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Chapter

Household Willingness to Pay for Improved Solid Waste Management Services: Using Contingent Valuation Analysis in India

Muniyandi Balasubramanian

Abstract

Solid waste management is one of the crucial problems in India. An increasing population, industrialization and urbanization have major sources for increasing solid waste in India. The per capita waste generation in India is between 0.6 and 1 kg per day also expected to increase in future. This chapter has discussed two important aspects first; there is lack of study on economic analysis India, second most of the studies have focused on urban solid waste management in India. The present study has used household willingness to pay through the contingent valuation method for improved solid waste management of 150 household in semi-urban areas in Madurai, India. The study has found that the household respondents are willingness to pay Rs 24 (US$ 0.34) for clean environment in the semi-urban area. This study has also found more than 95% of household respondents are willing to pay for solid waste management in Madurai. Most of the household respondents are felt improper solid waste management has one of the important reasons for health issue particularly for children and elderly people in the study area. The main policy implication of the study is to design proper solid waste management plan for collection, transportation, disposal and segregation of solid waste in semi-urban areas in India.

Keywords: solid waste, willingness to pay (WTP), recycling, India

1. Introduction

Solid waste management (SWM) is continuous to be a major challenge in developing world. Due to lack of appropriated planning inadequate governance, resource constraint ad ineffective management, solid waste especially insufficient collection and improper disposal of it is major problem for developing countries [1–10]. Solid waste in developing countries are less generated compared developed countries (see [2, 11, 12]. Solid waste generation is an increasing global environmental problem [13]. Moreover, most of the developing countries are still in the early stage of their urbanization and economic development process, people generally believe that a fast increase in solid waste generation should be unavoidable in the developing

countries [12]. Solid waste collection is one of the important problems in developing world like India. Smaller cities and town collect less than 50% of solid waste per day. Poor solid waste collection has creating many environmental and health problem in city in general particular in semi-urban areas. The annual waste generation has been observed to increase in proportion to the rise in population and urbanization, and issues related to disposal have become challenging as more land is needed for the ultimate disposal of these solid waste [14] More recently, cities have begun paying more attention to enhancing municipal system and suitable solid waste service delivery with special emphasis on involving the private sector.

Poor solid waste management in the developing countries consists of a major threat public health and environmental quality and reduces the quality of life particularly for the poorer residents in both urban and rural areas [12]. This paper reveals the supply side of solid waste management services have always been the major environmental problem in India previous research did only reduce the waste quantities and increasing recycling, landfilling, generation, collection and economic analysis if so, especially contingent valuation method for willingness to pay by how much? Although many studies have been carried out to answer this question.

1.1 Solid waste problem in India

India is the second largest nation in the world with a population of 1.21 billion, accounting for nearly 18% of world's human population, but it does not have enough resources or adequate systems in place to treat its solid waste. Its urban population grew at rate of 31.16% during the last decade to 377 million, which is greater than the entire population of the United States, the third largest country in the world accounting to population [15]. Solid waste management is a significant and growing problem in many urban areas in India due to economic development, urbanization, and improving living standard in cities of developing India have led to increase in the quantity of complex composition of municipal solid waste. Management of municipal solid waste resulting from rapid urbanization has become a serious concern for government departments, pollution control agencies, and regulatory bodies and public in most of the cities in India. The challenges of solid waste in Indian cities and town it addressed by various agencies the responsibility of the collection, removal and disposal of garbage from public places in urban areas and maintenance of dumping ground however, comes under the purview of the local municipal body which is the main formal stakeholder involved in the governance of solid waste management in India [16]. Solid waste management has been the most neglected area of urban development over the years and has accounted for severe health problems in urban areas all over the country. A number of cases have come to light because of mismanagement of municipal solid waste management [17]. Solid waste management has been major concern in developing India see [18–23] in urban areas. Moreover, increasing consumerism and development of technology also has increase in solid waste management process in semi-urban areas in India see [17, 24–27] lack of data and inconsistency in existing data is a major hurdle studying in developing nations like India. Semi urban area is very little information regarding solid waste produced in peri-urban areas unsatisfactory level of environmental services such as water supply the management of solid waste is going through a critical phase due to the unavailability of suitable facilities to treat and dispose large amount of municipal solid waste get generated daily metropolitan cities. Lack of financial resources, institutional weakness and improper technology and public apathy towards municipal solid waste are listed among the bottlenecks to provision of efficient and effective municipal solid waste management in India [24].

Municipal solid waste management has been found critical to public health and environmental improvements, urban areas of India became acutely aware of the problem in 1994, in the waste suspected in plague epidemic in Surat, an industrial city in the state of Gujarat. The first major attempt to develop a national strategy of solid waste management by National Environmental Engineering Research Institute [28], focused mainly the issues of urban areas with population more than 100,000. The Central Pollution Control Board study also reported widespread use of unnotified dumpsites for disposal of solid wastes in these towns. In spite of spending 30–50% of the total municipal budgets on solid waste management [29]. The unsatisfactory outcomes of current solid waste management services points to need for a sustainable solid waste management approach in semi-urban areas [27]. Delivery services is the another consequences of poor managed finance the failure of municipal bodies to deliver basic urban services. The management of solid waste in small towns in a particularly useful indicator of the efficiency of urban local bodies metropolitan cities are better provided with both water and solid waste management system then other urban and semi-urban centers [25]. The author also points out in Mirzapur (North-India small town) area, rickshaws piled high with waste can be seen careening through the streets, often through the streets, often depositing half of what they have collected on the road. The rest is thrown on the banks of the river Ganga that runs through the town. In Janjgir, even cycle rickshaws are not available. Men pulling handcarts clear the garbage. This naturally reduces the efficiency and frequency of collection. Many municipal bodies in small towns do not have the funds to transport solid waste to dumps outside the urban area. As a result, it is dumped within town limits. Hence, while in Mirzapur you see piles of garbage alongside the temples that dot the banks of the river Ganga, empty plots within town limits inevitably become garbage dumps in other towns.

2. Contingent valuation analysis

The Contingent Valuation Method (CVM) is a widely used non-market valuation method especially in the areas of environmental cost–benefit analysis and environmental impact assessment [30–32]. Contingent valuation is now used around the world in recent years, CVM has been extensively used in both developed and developing countries for valuation of a wide range of environmental goods and services (see [5, 33–37]). Ciriacy-Wantrup [38] had first proposed the contingent valuation method. Had discussed an individual should be interviewed and asked how much money they are willing to pay for successive additional quantities of collective extra-market good. If the individual values are aggregated the result corresponds to a market demand schedule (See [39]). Contingent valuation method of solid waste management research also emerged in developing countries Whittington et al. [37] Kathumadu in Nepal, [40] Gujranwala city in Punjab in Pakistan, Weldesilassie et al. [41] Addis Ababa Ethiopia, Murad et al. [42] and Chuen-Khee and Othman [1] in Malaysia, [43] in Yunnan Province China, Fonta et al. [44] in Nigera, Jianjun Jin et al. [45] Macao in China. India is very few studies to investigate the effect of waste of waste separation on the willingness to pay for improved waste management services for example Prasenjit Sarkhel and Sarmila Banerjee [46] adopted the contingent valuation method (CVM) with willingness to pay (WTP) of the household for waste management programme in a typical Indian Municipality the Ballay municipality in west Bengal including the willingness to pay questions, the contingent valuation questionnaire was divided into seven parts and the total number of samples were 570 and the mean willingness to

pay from the responses to the open-ended questions was calculated 75% of the respondents expressing their willingness to pay at less than $ 1 per month regular waste collection in Bally the municipality in West Bengal. Sukanya Das et al. [47] had studied in the willingness to pay (WTP) for improvements in the solid waste management (SWM) services provided in Chandernagore and south Dum Dum municipality of Greater Kolkatta in West Bengal in this study 101 randomly selected residents took part in that choice experiment survey. Data were analyzed with conditional logit and random parameter logit with the interactions models. The study had revealed that on an average the residents of these municipalities were willingness to pay less than $ 1. While, this study had indicated that the public on average cared much about improvements in solid waste management in their locality.

3. Background of the study

Madurai has an area of 52 km^2 with in an urban area now extending over as much as 130 km^2 and it is located at show location on an interactive map 9°56'N 78° 07′E/ 9.93°N 78.12°E 19.93; 78.12. It has an average elevation of 101 m above mean sea level [48]. In Madurai city the daily generation of waste escalated from 360 tonnes in 2001 to 543 tonnes in 2011 [49]. The semi-urban waste generation per day 67 tonnes [50, 51]. **Table 1** shows that Avaniyapuram generates the highest waste generates among the major semi-urban areas in Madurai. Madurai city has a

Sl. no	Semi-urban areas	Male	Female	Total	Solid waste generation metric tonnes per day
1	Paravai	8346	8000	16,346	4
2	Vilangudi	10,640	10,433	21,073	2
3	Anaiyur	19,305	18,997	38,302	3.2
4	Avaniyapuram	27,099	25,907	53,006	17
5	Tiruparankundram	19,615	1939	39,009	14
6	Harveypatti	4089	44,046	8135	2
7	Thirunagar	7640	7909	15,549	1.3
8	A.Vallaiapatti	3529	3539	7068	2
9	Palamedu	4127	4060	8187	2.4
10	Vadipatti	10,875	10,905	21,780	4
11	Sholavandan	10,845	10,816	21,661	3.4
12	Alanganallur	5574	5490	11,064	3
13	Elumalai	7051	6979	14,030	2.8
14	Peraiyur	4512	4368	8880	2.5
15	T. Kallupatti	4857	4582	9439	3.4
	Total	**148,104**	**167,970**	**293,529**	**67**

Source: Author's calculation.

Table 1.
Semi-urban areas of Madurai District.

number of problems with collection and disposal of solid waste in general semi-urban areas in particular. First collection coverage is hugely inadequate, second lack of cost recovery and the unsustainable fee structure for current waste collection and disposal are serious issues. Solid waste management is one of the important obligatory functions of rural areas. However, this has not been efficiency performed by the urban local bodies Madurai rural solid waste generation has been significantly increase for example, generation of agricultural waste is 4.32 tonnes for every 3 months but did not properly reuse or recycling semi-urban and rural areas having more problems such as electricity, water supply, lack of ponds or through tube wells. What about solid waste lie uncollected along roadsides or if collected are dumped in an low-lying land. The practices are not only despoiling the local landscape but are an immense health hazard. The rapid growth of population in semi-urban areas in the last decade has meant that the volume of solid waste liquid waste has increases but the institutional capacities to handle them, remain absent [24, 25, 27]. This study has introduction of service charges for solid waste management has been received much attention among local bodies due to the continuous financial shortage of the local government for providing waste management services to an acceptable level. The pricing this service has expected to bring about efficiency as well as sustainability in providing this services.

Sampling and design of survey questionnaire.

4. Materials and methods

The study is confined to Madurai semi-urban areas. Madurai district (region) is existing 15 semi-urban areas (see **Table 1**). The sample units were selected adopting the stratified random sampling method. A total of 150 schedule 10 household respondents from each semi-urban area. The design of the survey followed recommendations from the NOAA panel on contingent valuation (see [52, 53]) and consist of two sections. Questions in the survey's first section asked about respondent's socio economic conditions in the household's survey section two questioned respondents about their willingness to pay. The hypothetical improved condition, and how each consumer would pay for the improved waste management services in Madurai (**Figure 1**).

The contingent valuation employed a single-bounded dichotomous choice format by open-ended questions in the WTP section. The survey was conducted March–April 2012. The survey was given to 150 randomly selected in Madurai semi-urban areas data covered socioeconomic characteristics of the household, including gender, age, marital status, education, household income, family size, employment and WTP for environmental improvement and better solid waste management. **Table 2** describes the variables.

4.1 Willingness to pay for improved waste management services in the study area

The **Logit regression** model had been used for studying about the probability of occurrence of an event by fitting a logit function. It is a generalized linear model used for binomial regression. The logit model was adopted since the Ordinary Least Square (OLS) producer was not appropriate particularly when the dependent variable is dichotomous. The problem with the OLS estimate however is the non- fulfillment of $O = (Y_i/X)$ since $E (Y_i/X)$ in the liner probability model measures the conditional probability of the event Y occurring given X_1 and must necessarily lie between 0 and 1 [54]. Like many other forms of regression analysis,

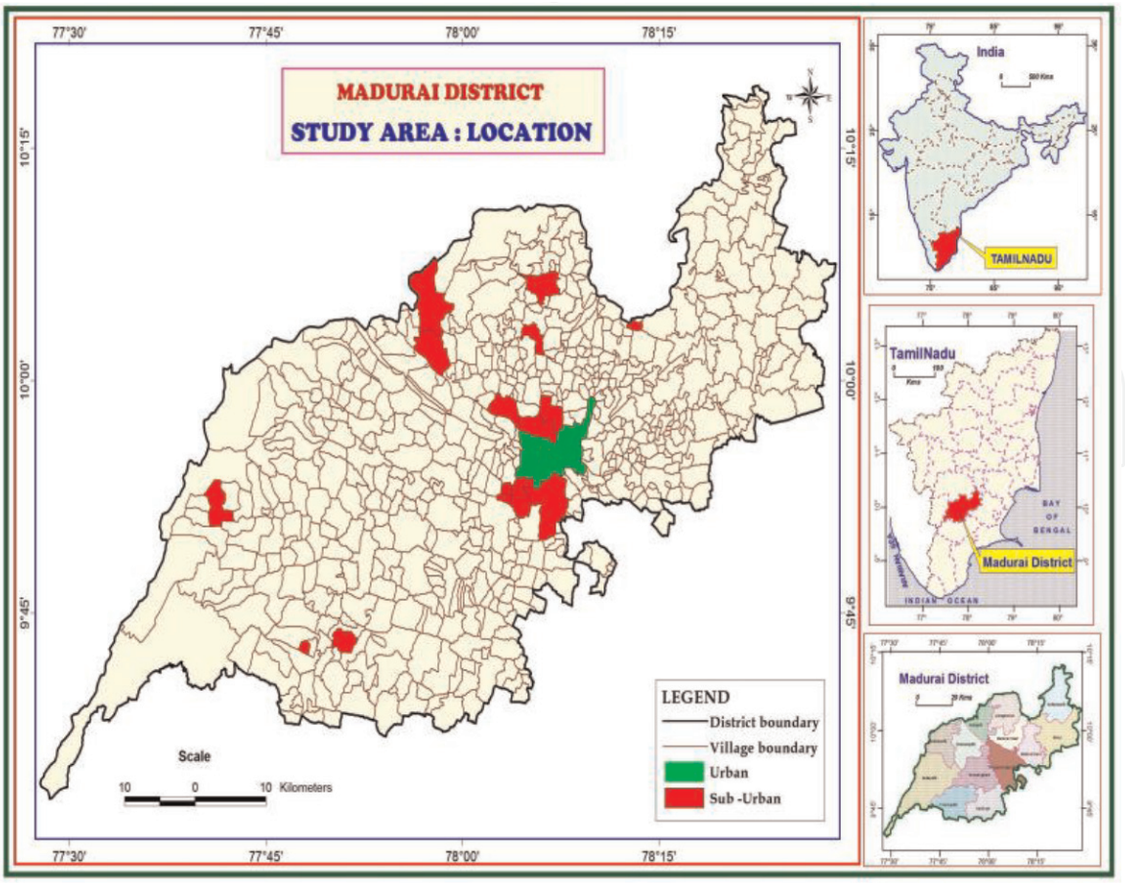

Figure 1.
Madurai semi-urban areas.

Variable definition	Description
Willingness to pay (WTP) de. var	1 if willingness to pay 0 otherwise
Age (AGR)	Age of respondent in year
Sex (SER)	Gender of respondent coded as 1 male for 0 female
Educational level (EDL)	Education of respondent represented as 1 for primary 2 for secondary 3 university level
Family size (Fam_Sz)	Number of members of the household
Income	Monthly income of the head of respondent in INR
Not satisfied	Are you satisfied for the present cleaning status if yes 1 and 2 no
Maximum amount willing to pay	Maximum amount of willing to pay for improved solid waste management

Table 2.
Description of the variables.

it makes use of several predictor variables that might be either numerical or categorical. This Study had applied the logit regression of willingness to pay for improved environmental quality, to determine the willingness of the respondents to bear the costs of improving the environmental quality in the study area. The Logit Model had been used to analyze the respondents' willingness to pay for an improved waste management service and the factors influencing their willingness to pay.

4.2 Willingness to pay for improved waste management services

To obtain the willingness to pay by the households for an improvement in their solid waste management, the responses of the households for willingness to pay was regressed on the socio economic characteristics. The coefficient estimates obtained for the WTP of the respondents (sex, age, education, family size, monthly size, monthly income, present cleaning status and maximum amount), the logit regression Model [55] was specified as

$$Y = \frac{1}{1+\exp^{-(\beta_0 + \beta_1 x)}}$$

where

Y = Response of households', sex, age, education, family size, monthly size, monthly income, present cleaning status and maximum amount of willing to pay for respondents to the willingness to pay question which was either

'1' if Yes or '0' if No.

β0 = is the intercept which is constant

β1 = is the coefficient of the price that the household are willing to pay for waste management services.

X = is a set of independent variable

4.3 Factors influencing willingness to pay for improved waste management services

To identify the factors influencing the willingness to pay of the sex, age, educational level, family size, monthly income, present cleaning status and maximum amount of willing to pay of the respondents for improved solid waste management, the respondents to the willingness to pay was regressed on the prices they were asked to pay and on the other socio- economic characteristics of the households. The logit regression Model was specified as

$$Y = \frac{1}{1+\exp^{-z}}$$

$Z = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_3 + \beta_4 x_4 + \beta_5 x_5 + \beta_6 x_6 + \beta_7 x_7$

Y = Response of the education, occupation, household size, income, method of collection, agency of collection, amount they were willing to pay, for the respondents to the willingness to pay question which was either '1' if Yes or '0' if No.

$\mathbf{x_1}$ = sex (dummy: Male = 1, Female = 2),

$\mathbf{x_2}$ = Age (years),

$\mathbf{x_3}$ = Education (Dummy: Primary = 1, Secondary = 2, University level = 3),

$\mathbf{x_4}$ = Family size (numbers),

$\mathbf{x_5}$ = Monthly income INR (Indian rupees'00),

$\mathbf{x_6}$ = Present solid waste cleaning status if satisfied **(dummy: yes = 1, no = 0),**

$\mathbf{x_7}$ = maximum amount of willing to pay.

The pseudo-R square and the chi-square were used to measure the goodness of fit of the model and the significance of the model used.

Table 1 had depicted population and solid waste generation of semi-urban areas of Madurai district. Avaniyapuram has been highest waste generation in Madurai

	N	Minimum	Maximum	Mean	Std. devia
Willingness to pay	150	1.00	2.00	1.2267	42,008
Sex	150	1.00	2.00	1.1667	0.37393
Age	150	26.00	74.00	46.9600	11.82585
Education	150	1.00	3.00	1.2067	0.50894
Working status	150	1.00	2.00	1.2600	0.44010
Occupation	150	1.00	4.00	2.3000	1.07909
Monthly income	150	2300.00	18500.00	7865.2000	3902.80448
Family size	150	1.00	2.00	1.4400	0.49805
Maximum amount wtp	150	00	3.00	2.4067	0.72442
Present status	150	00	1.00	0.2933	0.45682

Source: Author's calculation.

Table 3.
Descriptive statistics.

compared to other semi-urban areas. This table clearly shows that the Thiruparankundram semi-urban areas are second highest population and waste generation. Semi- urban areas had been one of the more wastes contribution by these percentage are in Madurai district; per day total waste generation 67 metric tonnes as shown in table (**Table 3**).

4.4 Data description

Table 4 provides WTP responses in relation to the socio economic characteristics of the sample households. About 96% of the respondents had positive WTP values for the improvement in solid waste management services. The average monthly income of the sample households was INR 7865 with a minimum monthly income INR 2300 and a maximum of the INR 18500. The average of respondents was 46 years and average family size 1.44. Furthermore, about 50.7% of the respondents were willing to pay more than 100 for clean environmental services. While this survey had found that the highest percent of the respondents had primary education 84 and 11.3% respondents was secondary education level. Found this survey percent of the respondents mentioned the solid waste problems in their neighborhood to be one of the most urgent environmental problems.

5. Results and discussion

In this section, we present the discuss the result of the logit regression analysis to help determine which factors are significant for improved solid waste management services as well the amount respondents are willing to pay.

The 150 completed interviews, 4 respondents had invalid responses[1] to the valuation question. For only one variable was quite significant. CVM method suffers from one more problem, that is, how to estimate aggregate values based on the

[1] By invalid, an identified actual or protect or zero to the valuation questions by asking respondents not willing to pay for SWMS. In this respect 2 respondent had no faith in the scheme, 1 respondents had already paid some kinds of taxes to local government, and 1 had insufficient income

individual values expressed through willingness to pay. **Table 5** the logit results for the variables that are significantly related to the probability of providing positive WTP values. While sex, educational level, family size, present solid waste management system is not satisfied, and age, educational level and maximum willingness to pay are negative. The study had significant found that the sex is important significant factor for improved solid waste management services in the study area. The sex and willingness to pay services 10 percent level of significance.

This study had found that the age and willingness to pay no significant effect on the amount of willingness to pay for improved solid waste management services. WTP and educational is also no quite significant and the maximum amount of willingness to pay for improved solid waste management services are negative responses represent from respondents in the study area. Household income and willingness to pay for solid waste management services in important significant factor [2] this study had found that the income is insignificant for improved solid waste management services. As seen in **Table 4** low income people are interesting more willing to pay but it quite significant 74 respondent out of 150 are willing to pay for improved solid waste management services. The current solid waste management system is unsatisfactory in urban Indian in general and semi-urban in particular. This study had found that the 70.7 percent of the respondent are felt current solid waste management system is satisfied. Indian municipalities have overall responsibility for solid waste management their cities or local areas but most of the cities and semi-urban areas currently unable to fulfill their duty to ensure environmentally sound and sustainable ways of dealing with waste generation, collection, transport, treatment, and disposal. The failure of municipal solid waste

Socio economic variable		**WTP (Yes/No for improved solid waste management services)**	
		Yes	**No**
Gender	**Male**	**96**	**29**
	Female	**20**	**5**
Age of household head (in years)	26–36	29	7
	37–46	33	11
	47–56	28	11
	57–66	21	4
	Above 67	5	1
Education level	Primary	97	29
	Secondary	16	1
	University	3	4
Monthly Income	2300–8300	74	17
	8301–13,301	31	12
	13,302–18,302	8	5
	Above 18,303	3	0
Family size	2–4	62	22
	5–8	54	12
Employment	Government	34	12
	Private	30	8
	Self-employee	34	7
	others	18	7

Source: Author's calculation.

Table 4.
Willingness to pay person and socio economic characteristics of sample household.

Variables	Coefficient	Wald statistics
Sex (SER)	2.282*	6.595
Age (AGR)	−17.100	.000
Educational level (EDLR)	1.764	2.461
Family size (Fam_Sz)	.684	.991
Income	−21.495	.000
Not satisfied	.378	.554
Maximum amount willing to pay	−.265	.348

*Source: Author's calculation, * represent 10% level of significance.*
Log Likelihood 89.437, Number of observation 150.
Chi-square LR statistics 35.628, Significance 0.002.

Table 5.
Logit model estimation of willingness to pay for improved solid waste management services.

Willingness to pay		Amount of willing to pay		
Yes	No	<50	51–100	>100
96 (96%)	4 (4%)	3 (2%)	65 (43%)	76 (50.7%)

Source: Author's calculation.

Table 6.
Respondent willing to pay for solid waste management services.

management (MSWM) can result in serious health problems and environmental degradation.

Table 6 represents the respondent willing to pay for solid waste management services 96% of the respondents are willingness to pay but very less amount respectively only 2% of the respondents are INR Rs 50 ($1), 43% of the respondents are INR 100 ($2) and 50.7% of the respondents are more than INR 100 ($2) for improved solid waste management services.

6. Conclusion

This study finds that an average willing to pay about INR Rs. 24 (less than $ 1). This result of the study show that the demand for improved waste management is only significant related to the sex of the household respondent. Attempts must be made to improve willingness to pay solid waste management services in the semi-urban areas. To achieve this government should concentrate first on awareness campaigns about the consequences of waste mishandling and impacts of improper solid waste disposal. Previous studies have done only micro level analysis of economics of solid waste management did not improve any significant and scientific methodology adopted in solid waste management. Very few studies have been done in economics of solid waste management in India particularly contingent valuation analysis improved solid waste management services. Further, will need more empirical analysis in economics of solid waste management for better understanding about efficient solid waste management services are future good environmental services. Individual behavior and attitude as important environmental conservation and reduce solid waste generation. Future research in solid waste management should concentrate integrated with physiological factors of household recycling behavior and socio economic factors of solid waste generation.

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