

A Study On Municipal Solid Waste Management And Inclusive Sustainable Environmental Development

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ABSTRACT

Environmental policies are gaining more importance and sophistication; there is growing demand supported and maintained life on earth since several decades and will continue the same in the days to come. But the subsistence of the environment in future without compromising the environmental degradation, the sustainable development is impossible. Therefore, the judicious utilization of natural resources are inevitable today to safeguard the future generation without which environmental sustainability is a daunting task. Municipal Solid Wastes (MSW) constitutes a serious problem in most urbanized cities. MSW includes commercial and residential wastes generated in municipal or notified areas in either solid or semi-solid form excluding industrial hazardous wastes, but including treated bio-medical wastes. The quality and quantity of MSW generated by a particular community will vary according to their socio-economic status, cultural habits, urban structure, population and commercial activities. The total quantity of waste generated by 23 metro cities in India was 30,000 tpd in 1999, which has increased considerably to about 52,000 tpd (Inance et al, 2004). Government bodies at all levels (central, state and municipal) are taking proactive steps to improve the MSW scene in India. The core aim of the research is to assess the economic impact of MSW in Thoothukudi Corporation in general and its environmental implications on human health in particular. Though the city of Thoothukudi is fast growing urban agglomeration but the present condition of environmental degradation is rampant due to various anthropogenic activities.

The survey results show that nearly 75 percent of the households are getting solid waste collection service including those getting private collection services but the Corporation did not fulfil the respondent's expectation with regard to municipal solid waste management, but this is based on daily generation and collection and not on the number of households getting collection services. To reduce the health and other environmental risks from inadequate MSW, it is high time the Corporation tries to provide solid waste collection service at household level, especially in South zone and North zone where these problems are most severe. Given this service coverage it is surprising that the households in Thoothukudi city is overwhelmingly (83.50 %) affected little due to solid waste and 4 percent of respondents have stated the service was worst towards municipal solid waste management (MSWM) by the Corporation. Econometric analysis of Tobit and Logit models are used to identify factors explaining the amount a household is Willingness to Pay (WTP).

KEY WORDS: Municipal Solid Waste, Inclusive, Sustainable, Environmental Development, Tobit, Logit Models and Willingness to Pay.

1. INTRODUCTION

Studies on environmental economic valuation provided a significant contribution in the field of economic sciences for an integrated management decision making process regarding environmental resources, as they favour the process of guidance, design and application of the strategies and policies applied to the protection and preservation of environmental goods and services (Santoyo et al., 2013). Environmental issues are often ignored due to various cost effectiveness of the management which leads to severe health and ecological problems of the society. One important factor of environmental problem in urban area is municipal solid waste (MSW). Improper MSW is greater threat to public health and environment. This paper analysed the MSW in Thoothukudi which is upgraded as Corporation recently by the Government of Tamil Nadu due to various socio-economic development factors. Today, MSW generation in urban cities across the globe due to increasing urbanization and consequent urban growth with more and more new colonies and extension areas, and changing life style of the people have tremendously increased and threatened the environmental sustainability. At this juncture, a holistic inclusive policy must be enacted to resort the existing MSW problems in urban cities. There are places where various forms, Corporations started the concept of promoting residential associations to look after the MSW collection in their colonies by engaging private sanitary workers. Under this circumstances, this kind of environmental problems cause greater concern over the municipal solid waste management(MSWM) which stimulate to carry out research and thereby to promote effective and efficient way of maintaining MSWM by the Corporations. This study would also to estimate further to referendum fee by way of introducing Willingness to Pay (WTP) model in order to improve solid waste management services in urban counterparts. However, survey results would also significantly facilitate to fix tariff ceiling to each and every household based on the service provided towards MSWM by the Corporation.

In 2011. Thoothukudi had a population of 17, 50,176 of which male and female were 865,021 and 885,155 respectively. The percentage of literacy is 86.52. The average literacy rate of Thoothukudi in 2011 was 86.16 compared to 81.52 of 2001. If things are looking out at gender wise, male and female literacy were 91.14 and 81.33 respectively. For the 2001 census, same figures stood at 88.32 and 75.13 in Thoothukudi district. Total literate in Thoothukudi district was 1,349,697 of which male and female were 703,106 and 646,591 respectively. In 2011 census, the child sex ratio is 963 girls per 1000 boys compared to figures of 953 girls per 1000 boys. According to the 2011 Census, the Thoothukudi district population is approximately 1.74 million as opposed to 1.57 million in 2001. The sex ratio works out to 1023 in 2011 as compared to 1050 in 2001. The decadal (2001-2011) growth rate is 10.56 per cent. The density of population in Tamil Nadu, a true indicator of population distribution, is 340 persons per sq. km in 2001, as against 369 in 2011. Thoothukudi district is today the most urbanized district in the State with 50.15 percent of its population living in urban areas.

Table:-1.1 Basic Demographic Indicators

S. No.	Indicators	2001	2011
1	Population	15,92,769	17,38,376
2	Decennial growth (%)	8.0	10.56
3	Population Density (Persons per sq. km)	347	378
4	Urban population (%)	42.28	50.15
5	Sex ratio	1050	1024
6.	Percentage of 0-6 years old	1,86,426 (11.70)	1,70,507 (9.81)

Source: Census documents 2001 and 2011

The core objective of the research is to assess the economic impact of Solid Waste Management in Thoothukudi Corporation in general and its impact on human health in particular using Contingent Valuation Method (CVM). The economic impact refers to the evaluation of work day's loss and health impact due to improper MSW by the corporation. The concept of inclusive sustainable environmental development can be achieved only by way of holistic urban planning, and providing good civic amenities by the government and thereby ensure good environment, quality drinking water accessible and free from disease – carrying germs, sanitary conditions which makes hale and healthy. All these complexities pose a greater challenge to the policy makers at this juncture. No proper MSWM measure is available. Existing legal agencies are helpless to maintain MSW in an effective way without including various stakeholders.

According to the United Nation's Centre for Human Settlements, only between 25 and 55 per cent of all waste generated in large cities is collected by municipal authorities. For instance, waste generation every day in Thoothukudi Corporation was estimated to be 218 million tonnes out of which 50% was left uncollected. As a significant portion of the population there does not have access to a waste collection service. It creates huge environmental problems among the inhabitants and caused various public health disorders, well-being and sustainability. The prevalence of health impact due to MSW in the urban areas of Thoothukudi Corporation is massive and inclusive policy is essential to curb health foregone expenditure.

2. DATA AND METHODOLOGY

The corporation is consists of 60 wards, with 1, 39,292 households which is divided into 4 zones namely North, South, East and West. This city is also called as Port city. It's having floating population around 40,000 per day. The population density is 4323/sq.km and it is also having 24 no's slums. Each zone is divided according to the size of population not exceeding a maximum of 40,670 per zone. In order to give equal representation to every zone and to every ward of the Thoothukudi Corporation, it was decided to cover 700 sample households (200 households for each zone which is having more or less 40,000 households and 100 households were chosen from the zone which is having less than 25,000 households). The field survey was performed during March 2016 to August 2016. Both primary and secondary sources of data were used. Primary data were administrated based on robust schedule based on stratified random sampling of 700 household respondents. The schedule comprises demographic particulars, environmental quality, and household WTP, door-to-door collection, available infrastructure, frequency of garbage collection, level of satisfaction of the consumers, improved MSM, health and environmental damage. Secondary health

data were collected from Primary Health Centres (PHCs), Deputy Director of Health Service, Kovilpatti- (HUD), Health Unit District, Thoothukudi and Directorate of Health Service, Chennai.

3. CONTINGENT VALUATION METHOD (CVM)

The regression models in which the dependent or response variable itself can be dichotomous in nature. Basically, it is a 'Yes' or 'No' type answer received from the respondents with regard to improvement of MSW. We use 1 or 0 value to measure and some of the respondents are willing to pay and some are not. To estimate and infer the WTPs, use Logit model. The actual contribution has been derived in terms of rupees towards MSM. In order to measure actual contribution for the respondent towards MSW, use Tobit model.

4. ANALYSIS AND DISCUSSION

The various zones were pooled to get a WTP group. Out of 700 respondents that were questioned on their WTP to improve solid waste management, 677 that is, 96.71 percent gave positive answers while the rest gave negative answers. These results have several noteworthy features. First, the model has a good fit. The chi-square value is 26.10, which is highly significant at 1 percent. Pseudo R^2 value is 0.23, which means that about 23 percent of the variations in WTP are explained by the included independent variables. Almost all the independent variables have positive influence on WTP except the variables of occupational classifications. Age variable is positively related to WTP. As the age goes up, the probability of getting a positive response also increases.

The variables – sex, income, education and distance – have a higher probability of influencing WTP for improving MSWM in Thoothukudi Corporation. In the case of sex variable, there was a higher probability of positive response from female respondents towards improving MSW as compared to male respondents. Awareness and income level was also higher among the female respondents compared to the males. When the respondent's income rises by 1 percent, the probability WTP for better MSW quality also rises by 0.4356 percent. Distance has a positive significance. Respondents residing closer to street dustbins showed higher probability for WTP for improving solid waste management. WTP dropped when the street dust bins are little away from the dwellings. Those dwellings near the landfills or disposal areas are important factors to decide positive influence on WTP since the coefficients of the variable is positive, it implies that a respondent, who has a higher education, knows about the importance of improving solid waste management in urban city and who has a higher probability of paying for it. Age and income are having a positive significance at 1 and 5 percent and sex has 5 percent level of significance.

The variable health cost also play a major role in determining WTP. If the health cost was high, the probability of WTP for improving the MSWM increased at 10 percent level of significance. Wage loss was less deciding criterion for WTP among the respondents. It directly influenced WTP and indicated a positive sign and significance at 5 percent. The deterioration of health was due to improper management of solid waste disposal and something has to be done to improve the surrounding environment.

Education at primary and high school education had a negative sign and significance at 5 percent. But education at degree level had a positive sign at 1 percent level of significance. Thus, education may also be interpreted as a proxy for the

knowledge about the poor quality of MSWM practices taking place in Thoothukudi Corporation and it clearly highlighted the importance of education at graduation level. As the level of education goes up, the probability of WTP for improving SWM also goes up. This was evident with respondents who had degree level education and those who had primary and high school level education do not have much awareness about MSW improvement. It had a positive sign and significance at 5 percent confirming the earlier results. Occupation with private, government and business groups had a negative impact on WTP. The respondents who have been working in the private sector are getting lower wages causing poor response towards WTP for improving MSWM.

Table:-1.3 Tobit Estimates of WTP for MS WM

Dependent variable: Willingness to Pay (WTP)

Independent Variables	Co-efficient	Marginal Effects
CONSTNAT	1.06689 (10.78)	0.2865
AGE	-0.00035 (-0.37)*	0.7078
SEX	-0.03282 (-1.44)*	0.1478
MS	-0.07721 (-108)***	0.2783
INCOME	-1.52004 (-1.49)*	0.1357
DISTANCE	8.75767 (0.90)**	0.3668
RUPWTP	-9.14336 (-0.75)*	0.4513
H COST	1.51179 (1.36)***	0.1733
WAGE LOSS	4.079 (0.73)**	0.4607
PRIMARY	-0.05785 (-1.40)**	0.1600
HIGH SCHOOL	-0.02822 (-0.87)**	0.3796
DEGREE	0.02785 (0.59)*	0.5512
PRIVATE	0.02426 (0.65)***	0.5152
GOVERNMENT	0.01056 (0.24)**	0.8081
BUSINESS	-0.01414 (-0.29)***	0.7666
POOR	0.02530 (0.78)***	0.8834
MIDDLE	0.04340 (1.37)**	0.2720
FAIRLY	-0.04283 (-1.16)**	0.2436
GREATELY	-0.00359 (-0.10)*	0.9173
South Zone	-0.03363 (-1.07)*	0.2839
East Zone	-0.02134 (-0.57)**	0.5649
North Zone	-0.03124 (-0.84)**	0.3989
Sigma	0.281	
Likelihood function	-188.6018	
N	677	

Source: Computed primary data

Note: figures in parenthesis show the t-values

*Statistically significant at the 1% level;

** Statistically significant at the 5% level;

*** Statistically significant at the 10 % level

Under this Tobit model, the actual magnitude of the monetary value of WTP is directly linked with the respondent's willingness to pay for improving MSWM. If the coefficient sign were positive, one unit increase in age when other things remain constant would increase the WTP amount by about 0.7078 percent. Sigma value (0.281) is highly significant. Because of this OLS is an unbiased estimate, which is highly significant, and it shows that leaving the sample would lead to selection bias. It is the case with that of the variable sex. It would increase the probability of WTP by about 0.1478 percentages for 5 percent. If the distance decreases, the probability of WTP

increases by 0.3668 percent. Health cost and wage loss have negative influence on WTP and some extent variable health has got positive influence at 5 percent level of significance. It would increase the probability by 0.1733 percent and 0.4607 percent respectively. Education has much stronger influence. As expected, it had improved the WTP amount at each level of education, namely, primary, high school and degree level, by about 0.1600 percent, 0.3796 percent and 0.5512 percent respectively. Occupation does not have any influence on the WTP amount for improving MSWM. Therefore, as predicted in theory, there are many factors that influence the WTP amount to deviate. It has negative sign and insignificant too. However, the variables government employees and business group have a positive effect on WTP. In contrast, one unit increase in the business group variable will influence WTP by 0.7666 percent as against the government employee, which is just 0.8081 percent. The respondents have responded well to the personal health loss due to solid waste as a subjective variable that influences an increase in the WTP amount by 0.2436 and 0.9173 percent, respectively, for fairly affected and highly affected variables. Thus, the estimated Tobit Model is a realistic in explaining the role of different socio-economic factors in the levels of WTP by the respondents.

Location, as captured by the variable representing different zones also influences WTP for improving MSWM. The variations in the level of WTP for the three zones are 0.2839, 0.5649 and 0.3989 percent respectively. East zone and North Zone have a higher level of WTP, as these zones generated more solid waste because port is located here and it also has huge small scale industries and commercial markets are located in these areas to generate huge volume of solid waste in this region. Another significant factor needs to be noted that, the lifestyle of the people in this zone is also one of the influencing factor to generate more MSW. The percentage of respondents who said 'yes' for the WTP question here is less as compared to other zones, whereas the actual mean value of WTP is relatively higher for East zone and South Zones showing their high income status. However, the magnitude of the amount of WTP for improving MSWM is not as much as we expected in all the zones. It has the negative sign with a statistically insignificant value.

It is important to note that it might be possible and correct to directly formulate a linear regression model based on OLS method using maximum WTP figures as the dependent variable. Similar to WTP, the data employed also exclude the protest bids. In addition, outliers are also identified and excluded from the estimation process. The outcome of the OLS model is given in Table-1.3 and the outcomes of both linear models are mostly on the expected lines, not only in terms of variables that affect the fees but also their signs and levels of significance. For WTP, coefficients associated with the variables: referendum fee, level of education, income, need of the study, severity of existing solid waste management practices and whether a respondent is living near street dust bins are all observed to be significant. Their positive relationships are also consistent with what we have predicted. It should be noted that sex seems to play a significant role in determining WTP in this equation. However, a relatively low R-squared is a bit of a concern. The explanation might lie on the fact that the actual fee (value of WTP) that respondents are willing to sacrifice has a very wide dispersion and their increments are very small, making it difficult for a model to precisely determine each individual figure. However, the results indicate a significant positive relationship between the referendum fee and the stated fee.

Regression results indicate that 26.10 percent of the variation in WTP was explained by the hypothesized household characteristics. Only age and marital status were not significant in explaining household WTP. This may perhaps be due to multi-

colinearity. All coefficients for the income and education variables were highly significant and negative as expected, suggesting that respondents who were degree holders (17.25%) with a household income in the range of Rs. 15,001 to Rs. 20,000 or more were willing to pay significantly more than those in other income and education categories. Hypothesis testing indicates that respondents who were degree holders with household incomes between Rs.15,001 and Rs.20,000 were also willing to pay significantly more than most respondents with less education and equal or less income. This finding, in conjunction with the lack of significance of most other differences in the above table suggests that income and education may not significantly influence WTP unless a respondent is a degree holder. The significance of the coefficients for income and education suggests that degree holders who were in the highest income class were willing to pay about Rs.300 more than degree holders with household incomes between Rs.20,001 and Rs.25,000. Hence, for degree holders, the level of income appears to be important.

The coefficients for sex (-1.44) had their hypothesized signs and were highly significant. Female respondents (SEX) were willing to pay about Rs. 185 more than male respondents, while respondents who depended on piped water or bottled water for drinking were willing to pay about Rs.85 less than those who relied on bore well or river water. Those who said they were very concerned about health risks from the proposed landfill were willing to pay Rs.350 more than those who said they were unconcerned. Another major finding of the results show that household size significantly reduced WTP only for households with more than four members. It seems possible that the lack of difference in WTP between the one-to-three person households may be due to likely presence of children in the latter offsetting the effect of the lower per capita income on ability to pay. The year of residence in Thoothukudi is also significant in determining WTP. However, certain anomalies existed in its parameter estimates. Because of the residence loyalty, one might expect that the respondents who had lived in Thoothukudi City longer would be willing to pay more than those who had moved in more recently. Another interesting point to be noted in the field survey is that the household characteristic that exhibited an unusual pattern in its coefficients was the distance of the household from the dustbins. Respondents who lived closer to the dustbin were expected to be willing to pay more than those who lived farther away. This pattern holds for distance of up to 500 meters, with households who lived within 50 to 250 meter were willing to pay between Rs.200 and Rs. 150 more than those who lived within 250 to 500 meters. However, those who lived more than 500 meters from the dustbin were not willing to pay significantly less than those who living within 200 meters. They were, in fact, willing to pay significantly more than those households located within 300 to 500 meters.

These findings reported above are valuable to policymakers for several reasons. First, since Thoothukudi Corporation is about to develop comprehensive MSWM plans, it could use the approach adopted here for evaluating the external costs or benefits of all wastes disposal alternatives including the use of street dustbins, landfill disposal, incineration and recycling. If such expenditures are to be made in a cost-effective manner, a more complete analysis is needed to compare the total costs of all solid waste disposal alternatives. Second, if minimizing the overall costs was the only objective and if similar results were found to hold for other areas, one might conclude that landfills should be sited in areas with fewer degree holders in higher income classes. However, equity considerations would likely limit an explicit statement of such a strategy publically.

5. CONCLUSION

With the growing amount of MSW and concerned Corporation inability to manage it properly mainly due to financial constraints, collecting fees from the public for improving the inclusive sustainable MSWM service seems to be the only viable option. This study was conducted in Thoothukudi Corporation of Tamil Nadu where the waste collection service is limited only to certain urban areas. It estimates WTP by 700 households selected based on stratified sampling method from all four zones of the municipality for improved MSWM service of waste collection and the factors influencing it. This study administered the CV method which directly asks the beneficiaries of their desired amount under hypothetical circumstances with the assumption that it will be implemented in the near future. The logit regression model was used to determine the factors that influence WTP for improved waste collection service and the tobit regression model was used to determine the factors that influence the maximum amount of money that the households are willing to pay for the improved waste collection service. This study found that the majority of surveyed households (96.71%) are willing to pay for the MSWM service. The mean WTP amount that households are willing to pay is Rs.108/- (1.66 US\$) per month. The municipality or the concerned stakeholders may consider this as a reference amount to impose a MSW collection fee in Thoothukudi Corporation as no such fee has been charged to the households until now. Improved regularity of SWM services and better geographical coverage of solid waste collection can be achieved by the revenue generated by the solid waste collection fee. The factors that significantly influence households' WTP are monthly household income, education of household head, environmental awareness and waste collection service. The significant factors that influence the maximum amount of money households are willing to pay for improved MSW collection service are monthly household income, environmental awareness and waste collection service. Concerned stakeholders and policy makers should consider these traits before enforcing a waste collection fee. For instance, since households' awareness of the environmental impact is positively significantly related to both WTP and the maximum amount of waste collection fee they are willing to pay, the government and concerned stakeholders should educate the households about adverse effects of indiscriminate disposal of waste on the environment in order to achieve inclusive sustainable environmental development, it requires more funding for MSWM.

6. REFERENCES

1. Khan R.R. 1994. Environmental management of municipal solid wastes. *Indian Journal of Environmental Protection* 14 (1), 26–30.
2. Smith VK (2006) "Fifty Years of Contingent Valuation." In A. Alberini and J.R. Kahn, eds., *Handbook on Contingent Valuation*. Cheltenham, UK: Edward Elgar Publishing.
3. Sacratees J. and Hari Govindaraj G., 2014. Estimating Economic costs of Municipal Solid Waste Management: using Contingent Valuation Method, (Edited) *Urbanisation in Asia Governance, Infrastructure and the Environment*, Springer, Pp.179-196.