Do The Socio-Economic Characteristics Influence Households' Preferences For Improved Solid Waste Management Options? (A Study in the Tinsukia District of Assam)

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Abstract: The effect of various socioeconomic characteristics on willingness to pay values for services attributes of Solid Waste Management has been evaluated in this study. Municipal SWM is the collection, treatment and disposal of solid wastes generated by all categories of Municipal population in an environmentally friendly and socially satisfactory manner using the available resources most efficiently. Local Governments are generally responsible for providing the SWM services, and nearly all local government laws give exclusive mandate of collecting all the wastes disposed outside homes or establishments. As cities grow economically, business activities and consumption patterns have a bearing on the volumes and types of solid waste produced. Since the time immemorial social environment has been influencing the human behaviour. Socio-economic environment means the economic condition, involvement in various productive activities, level of income, occupational distribution, age and sex composition etc. The enormous socio-economic factors such as caste, religion, sex, educational attainment etc. can significantly influence people's decision making process. Therefore, in this paper an attempt has been made to determine the important socio-economic factors that are influencing households' choices for improved Solid Waste Management options in Tinsukia District of Assam. From the study, value of Pseudo R^2 has been found to be 0.574 which indicates that 57.4 percent variation in the choices made by respondents are explained by the hypothesized socio-economic variables. The results show that all the socio-economic variables (except DIST) included in the model has a positive impact on the selection of improved SWM option. Out of the nine socio-economic variables, only six variables are found statistically significant.

Key Words: Solid Waste Management, Socio-economic, Household, Human Behaviour, Preferences.

1 INTRODUCTION

Solid Waste Management (SWM) is the process which involves collecting and disposing of solid wastes which are unavoidable by-products of human activities (Mussa, 2015). Municipal Solid Waste (MSW) in India which includes garbage, metals, bottle or glass, plastics, paper, and fabric have been increasing in recent years because of population increase, increase in income, rapid urbanization, technology and improper throughway culture of people. The increased pace of urbanization and a migratory population pressure in urban areas has been posing a challenge to urban environment management especially in developing countries (Annepu, 2012). In general, the Municipal SWM is the collection, treatment and disposal of solid wastes generated by all categories of Municipal population in an environmentally friendly and socially satisfactory manner using the available resources most efficiently. Local Governments are generally responsible for providing the SWM services, and nearly all local government laws give exclusive mandate of collecting all the wastes disposed outside homes or establishments. As cities grow economically, business activities and consumption patterns have a bearing on the volumes and types of solid waste produced. Similarly, Productivity loss is exacerbated by longer hauls required for the fleet, as open lands for disposal are further and further away from the Municipal centers (Sansa and Kaseka, 2004). The challenge is to rationalize workers and vehicle performance, while expanding services to a growing Municipal population. Since the time immemorial social environment has been influencing the human behaviour. Socio-economic environment means the economic condition, involvement in various productive activities, level of income, occupational distribution, age and sex composition etc. The enormous socio-economic factors such as caste, religion, sex, educational attainment etc. can significantly influence people's decision making process. Therefore, in this paper an attempt has been made to determine the important socio-economic factors that are influencing households' choices for improved Solid Waste Management options in Tinsukia District of Assam.

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2 OBJECTIVES OF THE STUDY

- To analyze the socioeconomic characteristics of the residents of Tinsukia District of Assam.
- To determine the socio-economic factors influencing the households' preferences for improved solid waste management options in Tinsukia district of Assam.

3 RESEARCH QUESTION

Do the socio – economic factors like income, age, education level, household size etc. affect the households' choice for a particular option of Solid Waste Management?

4 DATA COLLECTION AND SAMPLING TECHNIQUE

Both primary and secondary data has been used in this study. Secondary data required for the study has been collected from different sources like District Handbook of Assam, Census Report, Survey Report of Tinsukia Municipal Board, Statistical Handbook of Assam etc. The primary data used in the study was collected from 220 randomly selected households through a sample survey. Sample has been drawn by following a multi-stage sampling technique. The data required for the study has been collected by personally interviewing the sample

households with the help of a structured questionnaire.In the first stage Tinsukia district has been purposively selected for the study, since it is the largest district of upper Assam region of the state in terms of geographical area and second largest in terms of population. In the second stage Tinsukia district has been stratified into towns. There are 13 towns (census + statutory) in the Tinsukia district, of which Tinsukia town has been selected as study area because it is only the Municipal Body in the Tinsukia distrct of Assam consisting of 15 wards and 131 lanes. Again the fifteen wards have been classified into 5 strata, each stratum containing 3 wards based on geographical setup, viz; east, west, north, south and central zone and one ward has been selected from each stratum based on simple random sampling method. Finally, 7 percent of households were selected from each ward using systematic random sampling method which constituted a total sample of 220. It is worth mentioning that the sampling unit is the household not the individual, since if implemented, payments for SWM services will come from households, not individuals.Econometric model specification for choice ModelingFor this particular study two models are estimated using the data from the household survey in Tinsukia municipal town. The first model is a basic specification, which shows the importance of service attributes in explaining the respondents' choice for different solid waste management options. The specification for this model is as follows:

Vij=ASCj+β1*SEG+β2*PCMD+β3*DWC+β4*CTWC+β5*CCD+β6*DTDC+β7*AMT ----(1)

Where (j = 1,2,3; ASC =0 for j=1 and 1 for j= 2 or 3)

This model looks at the utility derived from the attributes considered.

Defining variables:

Dependent variable

Vij = Utility of individual i for option from the jth option (where j=0 for status quo and j=1 for choice options)

Independent variables

ASC: This variable stands for Alternative-Specific Constant and takes the value 1 for option 2 and 3 in the choice sets and 0 for the base option. Segregation of wastes (SEG): This attribute takes the value 1 to indicate the need for separation of wastes and 0 otherwise.Pollution Control Measures at the Dumpsite (PCMD): This attribute takes the value 1 for taking some pollution abating measures at the dumpsite and 0 otherwise.Waste Collection on Daily Basis (DWC): This attribute takes the value 0 if it is absent and 1 if present.Covered Trucks for Waste Collection (CTWC): This attribute takes the value 1 if it is needed and 0 otherwise.Covered Community Dustbins (CCD): This attribute also takes the value 1 if it is needed and 0 otherwise.Door to Door Waste Collection (DTDC): This attribute takes the vale 1 indicating the need for door to door collection of waste and 0 otherwise.The coefficients of all the non-monetary attributes (SEG, PCMD, DWC, CTWC, CCD and DTDC) are expected to take on a positive sign because an increase in all these attributes will increase the utility of the respondents. Additional Municipality Tax (AMT): This attribute represents the monthly charges levied on the households. Its coefficient is expected to take on a negative sign because an increase in cost will decrease the utility of respondents. The second model is extended to include the socio-economic variables of respondents in addition to the service attributes in the choice sets. It is specified on the basis of the assumption that socio-economic variables influence respondents' behavior and preferences. However as stated earlier they cannot be included separately in the model. Because respondents' characteristics do not vary across alternatives 'Hessian Singularities arises in the estimation unless the socio-economic characteristics are introduced as interaction with either the alternative specific constant or the attributes. Nine variables are included in this extended model as interaction with the ASC. Vij = ASCj+Y1*ASCj*AGER+ Y2*ASCj*GENR+ Y3*ASCj*EUDR+Y4*ASCj*MTHIN+Y5*ASCj*QUANT+Y6*ASCj*DIST+Y7*ASCj*HOWN+Y8*ASCj*HSIZ+Y9*ASCj*RYRS+ β1*SEG+β2*PCMD+β3*DWC+β4*CTWC+β5*CCD+β6*DTDC +β7*AMT ---------- (2)This model considers the attributes together with some selected socio-economic variables. The ASC captures the mean effect of the unobservable factors in the error term for each attribute. This provides a zero mean for the error term and causes the average probability of selecting each attribute over the sample to equal the proportion of respondents actually choosing the alternative. Defining variablesAge of the respondent (AGER): A negative sign is expected for its coefficient because in most cases older people are adapted to traditional way of living and they will be less willing to pay for improvement. Age is a continuous variable in the regression model. Gender of the respondent (GENR): This variable will take the value 0 if the respondent is male and 1 for female. Since women will have more responsibility to collect and dispose the waste generate by the household, it is expected that women will have more preference than men for improved SWM plans. Its coefficient is expected to take a positive sign. Education Level of the respondent (EDUR): Respondents with higher education levels are expected to have more aware about environmental issues. This is a categorical variable and it will take the value 0 for below high school level and 1 for high school and above. Therefore its coefficient is expected to take a positive sign because it is assumed that highly educated people are more concerned about environmental issues.Monthly total household income (MTHIN): Respondents with higher income will have greater capacity to pay for the improved management options (here improved SWM is assumed to be a normal good). It is a continuous variable and its coefficient is expected to take a positive signHousehold weekly generation of solid waste (QUANT): Households generating larger amount of waste are expected to support the improved SWM options. Its coefficient is expected to take a positive sign.Household distance from the municipality dustbin (DIST): The respondents whose houses are on a smaller distance from the community dustbin are expected to choose improved options of SWM more frequently. Since their houses are closer to the community dustbins, they are expected to have better knowledge about the situation than those whose houses are located on a larger distance. Its coefficient is expected to have a negative sign. House Ownership (HOWN): This variable will take the value of 1 if the house is rented and 0 otherwise. Its coefficient is expected to take a positive value. Size of the Household (HSIZ): Households with larger family size will tend to generate greater amount of solid waste. Hence, respondents with larger family size will choose improved SWM systems more frequently than those with smaller family size and its coefficient is expected to take a positive sign.Years of Residence in the Town (RESY): Its coefficient is expected to take a positive sign since permanent residents are expected to be more concern about the environment and other problems of the area where they live. After having a clear idea about the

methodology to be employed, we can now proceed to analyze the households' preferences for improved solid waste management options in Tinsukia municipal town.

5 DESCRIPTIVE ANALYSIS OF THE SURVEYED DATA:

Since socio-economic factors are assumed to influence the people's choice of an improved SWM plan, here we will discuss some selected socio-economic characteristics of the surveyed households. Simple descriptive statistics for some selected socio-economic variables are shown in Table 1.

Table 1 shows that the mean age of respondents for the sample was around 45 years with a minimum of 20 years and a maximum of 85 years. The average years of residents of the surveyed households in Tinsukia municipal town was found to be around 22 years and the average family size was 5 members. The average household solid waste produced per week was about 10 kg and the average distance from the nearest municipality dustbin is 1 km. The mean of total household monthly expenditure was found to be Rs. 18,227 with a minimum of Rs. 2000 and a maximum of Rs. 140,000.

Table 1 Mean of Some Selected Socio-Economic Variables

Variables	Mean	Minimum	Maximum	Std. Error of Mean	Std. deviation
Age of the respondent	45.170	20.00	85.00	0.238	11.67
Years household has been a resident of the municipality	22.160	1	65	0.284	13.95
Household weekly generation of waste (in kg)	10.790	2	35	0.134	6.602
Total household monthly expenditure (in Rs.)	18227.50	2000	140000	308.26	15101.60
Distance from the nearest municipality dustbin	1.009	0.01	3.6	0.016	0.799
Age of waste manager	40.80	22	68	0.183	9.01
Size of the household	5.53	2	15	0.053	2.61
Total Household Monthly Income (in Rs.)	28102.50	2000	350000	692.831	33941.652

Source: Field Survey

Sex of the Respondents

After reviewing the literature it has been found that the sex of the respondents have a significant impact on the decision making process. Therefore, the choice of a particular SWM option is assumed to be influenced by the sex of the respondents. The percentage distribution of respondents is explained in table 2.

Table 2 Percentage Distribution of Respondents by Sex

Sex	Frequency	Percentage
Male	156	78.0
Female	44	22.0
Total	200	100

Source: Field Survey

Table 2 shows the percentage distribution of respondents in terms of their sex. 78 percent of the respondents are male and the remaining 22 percent of the respondents are females.

Educational Attainment of the Respondents

Education is an important component in any act or experience that has a formative effect on mind. In its technical sense, education is the process by which society deliberately transmits its accumulated knowledge, skills and value from one generation to another.

Table 3 Percentage Distribution of Respondents by Educational Attainment

Educational Level	Frequency	Percentage
Illiterate	12	6.0
Primary Level (I-V)	7	3.5
M.E. Level (VI-VIII)	20	10.0
High School Level (IX-X)	60	30.0
Higher Secondary	51	25.5
Degree Level	48	24.0
Master Degree	2	1.0
Total	200	100

Source: Field Survey

Table 3 shows the percentage distribution of respondents in terms of their educational attainment. Only 6 percent of the respondents were found to be illiterate and majority of the respondents have completed their education at different levels. 30 percent of the respondents have completed their education up to high school level, 25.5 percent have completed their education up to higher secondary, 24 percent have completed their education up to degree level and only 1 percent of the respondents have completed their master degree. Occupation of the Respondents Table 4 shows the percentage distribution of respondents into different occupations. Majority of the respondents (51 percent) are involved in different kind of business activities while 11.5 percent are engaged in government jobs. 16.5 percent are found to be in private sector jobs, 10 percent are housewives and only 3.5 percent of the respondents are retired from their service.

Table 4 Percentage Distribution of Respondents by Occupation

Occupation	Frequency	Percentage
Government Job	23	11.5
Private Sector Job	33	16.5
Business	102	51.0
Wage Earner	15	7.5
Housewife	20	10.0
Retired	7	3.5
Total	200	100

Source: Field Survey

Marital Status of the Respondents

Table 5 Percentage Distribution of Respondents by Marital Status

Marital Status	Frequency	Percentage
Married	176	88.0
Divorced	2	1.0
Widow	11	5.5
Single	11	5.5
Total	200	100

Source: Field Survey

Table 5 shows the marital status of respondents. Out of 200 respondents, 176 (88%) were found to be married. 5.5 percent of the respondents are widow, 5.5 percent are single and only 1 percent of the respondents are divorced.

Types of Dwelling Unit

Table 6 Percentage Distribution of Respondents by Dwelling Unit

Types	Frequency	Percentage
Pucca	109	54.5
Semi- Pucca	50	25.0
Kachha	41	20.0
Total	200	100

Source: Field Survey

Table 6 shows the types of dwelling units of the surveyed households. Around 54 percent of the respondents are living in pucca houses, 25 percent are living in semi-pucca houses and 20 percent are living in kachha houses. Around 78 percent of the respondents are living in their own houses and the remaining (22 percent) are living in the rented houses. Age of the RespondentIndividuals above the age of 21 years have been considered as sample respondents in the study. The members above age 21 in the household are considered as respondents simply because of their expectedly higher levels of knowledge, awareness, consciousness and mental maturity compared to the under 21 members.

Table 7 Percentage Distribution of Respondents by Age Groups

Age Group	Frequency	Percentage
21-30	23	11.5
31-40	52	26.0
41-50	70	35.0
51-60	40	20.0
61-70	11	5.5
71-80	3	1.5
81-90	1	0.5
Total	200	100

Source: Field Survey

6 FACTORS DETERMINING WILLINGNESS TO PAY OF RESPONDENTS' FOR IMPROVED SWM PLAN

The management of solid waste in urban areas is a critical issue for some developing countries in Asia which requires immediate attention (Subhan et al., 2014). Poor management and improper regular dumping of solid waste degrades the environmental quality and creates environmental pollution. Therefore community participation as an alternative approach to municipal own waste management is very important to tackle the waste management problem (Das and Gogoi, 2013). However willingness to pay of people is influenced by several socio-economic factors.Theoretical FrameworkDas and Gogoi (2013) have made an attempt to explore the possibility of community participation as an alternative approach to municipal waste management. According to them, community participation approach will be sustainable only if there is proper demand by the residents for better SWM service. They have identified some socio-economic factors like monthly income of the household, volume of garbage, health expenditure of the household, size of the household etc which influences people's WTP for improved SWM plans. Roy et al. (2013), have conducted a study to determine residents' WTP for sustainable solid waste management scheme in Silchar municipal area. According to them, WTP of of residents' is influenced by factors like average monthly household income, household size, average education, environmental awareness, number of working women in the household etc. Again Banga et al. (2011) have concluded that WTP of residents' is influenced by monthly household income, education, age, occupation, and house ownership. According to Subhan et al. (2014), WTP is affected by type of house, age of respondent, gender, race, educational qualification, recycling practices, monthly household income and family size. Some other studies (Chuen-Khee and Oathman, 2009) concluded that WTP is influenced by both socio-economic and environment attitudinal factors. They have identified thirteen such variable to influence the WTP and they are- distance ratio of proposed site to existing site of SWM facility from residents' residence, age of the respondents, household size, number of children below 10 years in the house, gender of the respondents, race, respondents' concern about where the SW they generate would be disposed, respondents' relation with any environmental organization, house ownership, educational qualification, occupation, monthly household income, respondent' support to peaceful street demonstration to stop construction of harmful SW disposal facility.Specification of the Empirical Model Existing literature indicates that the residents' WTP is influenced by several socio-economic and environmental attitudinal factors. For the present study nine socio-economic factors has been specified. These variables have been included in the model as interaction with ASC. Since the respondents' characteristics do not vary across alternatives, we can not include the socio-economic variables separately in the model (Jin et al., 2005).

$$Vij = ASCj+Y1*ASCj*AGER+ Y2*ASCj*GENR+ Y3*ASCj*EUDR+Y4*ASCj*MTHIN+Y5*ASCj*QUANT+Y6*ASCj*DIST+Y7*ASCj*HOWN+Y8*ASCj*HSIZ+Y9*ASCj*RYRS+ β1*SEG+β2*PCMD+β3*DWC+β4*CTWC+β5*CCD+β6*DTDC +β7*AMT ---------- (3)$$

This model considers the attributes together with some selected socio-economic variables. The ASC captures the mean effect of the unobservable factors in the error term for each attribute. This provides a zero mean for the error term and causes the average probability of selecting each attribute over the sample to equal the proportion of respondents actually choosing the alternative.

Table 8 Description of the Explanatory Variables

Variable	Definition	Type	Value
AGER	Age of the respondents	Quantitative	
GENR	Gender of the respondents	Categorical	0 for male and 1 for female
EDUR	Educational attainment of the respondents	Categorical	0 for below high school level and 1 for high school and above
LNMTHIN	Log of total household monthly income	Quantitative	
QUANT	Quantity of waste generated by household on weekly basis	Quantitative	
DIST	Distance of respondents' house from the nearest community dustbin in kms	Quantitative	
HOWN	Ownership of the house	Categorical	1 if yes and 0 otherwise
HSIZ	Size of the household	Quantitative	
RESY	Years of residents in the town	Quantitative	
ASC	Alternative specific constant	Categorical	1 for improvements and 0 for status-quo

The socio-economic variables (RESY, GNR, MARS, DIST, AGER, EDUR, MTHIN, QUAN and HOWN) have been included in the model by interacting them with the ASC to account for the heterogeneity in preferences. The results of the extended CLM are displayed in table 9

Table 9 Results of the extended Conditonal Logit Model

Variables	Coefficients	Std. Error	P> |Z|
ASC	-0.447	0.975	0.646
SEG	1.729*	0.209	0.000
PCMD	0.941*	0.151	0.000
DWC	2.273*	0.229	0.000
CTWC	1.980*	0.201	0.000
CCD	0.424**	0.205	0.039
DTDC	2.655*	0.211	0.000
AMT	-0.064*	0.006	0.000
ASC*AGER	0.028**	0.014	0.049
ASC*MTHIN	0.855*	0.256	0.001
ASC*EDUR	0.269**	0.133	0.046
ASC*DIST	-0.201**	0.093	0.030
ASC*GENR	1.029**	0.4656	0.027
ASC*HSIZE	0.141**	0.068	0.037
ASC*RYRS	0.012	0.010	0.274
ASC*HOWN	0.670	0.375	0.740
ASC*QUAN	0.008	0.027	0.764

**denotes significance at 1 % level and ** denotes significance at 5 % level*

Summary Statistics:
Log Likelihood = -373.60 Pseudo R2 = 0.574
LR Chi2 = 967.61 Iteration Completed = 5
No. of observation = 2398 Sample = 200

The value of Pseudo R^2 is found to be 0.574 which indicates that 57.4 percent variation in the choices made by respondents is explained by the hypothesized socio-economic variables. The results show that all the socio-economic variables (except DIST) included in the model has a positive impact on the selection of improved SWM option. Out of the nine socio-economic variables, only six variables are found statistically significant. Total household monthly income (MTHIN) is found to be statistically significant at 1 percent and its coefficient has a positive sign which indicates that respondents with higher level of income have greater capacity to pay and would choose the improved SWM option more frequently. Every one unit (i.e. 1 thousand) increase in income increases the probability of selecting improved option by 0.85 units. The coefficient for education (EDUR) is positive and significant at 5 percent significance level which suggests that respondents with higher level of education would have greater awareness about the existing SWM problems and would prefer the improved plans of SWM. It means that if the people are educated above high school level then the probability of selecting an improved SWM option increases by 0.26 units. The coefficient of the household size (HSIZE) is also positive and significant at 5 percent level which means that the households with larger family size are more frequently in favour of improved SWM plans. The reason may be that the households with larger family size would generate more solid waste and support the improved plans of SWM more frequently than the households with small family size. The coefficient for the household' distance from the nearest community dustbin (DIST) is negative which indicates that the respondents whose houses are located at a larger distance from the municipality dustbin are not in favour of improved SWM plans. The result implies that every one meter increase in distance from the community dustbin decreases the probability of selecting an improved SWM plan by 0.20 units. This reflects that if the community dustbins are provided at a more frequent interval then residents will favour the improved plans of SWM. Again the coefficient for the age of the respondent (AGER) is found to be positive which is in opposite of the priori sign. The positive coefficient indicates that more aged respondents would favour the improved SWM plans more frequently. Again the coefficient for the gender of the respondent (GENR) is also positive indicating that female respondents are in more favour of improved SWM plans than the male respondents. This may be due to the reason that women are mainly responsible for kitchen works and solid waste management activities, so they are more concerned about the improved SWM plans. The coefficient for the years of residence (RYRS) is positive which indicates that the permanent residents would take the improved plans of SWM than the temporary residents. It means that every one unit increase (i.e. one year) in residence year increases the probability of selecting an improved plan of SWM by .01 units. However, the coefficient for residence year is not statistically significant.Out of the nine socio-economic variables, five are statistically significant at 5 % level and income is significant at 1 percent level. Compared to the basic CLM , the extended CLM has a high level of parameter fit. The larger the value of Pseudo Rsquare Statistic, the better is the fit of the model to the observed data. As it can be seen from the results that the extended model has a larger Pseudo Rsquare (57.4%), so its fit is also better than the basic CLM.Similar type of results has been found in some other studies also. Some studies have interacted the socio-economic variable with alternative specific

constant (Jin et al. 2005, Berihum, Y. 2010) and some others have interacted it with the attributes of the service (Das et al. 2008).

7 CONCLUSION

The results of the model suggest that the socio-economic factors have been influencing the households' preferences for improved SWM plans in Tinsukia district of Assam. Age of the respondent, monthly household income, education of the respondent, gender of the respondent, size of the household etc. are some significant socio-economic factors that have significant impact on households' preference for improved SWM plans. From the study, value of Pseudo R^2 has been found to be 0.574 which indicates that 57.4 percent variation in the choices made by respondents are explained by the hypothesized socio-economic variables. The results show that all the socio-economic variables (except DIST) included in the model has a positive impact on the selection of improved SWM option. Out of the nine socio-economic variables, only six variables are found statistically significant. Policy makers should take into account the information about the preference of service receivers to design appropriate solid waste management in Tinsukia.

8 LIMITATIONS OF THE STUDY

This study analyses households' preferences for improved solid waste management options in Tinsukia municipal town using one of the stated preference approach known as choice-modeling (CM) technique. The study is limited to residential solid waste and does not include commercial and industrial solid waste so as to avoid complications.

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