

# FACTORS AFFECTING HOUSEHOLD PARTICIPATION IN SOLID WASTE MANAGEMENT SEGREGATION AND RECYCLING IN BANGKOK, THAILAND

Walailak Atthirawong  
Department of Statistics, Faculty of Science  
King Mongkut's Institute of Technology Ladkrabang, Bangkok10520, Thailand  
Email:walailaknoi@gmail.com

## KEYWORDS

Household Participation, Multiple Regression Analysis, Recycling, One-way Analysis of Variance, Segregation, Solid Waste Management

## ABSTRACT

The number of population in Bangkok, the capital of Thailand, is increasing every year. The capital produces about 9,900 tons of garbage daily or 1.53 kilograms per person which only 13% of waste is recycled per day. This presents a serious challenge and concern of municipal authority in solid waste management. This study examines Bangkok residents' practices, knowledge of waste management, as well as the level of community mobilization and the level of household participation in solid waste segregation and recycling. One-way Analysis of Variance (ANOVA) was employed to test whether there was statistically significance between the level of household participation among different zones in Bangkok. Additionally, the study also analyzed factors affecting the level of household participation using Multiple Regression Analysis. Data were collected by means of hand-delivered questionnaires. A total of 400 respondents were selected using multi-stage random sampling by dividing Bangkok into three zones. The results showed that about two-thirds of the residents had got high level on knowledge and understanding on solid waste management. However, the results of ANOVA revealed that there was no significant difference between the level of household participation among residents who live in different zones. The level of participation in solid waste segregation and recycling of households in Bangkok was significantly influenced by promoting campaign and training programs continuously from local authorities and age of the residents. Finally, the discussion of the results of the study is presented and further study is also mentioned.

## INTRODUCTION

Bangkok, the capital of Thailand is an enormous administrative area which has more than 1,500 square kilometers. At the 2010 census, Bangkok had overall total population of 8.28 million. Even though, in 2015 only about 6 million people were registered residents (<http://bangkok.go.th/info/>). Due to the large number of population, Bangkok like other big cities has faced a high level of environmental pollution and waste management problems. The capital produces about 9,900 tons of garbage daily or 1.53 kilograms per person but only 13% of waste is recycled per day. The remaining 8,700-plus tons are dumped in landfill (<http://thaipublica.org/2014/11/bangkok-big-garbage-problem/>). The main reasons of disposing of waste into landfill are that it is the simplest, cheapest and most cost-effective method (Barrett and Lawler 1995). Solid waste disposed in a landfill requires a complex process which also leads to hazardous emissions (Omar and Hani 2006). These have become a treat to human health and quality of life problems everywhere. A range of programs and policy instruments are required from the government and stakeholders to manage those waste appropriately in order to improve these problems. Creating an environmentally sustainable community requires an involvement of households in recycling solid waste (Kato et al. 2015). As such, it is necessary to increase the public awareness of waste generation and separation at source which will reduce the volume of waste to deposit. Not only waste reduction can help in reducing the expenditures and investment of government through lower collection, treatment and disposal but also protecting the environment.

Nowadays, environmental issues as well as the concern regarding the problems of waste have been increasing in every sector yet only little participation implements it. In order to promote recycling among households, it may require an understanding impact of factors affecting household participation in solid waste recycling. Consequently, the broad objective of this research is to investigate factors affecting household participation in solid waste recycling in Bangkok city, the capital of Thailand. Specifically, the research analyzes the level of community mobilization and knowledge on waste

management and examine the relationship among the level of community mobilization and knowledge of household participation and demographic characteristics towards the level of household participation in solid waste recycling.

The structure of the remainder of this paper is therefore organized as follows. Section 2 describes research methodology employed in this study. Results obtained from the survey are described in Section 3. Finally, conclusion, discussion as well as practical implications for policy makers and waste management planners are then discussed in the final section.

## RESEARCH METHODOLOGY

### Survey Design and Sampling Method

Data for this research were collected by means of hand-delivered questionnaires during November and December 2015. Population in this study referred to individuals residing in Bangkok, the capital of Thailand. The number of residents in Bangkok (N) was 5,696,409 people in 2015 (<https://th.wikipedia.org/>). Due to the population being enormous, a total of 400 sample sizes (n) were selected for this study (Yamane 1973). In order to define respondents who fill in the questionnaire, multi-stage sampling technique was used to select the respondents (Som 1996). At the first stage, stratified random sampling was employed by dividing Bangkok, which comprises of 50 districts, into three strata (h) i.e. inner area (21 districts), middle area (18 districts), and outer area (11 districts) as shown in Figure 1. Next, proportion allocation for each stratum ( $n_h$ ) was assigned using  $n_h = \frac{N_h n}{N}$  formula. Residents in each stratum were then selected using convenience sampling procedure. To obtain these samples, a questionnaire was distributed to each household by survey teams and finally 400 complete questionnaires were returned and used for further analysis.

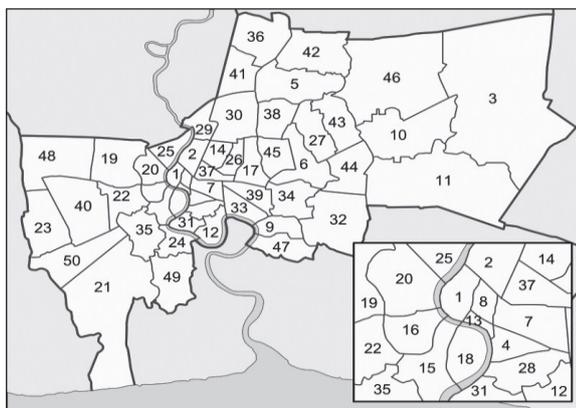


Figure 1: Bangkok Metropolitan Area

Source: [https://en.wikipedia.org/wiki/List\\_of\\_districts\\_of\\_Bangkok](https://en.wikipedia.org/wiki/List_of_districts_of_Bangkok)

## Research Instruments

This research used a quantitative method and the instrument for gathering data was questionnaire, which was composed of five parts:

**Part 1:** Inquiries about general information, socio-economic characteristics of household and waste generation in the residence, as well as waste behavior.

**Part 2:** The respondents were asked whether they have knowledge and understanding about solid waste disposal and recycling.

**Part 3:** The questions regarding the level of community mobilization awareness in solid waste management such as adequate separated recycle bins advertisement and providing information concerns about solid waste management. Each question gauges according to a five-point Likert-type scale (Wolfer 2007). Level 1 means that factor was minimal supported in practices, whereas level 5 means that factor was supported at maximum in practices.

**Part 4:** The fourth part was the main part of the questionnaire including queries about the level of participation in waste recycling practices including 12 variables. Each variable gauges according to a five-point Likert-type scale (Wolfer 2007). Level 1 means that factor has minimal participation in waste recycling practices, whereas level 5 means that factor has maximum participating in waste recycling practices.

**Part 5:** Inquiries about opinions and ideas on how to promote households involving in solid waste recycling and source reduction, establish concerns and awareness in environmental issues and the existing barriers or obstacles for separating waste disposal in practices.

### Reliability

A pilot study was carried out with 30 respondents. Cronbach's Alpha coefficient was used to test for a reliability of the instrument in Part 3 and 4 which were equal to 0.89 and 0.85, respectively. It is implied that the tool is sufficient and reliable for being used to collect data in primary source (Creswell 2002).

### Analytical Techniques

Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) version 19.0 for Windows. Descriptive statistics for each variable including mean, standard deviation and percentage were calculated to explain demographic characteristics, the level of household participation in solid waste recycling, the level of knowledge of waste management, types of waste generated at the residence, as well as methods of disposing solid waste in Bangkok. One-way Analysis of Variance (ANOVA) was employed to test whether there was statistically significance between the level of

household participation among three zones in Bangkok i.e. inner, middle and outer zones. Whilst Multiple Regression Analysis was employed to scrutinize factors affecting the level of household participation in solid waste recycling in the study. Before conducting regression analysis, correlations of all variables were investigated which were used to determine the bivariate relationships; for instance, the strength and direction between each predictor and dependent variable. The predictor variable which correlated to any of dependent variables were then further entered into Multiple Regression Analysis to explore the effect of variables on the level of household participation. Four principal assumptions of multiple regression analysis, i.e. linearity and additivity, statistical independence of the errors, homoscedasticity (constant variance) of the errors, and normality of the error distribution were tested before further using the models (Ryan 2009). The results of this research were accordingly displayed using statistical tables for interpretation in the following section.

The multiple regression model employed to investigate factors affecting household participation in solid waste segregation and recycling in this research is expressed as follows:

$$Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \varepsilon_i \quad (1)$$

where:

$Y$  = The level of household participation in waste segregation and recycling practices

$X_1$  = Gender (1 if women; 0 otherwise)

$X_2$  = Age (1 if more than 35 years old; 0 otherwise)

$X_3$  = Education (1 if undergraduate level or above; 0 otherwise)

$X_4$  = Perceived suitable guidance on waste segregation from the municipality (1 if yes; 0 otherwise)

$X_5$  = Knowledge of solid waste management

$X_6$  = Promoting campaign and training programs continuously by local authorities

$X_7$  = Creating network for protecting environment by communities

$X_8$  = Providing enough different separate bins for encouraging segregation from local authorities

$\varepsilon_i$  = The random error term

## RESULTS

### Demographic Characteristics of the Respondents

According to the questionnaire, the respondents were more women (56.89%) than men (43.11%). The highest percent of respondent were 15-24 years and 25-34 years old (32.00%) equally, followed by 45-54 years old (16.75%). Half of the respondents had achieved undergraduate level (50.38%), followed by higher school certificate level (15.54%). 27.35% of the

respondents were working in private sectors and 22.03% are students/graduate students. 47.75% of the household size is 3-5 people, followed by more than 5 people (34.75%). The respondents indicated that almost half of major constitutes of wastes generate from households were general wastes e.g. plastic bags, foils, etc. (49.45%) and 34.34% are compostable wastes e.g. fruits and vegetables, leaves and so on.

The respondents were also asked how they disposed wastes at their residence. About 57% said that they did not segregate before disposal yet. The main reason or obstacle for not segregating solid waste at the residence was that the majority of respondents (36.48%) didn't have enough separation bins at source, followed the fact that even though they did not have any obstacles, they didn't intend to do it (34.07%). Whereas, the rest of the respondents (43%) claimed that they sort them at their residence before disposal. After segregation, most of them sold them for recycling at scrap dealers or garbage shops (55.61%). About 28% put them to the collection points after sorting in separate bags which was easy for collectors to further manage. When asked whether or not they had ever perceived awareness campaign on waste segregation and recycling in their communities from the municipality, 56.82% of the respondents indicated that they hadn't heard about it.

### Knowledge on Solid Waste Management

Results from Table 1 showed that 68.74% of the residents had got high level on knowledge and understanding on solid waste management. The mean score of knowledge on solid waste management equals to 8.15 (S.D. = 1.24) which is quite high average score.

Table 1: Knowledge on Waste Management

Level of knowledge on waste management	n	Percent	$(\bar{X})$	S.D.
Low	4	1.03	3.75	0.50
Medium	117	30.23	6.75	0.54
High	266	68.74	8.84	0.72
Total	387	100.00	8.15	1.24

### One-way Analysis of Variance (ANOVA)

Table 2 shows the results from using ANOVA to investigate the mean difference in the level of participation on solid waste segregation and recycling of household between residents who live in three zones in Bangkok namely inner, middle and outer areas. It was revealed that the level of participation on solid waste segregation and recycling of residents in three different zones were similar behaviour in nature.

Table 2: ANOVA Test

Source of Variation	Sum of Squares	df	Mean Square	F	p-value
Between Groups	308.100	2	154.050	1.532	0.217
Within Groups	39,929.490	397	100.578		
Total	40,237.590	399			

**Factors Affecting Household Participation in Solid Waste Segregation and Recycling**

Before conducting Multiple Regression Analysis, the assumptions were investigated. Table 3 displays the results of residual of normality test. Muticollinearity by examining tolerance and the Variance Inflation Factor (VIF) was also tested before further analysis and shown in Table 4. Furthermore, normal probability plot of the residuals in Figure. 2 shows that there is no data which stay far away from the slope line and the results from Table 5 also support the assumption. Hence, it can be implied that the regression model is appropriate for further study.

Table 3: The Result of Residual Normality Test

Residual Normality Test	Result
Standard Deviation	0.586
Kolmogorov Smirnov Z	0.038
Asymp.sig. (2-tailed)	0.183

Table 4: Muticollinearity and the Variance Inflation Factor (VIF) Values

Variables	p-value	Collinearity Statistics
Promoting campaign and training programs continuously by local authorities (X <sub>6</sub> )	0.000**	1.001
Age (X <sub>2</sub> )	0.050*	1.001

\* significant at p-value < 0.05 level

\*\* significant at p-value < 0.01 level

Table 5: Tests of Normality

	Kolmogorov-Smirnov*			Shapiro-Wilk		
	Statistic	df	p-value	Statistic	df	p-value
Standardized Residual	0.086	385	0.00**	0.983	385	0.00**

\* Lilliefors significance correction

\*\* significant at p-value < 0.01 level

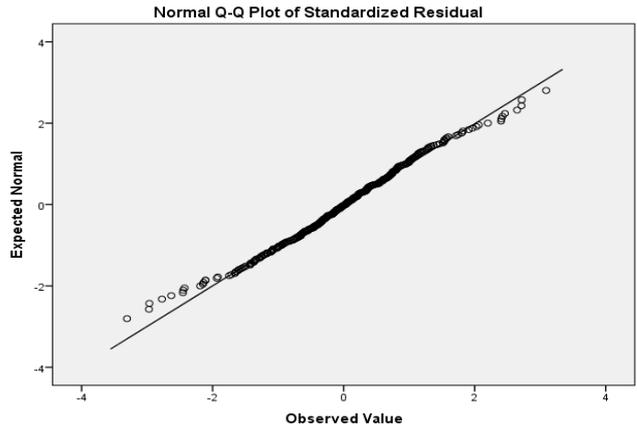


Figure 2: Graph of Normality Plot

Table 6 demonstrates the result of Multiple Regression Analysis explaining the variables which influence household participation in solid waste segregation and recycling. The result shows that promoting training programs continuously by local authorities and age have significant influence to the level of participation in solid waste segregation and recycling of households in Bangkok. The value of the coefficient of determination (R<sup>2</sup>) indicates that 51.0% of the variations in the level of participation in solid waste segregation and recycling of household is explained in the regression model.

Table 6: Factors Affecting Household Pparticipation in Solid Waste Segregation and Recycling

Variables	Estimation	SE	t-statistics	p-value
X <sub>6</sub>	0.598	0.03	20.029	0.000**
X <sub>2</sub>	-0.121	0.06	-1.967	0.050*

\* significant at p-value < 0.05 level

\*\* significant at p-value < 0.01 level

R<sup>2</sup> = 0.510

F-value = 204.303

**CONCLUSION**

This research explored factors affecting the level of participation in solid waste segregation and recycling of households in Bangkok metropolis, as well as examining current Bangkok households waste management practices and their knowledge of waste management. Data were gathered from survey conducted using multi-staged sampling technique during November and December 2015 by means of hand-delivered questionnaires. It is interesting to note that the knowledge and understanding in solid waste management of the respondents of this study are at a high level. However, only 43% of them do segregate at their residence before disposal. The main reasons or obstacles for not segregating solid waste at home were that the majority of respondents (36.48%) didn't have

enough separation bins, followed by not intention to do so (34.07%). These findings imply that although the score of household's knowledge on recycling is high, the level of waste sorting is still low in practice. The result supports with the previous study of Latif et al. (2013) and Otitoju (2014). In addition, the findings is also in line with the research outcomes of Atthirawong (2015) which revealed that there was only 13.1% of the college students at KMITL university in Bangkok always separate their garbage before disposal even they had high level of opinion on solid waste management. The results from applying Multiple Regression Analysis indicated that there were only two factors which affected household participation of Bangkok residents' i.e. perceived promoting campaign or training program on solid waste management and age of the residents. As such, the local authorities should launch the intensive campaign, seminar orientation for waste education and awareness towards waste management continuously. The role of individual in waste management at source should be highlighted through regular media, campaign as well as consistent monitor (Ann et al. 2009). However, the findings indicate that age of the residents and the level of participation are in the opposite side. The evidence shows that the older people have lower participation in solid waste segregation and recycling. As such, those campaigns should target at both the older and the younger people continuously to encourage them in order to take part in segregation process in the future. It is necessary for each household to arrange a suitable space and separate bin for disposal in the residence to make an activity possible.

In order to make recycling to success, many parties are needed to be involved. Efforts are needed to engage by making collaboration and partnership with the relevant stakeholders. Policy formulation, developing efficient recycling initiatives and implementing an integrated waste management programs to the citizens will be needed to conduct and manage which should be started at the lowest level (Worku and Muchie 2012).

Enforcement people to practices waste recycling by laws, as well as determination different price levels of household disposal from waste generation may be compulsory to reduce the number of garbage collection and environmental issues. At the same time, it is crucial for municipal and communities to provide the necessary enabling facilities for the residents as well (Otitoju 2014). As Price (2001) mentioned, the role of local authority and public actions were prevailing to the success of sustainable waste policies. Thereby, it is also desirable to increase awareness of the environment problems to individuals as this can be changed individuals behaviors into everyday routine in waste recycling (Lober 2007). Incentive should also be contributed to the businesses, local authorities and municipal workers that in responsibility in collection and disposal of solid waste (Worku and Muchie 2012).

These issues should be implemented in the same direction.

Although this study has provided useful and update information on the level of participation of solid waste recycling of Bangkok citizen. There are still limitations of this study. A small of sample was undertaken compare to the number of population of the capital. This study also does not measure intention and attitude to segregate and recycle of the residents. Consequently, there are several issues to further investigation in these areas. For instance, the Theory of Planned Behaviour (TPB) framework (Ajzen 1991) should be employed for further investigation as the results of the study revealed that only knowledge on waste management as well as relevant factors may not be enough to enlighten behavior of the respondents in participation in solid waste management. The theory will enable to identify success key factors which are likely to encourage or discourage performance of behavior (Tonglet et al. 2004). The incorporation of additional variables would contribute to the explanation of the level of participation or behavior in recycling.

#### ACKNOWLEDGEMENT

The author would like to thank Faculty of Science, King Mongkut's Institute of Technology Ladkrabang, the sponsor of this research funding. Appreciation also goes to all Bangkok residents who participated in this survey and all survey teams who assisted in administrating surveys.

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**WALAILAK ATTHIRAWONG** is Associate Professor of Operations Research at Faculty of Science, King Mongkut's Institute of Technology Ladkrabang (KMITL) in Thailand. She had received Ph.D. in Manufacturing Engineering and Operations Management at the University of Nottingham in 2002. Her research interest are logistics and supply chain management, simulation, multi-criteria decision making and optimization. Her e-mail address is : walailaknoi@gmail.com