WTP = b1 + b2\ PCi + b3\ Ed + b4\ Cd + b5\ Gen + b6\ Ea + b7\ Hs + u.$$

The model was used to test the following hypotheses

- WTP for improved environmental quality has a positive relation with the years of education, as education brings more awareness
- Children will be an incentive for WTP due to the concern for future generations

- Environmental ethic will be positively related to WTP.
- Having a Permanent house near the site will be an incentive for a higher WTP.

RESULTS

The major health problems faced by the households were in the form of headache, common cold.etc. The households rated the presence of foul smell as the major disamenity followed by increased population of flies, vermin, pests, particulate air pollution and visual impacts like dirty surroundings and litters.91% of households were aware of the various environmental problems. Around 79% agreed that environmental quality has worsened over the years and cited the presence of the landfill as the main reason. Around 95% of the households consider environmental projects as very important and 91% felt that environmental problems must be solved irrespective of the cost involved. The average monthly willingness to pay for an improved solid waste disposal system was 14.92 Pesos / month/ household if the government carried out the project and 26.24 pesos/month/household if a private agency carried out the project. 81% of the households cited health concerns as the main the reason for willing to pay.

The econometric model used determined that percapita income, the number of children, gender and ownership of house affects positively the WTP of the household. Environment ethic does not play any role in determining the WTP. With respect to educational attainment, those with formal education were more likely to pay than those with no education.

Ordinal Regression allows one to model the dependence of a polytomous ordinal response on a set of predictors, which can be factors or covariates. The design of Ordinal Regression is based on the methodology of McCullagh (1980, 1998).

Standard linear regression analysis involves minimizing the sum of squared differences between a response (dependent) variable and a weighted combination of predictor (independent) variables. The estimated coefficients reflect how changes in the predictors affect the response. The response is assumed to be numerical, in the sense that changes in the level of the response are equivalent throughout the range of the response.

In this particular study, the model is given by

$$P(WTP \leq j) = \exp(\alpha_j + \beta_1 * PCI + \beta_2 * Ed + \beta_3 * Cd + \beta_4 * Gen + \beta_5 * Ea + \beta_6 * Hs)$$

$$/ \{1 + \exp((\alpha_j + \beta_1 * PCI + \beta_2 * Ed + \beta_3 * Cd + \beta_4 * Gen + \beta_5 * Ea + \beta_6 * Hs)\}$$

Where $j = 0, 1, 2$.

The cumulative probabilities reflect the ordering, with $P(Y \leq 0) \leq P(Y \leq 1) \leq P(Y \leq 2) = 1$. Models for cumulative probabilities do not use the final one, $P(Y \leq 2)$, since it necessarily equals 1. In this study, $Y = 0$ denotes unwillingness to pay, $Y = 1$ denotes willingness to pay only P1.00 and $Y = 2$ denotes willingness to pay more than P1.00.

- The test below tests the hypothesis that at least one of the independent variables (PCI, Educ, Cd, Gen, Ea, Hs) does not significantly affect the household's willingness to pay.
- The p-value of the test is equal to 0.09, which indicates that the independent variables do not significantly affect the willingness to pay of the households at the 0.05 level of significance.

Model Fitting Information[a]

Model	-2 Log Likelihood	Chi-Square	df	Sig.
Intercept Only	139.087			
Final	126.734	12.352	7	.090

Link function: Logit.

a. Location = Rodriguez

- The rule of thumb for the McFadden pseudo R^2 is to conclude that the model has an excellent fit if the value falls between 0.2 and to 0.4.
- The value for this model is 0.085, which is outside of the range of perfect fit. Thus, we conclude that we failed to get a perfect fit.

Pseudo R-Square[a]

Cox and Snell	.138
Nagelkerke	.168
McFadden	.085

Link function: Logit.

a. Location = Rodriguez

- The next table shows the test of significance of each independent variable in explaining the household's willingness to pay
- The fitted model, based on the output is given by

$$P(WTP \leq 0) = \exp(-5.079 + 0.0000329*PCI + b_2*Ed - 0.479*Cd - 0.995*Gen + 0.376*Ea - 2.142*Hs)$$

$$/ \{1+ \exp(-5.079 + 0.0000329*PCI + b_2*Ed - 0.479*Cd - 0.995*Gen + 0.376*Ea - 2.142*Hs) \}$$

$$P(WTP \leq 1) = \exp(-2.249 + 0.0000329*PCI + b_2*Ed - 0.479*Cd - 0.995*Gen + 0.376*Ea - 2.142*Hs)$$

$$/ \{1+ \exp(-2.249 + 0.0000329*PCI + b_2*Ed - 0.479*Cd - 0.995*Gen + 0.376*Ea - 2.142*Hs) \}$$

$$P(WTP \leq 2) = 1$$

Where $b_2 = 0.449$ if Educ = 2, and $b_2 = 0.512$ if Educ = 3.

- If we look at the p-values of the tests (under the column labelled Sig), all values are greater than the level of significance 0.05 except for the intercept for WTP when its value is 0 (0.008) and gender (0.048). This means that the only significant variable is gender and that the intercept for WTP = 0 is different significantly from 0.
- If we look at the signs of the coefficients, we note that the coefficients for the number of children, gender and ownership of house are negative. This means that households with a bigger number of children tend to be more unwilling to pay than those with a smaller number of children. Moreover, if the head of the household is male, the household tends to lower the probability of paying. Lastly, households that owned their houses tend to lower the probability of paying.

- The variables PCI, Ea and Educ, on the other hand, have positive coefficients. This means that the higher the PCI, the more likely that the household will be willing to pay. Also, having environmental ethic helps increase the probability that the household will be willing to pay to enjoy the benefits of the project. And the higher the educational attainment, the more likely is the household to pay.
- Note that despite the logical explanation of the relationship between each independent variable and the willingness to pay, the tests say that these relationships are not significant except the one between the gender of the household head and the willingness to pay.

Parameter Estimates[b]

		Estimate	Std. Error	Wald	df	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Threshold	[WTP = .00]	-5.079	1.907	7.096	1	.008	-8.817	-1.342
	[WTP = 1.00]	-2.249	1.848	1.482	1	.223	-5.871	1.372
Location	PCI	3.290E-05	.000	.095	1	.758	.000	.000
	CHILDREN	-.479	.492	.950	1	.330	-1.444	.485
	GENDER	-.995	.504	3.893	1	.048	-1.983	-.007
	EA	.376	1.207	.097	1	.755	-1.989	2.741
	HS	-2.142	1.139	3.541	1	.060	-4.374	.089
	[A3=2]	.449	1.070	.176	1	.675	-1.649	2.546
	[A3=3]	.512	.497	1.062	1	.303	-.462	1.487
	[A3=4]	0[a]	.	.	0	.	.	.

Link function: Logit.

a. This parameter is set to zero because it is redundant.

b. Location = Rodriguez

The major conclusions of this study

- Most people living near the site believe that the environmental quality has worsened due to the presence of the landfills.
- People are generally concerned about the effects of the landfill especially the health effects.
- The per capita household income is a variable that shows positive relationship with WTP in both cases. The rest of the variables don't show consistent relationships.
- The WTP for the private agency project is higher than the WTP for the government project.
- A large number of people considers environmental projects as very important and feels that the problems must be solved irrespective of the costs involved.
- The majority of the residents in Rodriguez don't like to have a sanitary landfill in their area.

Based on the above conclusions the following recommendations can be proposed.

- The urban solid waste problems in Philippines are becoming increasingly complex and there must be a greater focus on health and the environmental aspects in the national and local level planning. Reforms to evolve and to implement programs to prevent environmental degradation and the transmission of disease-causing agents through the environment must be designed.
- The ever-increasing generation of solid waste must be tackled through innovative strategies of control. Waste

minimization, reuse and recycling of waste should be encouraged at all levels.

- Information gathered from the impact studies must be used as important guidelines for the development of and revision of policies.
- To make the new policies and plans more effective the continuous and meaningful interactions between stakeholders and the public are of great importance. Risk perception studies and impact assessment studies must be conducted on a regular basis so that community values can be incorporated in the environmental management policies.

Population growth, economic development, changing lifestyles and social attitudes, the long-term impacts of past human interventions are all contributing to increasing problems of environmental health. The problem of solid waste management in Metro Manila continues to grow exponentially. In the present study it becomes clear that the environmental problems and the health and disamenity effects in particular due to solid waste needs to be urgently addressed and a sustainable solid waste disposal system has to be evolved.

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