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Factors determining the public receptivity regarding waste sorting: a case study in Surabaya city, Indonesia

Rulli Pratiwi Setiawan[1,2]

Abstract

Waste sorting at the source has been enforced by the Government of Indonesia since the implementation of the Waste Management Law No. 18 Year 2008. However, waste sorting is still not a popular practice in households. We present the findings of a survey conducted for 900 households' receptivity regarding waste sorting at the source. A logistic regression model allowed us to examine the socio-economic characteristics determining the public receptivity regarding waste sorting at the source. The results show that household heads' years of education, family members, current sorting practices and understanding of sorting obligations, are the factors determining the public receptivity regarding waste sorting at the source. Moreover, we also assessed the main reasons why households have not practiced waste sorting at the source yet. The three main reasons are mixed collection and transport (26%), lack of sorting facilities (23%), and lack of time (22%). The findings provide useful insight for the local government in developing mechanisms for the implementation of waste sorting at the source on larger scales as a part of the waste reduction program.

Keywords: Obligation, Waste sorting, Public receptivity, Binary logistic regression, Surabaya

Introduction

Solid waste management remains a major challenge for cities, especially in developing countries. Cities with a high population, and an increasing per capita income, are usually facing high volume waste generation [1–3]. Waste sorting at the source, as an initial step to recycling, is currently being promoted in developing countries because it is considered an effective long-term means to overcome the solid waste problem [4].

The Government of Indonesia has enacted Law No. 18 Year 2008 regarding Waste Management. This law mandates that each person is obligated to waste sorting at the source. Sorting at the source is a critical step in the waste management cycle, as it ensures that the waste generated will be reused. Reuse of waste is also highlighted in the law as part of waste reduction. This law is followed by the Government Regulation No. 81 Year 2012 on Household Waste Management and Household-like Waste Management. Moreover, the obligation for waste sorting at the source is explained in detail in the Regulation of Public Works Ministry No. 3 Year 2013. However, waste sorting at the source is not yet a widespread practice in Indonesian cities.

Surabaya is the second largest city in Indonesia with an advanced household waste management service. However, the study conducted by Dhokhikah et al. [5] in the east of Surabaya showed that only 47% of the respondents had already implemented household waste sorting. Out of the respondents who had not implemented waste sorting, there are 62% of the respondents willing to separate household waste. Waste sorting activity is mainly performed in certain pilot areas. Understanding the factors that contribute to the acceptance of waste sorting policy is important because the government can receive more support to implement the policy. Furthermore, the government can prioritize the policy implementation to the most responsive group of people.

A study conducted by Basili et al. analyzed demand for environmental quality related to a new garbage plan

Correspondence: rullips@gmail.com
[1]Graduate School for International Development and Cooperation, Hiroshima University, Hiroshima 739-8529, Japan
[2]Department of Urban and Regional Planning, Institut Teknologi Sepuluh Nopember, Surabaya 60111, Indonesia

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using concepts of willingness to pay and willingness to accept [6]. To provide a clear meaning, this research used the terminology of public receptivity regarding waste sorting to explain the households' acceptance of waste sorting. A previous study that used public receptivity terminology was conducted in the field of in-house water recycling [7].

As mentioned previously, waste sorting at the source is one of the vital elements of waste management. In developing countries, waste sorting at source has been practiced mainly at the pilot program level. Consequently, it has not been widely adopted on a larger scale [8]. Several studies have shown that recycling behavior, as well as waste sorting practice, is influenced by convenience [9, 10]. However, convenience is not the only reason for not taking part in the recycling of waste [11].

Some researchers divided the factors that influence participation of households in waste sorting into internal, external, and sociodemographic factors [12, 13]. Internal factors are intrinsic factors that affect individual's participation, such as attitude, beliefs, and responsibility. External factors are the factors that encourage or discourage the individual's participation, such as the availability of waste sorting facilities. Sociodemographic factors include variables such as gender, age, education, and income. The scope of this study is the sociodemographic factors that influence public acceptance of waste sorting.

A study conducted by Czajkowski et al. argued that a majority of people in the municipality of Podkowa Leśna, Poland, are willing to do waste sorting at the household level [14]. There exist significant relationships between households' characteristics and heterogeneous preferences for waste sorting at home [15]. However, studies that examined the sociodemographic variables related to waste handling behaviors showed mixed results. Some studies have reported that socio-economic factors of households such as age, income, household size, and employment are the determinants of waste handling behaviors [10, 16–21]. Matsumoto provides an empirical summary of studies at the household-level that assessed the relationship between the sociodemographic variables and the recycling intensity as well as the waste reduction effort [22]. Previous studies concluded that gender and income have a relationship to the waste separation behavior [10, 20], while other studies stated that there is no relationship between gender and recycling activities [16, 18, 23]. No relationship between income and recycling activities was also found by others [24, 25].

The results of previous studies indicate that we cannot generalize the sociodemographic variables influencing the public receptivity regarding waste sorting at the source. By understanding the factors that drive people to accept waste sorting, the local government can formulate a strategy to foster the waste sorting practice as a part of the household waste management program. The main objective of this study is to determine the factors influencing public receptivity regarding waste sorting in Surabaya, Indonesia. In addition, we also examine the factors influencing the understanding of the obligation to waste sorting. The influencing factors are crucial for the local government to garner more support from the households to practice waste sorting at the source.

Material and methods

This section describes the study area, sampling methods as well as the questionnaire structure and data collection.

Description of the study area

Surabaya is the capital city of the East Java Province, Indonesia. The city has an area of 326.8 km^2 and a population of 2,599,800 inhabitants as of 2017. Surabaya is divided into 31 districts and 154 sub-districts. Surabaya was selected as the study area because the practice of household waste management in the city is recognized better than the other cities in Indonesia. The awareness of citizens in Surabaya is also considered better among other cities. Therefore, it is important to examine what factors that influence the citizens' awareness such as the public acceptance of waste sorting at source.

Ideally, stratified random sampling is the best option to have a represent picture of the whole city of Surabaya. However, implementing this option requires more time and budget. Therefore, selecting one subdistrict that has diverse households' characteristics is considered the best choice to represent the entire city. The investigation was carried out in the Airlangga sub-district that is located in the city center.

Sampling method

We selected Airlangga sub-district purposively, and randomly chose three neighborhood associations from among the listed neighborhoods within the sub-district. Airlangga sub-district has eight neighborhood units and 34 neighborhood associations. We randomly selected neighborhood associations 1, 3, and 5. The selected sampling area is presented in Fig. 1. In total, we successfully surveyed 900 sample households.

Questionnaire and data collection

The questionnaire contains close-ended questions and the structure is divided into four sections. The first section was related to general information about the respondents. This was followed by questions that evaluate their behavior toward household waste disposal. The next section examines the current practice and satisfaction in household waste management service. The last

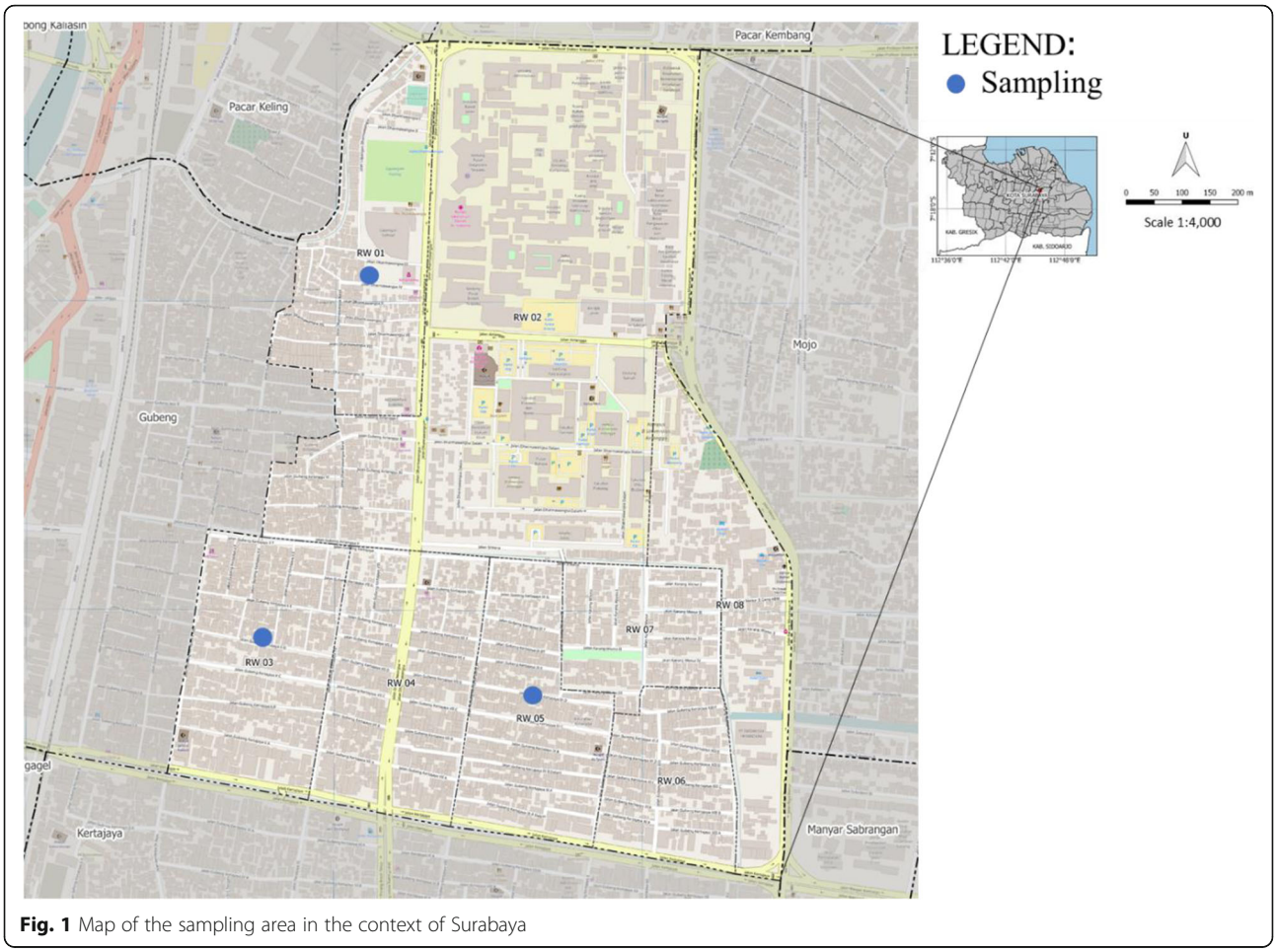

Fig. 1 Map of the sampling area in the context of Surabaya

section included questions to evaluate the public receptivity regarding waste sorting. The detailed questions in each section is presented in Table 1. The data were obtained using face-to-face interview. The main survey was conducted for 14 d during August 17–30, 2017, which was preceded by a pilot survey. We received 900 responses, which corresponds to a response ratio of 98%.

Data analysis

We applied a logistic regression method to explain the relationship between independent variables and outcome variables. The independent variables used in this study are the socio-economic characteristics of households, such as gender, age, household head's years of education, family members, and monthly income. While the outcome variables were described as follows:

(1) Understanding the obligation to perform waste sorting (Y1)—understanding of households and their obligation to perform waste sorting at the source, according to the law.

(2) Public receptivity regarding waste sorting (Y2)—acceptance from households whether they will participate in waste sorting or not.

A binary logistic regression was applied to evaluate the socio-economic factors determining households' satisfaction regarding the current waste management service, understanding the obligation for waste sorting, and the public receptivity regarding waste sorting at the source. The logistic regression model is presented as follows:

$$\log \frac{p(x)}{1-p\,(x)} = \beta_0 + \beta_1 X_1 + \ldots + \beta_p X_p + e \qquad (1)$$

where p is the probability of public receptivity regarding waste sorting at source; β_0 is the constant term; β_1 and β_p are the coefficients of the independent variables, X_1 and X_p are the vectors of independent variables, and e is the error term.

Results and discussion

This section describes the socio-economic characteristics of the respondents' behavior toward household waste

Table 1 Questionnaire design

No.	Description	Type of question
I.	*Respondent General Information*	
	Name	Open-ended
	Gender	Close-ended
	Age	Open-ended
	Household head's years of education	Close-ended (multiple choice)
	Family members	Close-ended (multiple choice)
	Monthly income	Close-ended (multiple choice)
	Home ownership	Close-ended (multiple choice)
II.	*Behavior toward Household Waste Disposal*	
	Total waste generation	Close-ended (multiple choice)
	Person responsible for household waste disposal	Close-ended (multiple choice)
	Waste sorting before disposal	Close-ended (multiple choice)
	Walking time to the nearest waste collection station	Close-ended (multiple choice)
III.	*Current Practice and Satisfaction toward Household Waste Management Service*	
	Regular schedule for waste collection	Close-ended (multiple choice)
	Satisfaction toward waste management service	Close-ended
	Understanding the obligation for waste sorting	Close-ended
IV.	*Public Receptivity*	
	Receptivity of waste sorting	Close-ended
	Reasons for rejecting waste sorting	Close-ended (multiple choice)

disposal, the current practices and satisfaction regarding household waste management services, public receptivity and reasons for rejection, factors influencing satisfaction regarding current waste management service, understanding the obligation for waste sorting, and the factors influencing the public receptivity regarding waste sorting.

Socio-economic characteristics of the respondents

The socio-economic backgrounds of the respondents are shown in Table 2. Of all the respondents, 33.4% were male and 66.6% were female. The age of the respondents ranged from 17 to 94 years old, with the middle group at 35 to 60 years old accounting for 68.8% of the respondents. In the sample, 51% of the household heads have had 10 to 12 years of education, that means more than half of the household heads have completed their senior high school. Working in the private sector is the most common occupation in the study area, with 41.2%. There are more than 60% of households who have been living in the area for more than 20 years. Those who have family member no more than 4 people accounted for 77.2% of the respondents.

Behavior toward household waste disposal

The information concerning behavior toward household waste disposal is divided into four questions, i.e., total daily waste generation per household, person engaging in daily waste disposal to the collection station, waste sorting before disposal, and walking time to the nearest collection station. The results are shown in Table 3. More than 48% of the households generate ≤1 kg waste daily. The person who generally engaged in household waste disposal was mainly the mother or the wife at 44.1%. A high proportion of respondents (41.2%) also answered that maid is the person who helps to dispose of the waste. More than 58% of the households have been practicing waste sorting before disposal. Households who have 6 to 10 min walking time to nearest collection station had the highest share with more than 65% of the respondents.

Current practice and satisfaction toward household waste management service

The questions under this section are divided into three parts, i.e., regular schedule for waste collection, satisfaction toward the waste management service, and understanding the obligation to household waste sorting. Table 4 shows that majority of the respondents (92%) have a regular schedule for household waste collection. The waste collection schedule is usually three to five times a week. For the question of satisfaction of households toward waste management service, more than 72% of respondents satisfied with the current household waste service. The response to the question of understanding the obligation toward waste sorting shows that less than 40% of respondents are aware that the waste management law obliges them for waste sorting at source. It means that the obligation to waste sorting is not yet widely known, although the implementation of the law has been started in 2008.

Public receptivity and reasons for rejection

The fourth section of the questionnaire asked about the acceptance of doing waste sorting and reasons for not doing waste sorting. Table 5 shows that the practice of waste sorting is accepted by more than 90% of the respondents. This result indicates that waste sorting program has high probability to be supported by households. We also assessed the main reasons why

Table 2 Descriptive statistics of socio-economic characteristics of the respondents

Socio-economic characteristics	Category	Observation	No of respondents (%)	
			Freq.	Percentage
Gender	Male	900	301	33.4
	Female		599	66.6
Age	18–34	900	114	12.7
	35–60		619	68.8
	> 60		167	18.6
Household heads' years of education	≤ 9 yr	898	186	20.7
	10–12 yr		459	51.1
	> 12 yr		253	28.2
Length of stay	≤ 5 yr	900	70	7.8
	6–10 yr		108	12.0
	11–20 yr		157	17.4
	> 20 yr		565	62.8
Family members	1–4	897	692	77.2
	5–6		176	19.6
	> 6		29	3.2
Monthly income	< IDR 3,000,000	898	453	50.5
	IDR 3,000,000–6,000,000		338	37.6
	> IDR 6,000,000		107	11.9

Note: 1 USD = IDR 14,344 (rate in July 2018)

Table 3 Behavior toward household waste disposal

Questions	Number of respondents	Percentage (%)
Household waste generation		
≤ 1 kg	431	48.4
1.1–1.9 kg	324	36.4
2–2.5 kg	87	9.8
> 2.5 kg	49	5.5
Person(s) engaging in household waste disposal		
Husband/father	77	8.6
Wife/mother	395	44.1
Child	24	2.7
Maid	369	41.2
All family members	30	3.4
Waste sorting before disposal		
Yes	520	58.0
No	376	42.0
Walking time to nearest waste collection station		
< 5 min	167	18.6
6–10 min	590	65.7
11–15 min	115	12.8
> 15 min	26	2.9

households have not practiced waste sorting at the source yet (see Fig. 2). The three main reasons are mixed collection and transport (26%), lack of sorting facilities (23%), and lack of time (22%).

Understanding the waste sorting obligation and the factors influencing the public receptivity regarding waste sorting

Socio-economic conditions, like educational level and income, are most often the factors correlated with the citizens' perceptions and attitudes towards environmental policies. This section shows the results of the analysis regarding the understanding of waste sorting obligation and the public receptivity regarding waste sorting.

Table 4 Understanding of the obligation to waste sorting

Questions	Number of respondents	Percentage (%)
Regular schedule for waste collection		
Yes	833	92.8
No	65	7.2
Satisfaction toward waste management service		
Yes	650	72.5
No	246	27.5
Understanding of the obligation to waste sorting		
Yes	339	37.8
No	557	62.2

Table 5 Public receptivity

Questions	Number of respondents	Percentage (%)
Public receptivity regarding waste sorting		
Yes	843	94.1
No	53	5.9

Table 6 presents the factors influencing households' understanding of waste sorting obligation. There are three significant factors influencing the understanding of waste sorting obligation, those are: gender, monthly income, and current sorting practice. The other three factors, such as age, household heads' years of education, and family members are not significant factors in determining the households' understanding of waste sorting obligation. Insignificant result of age as a factor that determines the understanding of waste sorting obligation is consistent with a previous study by Werner and Makela who found no significant relationship between age and waste recycling behavior [23]. While the insignificant factor of family members is supported by others that household size does not have significant relationship with waste recycling behavior [10, 21]. The insignificant result of education confirms the findings of many other investigators [16–19, 23, 26].

Female respondent was found to be positive and highly significant at 1%. This implies that the probability of waste sorting increased if the respondent was a female. The possible explanation for this result is that women are more engaged in household waste disposal. The respondent who has monthly income more than six million rupiahs was positive and significant at 5% level. This implies that the higher the monthly income, the higher the probability that the respondent understands the obligation of waste sorting. The plausible argument for this result is higher income respondents may have a higher probability of accessing information.

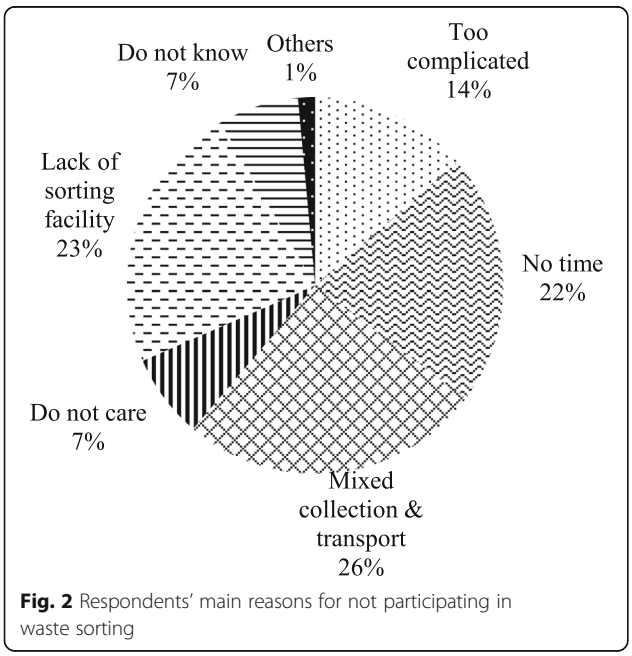

Fig. 2 Respondents' main reasons for not participating in waste sorting

Table 6 Results from the binary logistic regression on understanding of obligation to perform waste sorting

Socio-economic variables	Understanding of sorting obligation
Gender	
Female	0.5345*** (0.1564)
Age	
Middle (35–60)	0.1738 (0.2177)
Old (> 60)	0.1397 (0.2723)
Household heads' years of education	
10–12 yr	0.3051 (0.2021)
> 12 yr	0.2272 (0.2431)
Family member	
5–6 people	0.2139 (0.1769)
> 6 people	−0.6335 (0.4531)
Monthly income	
IDR 3– < 6 million	0.2424 (0.1642)
IDR > 6 million	0.5307** (0.2547)
Current sorting practice	
Yes	0.4680*** (0.1422)
Constant	−1.614*** (0.3074)

Note: Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Table 7 provides evidence that household heads' years of education, family members, current sorting practice, and understanding of the obligation regarding waste sorting showed significant results as factors determining the public receptivity regarding waste sorting. In terms of education, this research showed similar results as previous studies conducted by others that well-educated people are not necessarily more engaged in recycling activities [10, 27]. Households who have more family members have higher acceptance regarding waste sorting policy at the source. This result confirms the findings of previous studies, that number of individuals in the household has a significant role in determining waste recycling behavior [10, 21, 26]. Moreover, our research also provides evidence that the waste sorting policy is more accepted by the households who have already practiced waste sorting and understood the sorting obligation. The other three independent variables, such as gender, age, and monthly income were not statistically significant. This result is consistent with previous studies by different investigators that age does not necessarily influence the waste recycling activities [16, 18, 23].

Table 7 Results from the binary logistic regression on public receptivity regarding waste sorting

Socio-economic variables	Public receptivity regarding waste sorting
Gender	
Female	−0.4007 (0.4753)
Age	
Middle (35–60)	−0.0812 (0.7975)
Old (> 60)	−1.1011 (0.8382)
Household heads' years of education	
10–12 yr	1.1534** (0.5169)
> 12 yr	0.7074 (0.6891)
Family member	
5–6 people	−0.9875** (0.4684)
Monthly income	
IDR 3– < 6 million	0.5829 (0.5777)
IDR > 6 million	0.1913 (0.9141)
Current sorting practice	
Yes	1.3457** (0.5600)
Understanding on sorting obligation	
Yes	0.8693* (0.5220)
Constant	2.9727*** (0.9416)

Note: Robust standard errors in parentheses
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Household heads who have education years between 10 to 12 yr were found to be positive and significant at 5%. Respondents who have a family member between five to six people is also positive and significant at 5%. This indicates that the more the family member, the higher the probability that the waste sorting policy is accepted by the respondents.

There was a significant difference at 5% in current practice of waste sorting. The possible argument is because respondents who already practice waste sorting are more familiar with the activity. Thus, the acceptance of households regarding waste sorting is higher for those who have already practiced waste sorting. Understanding of households on sorting obligation also influences the public receptivity regarding waste sorting. A respondent who understood sorting obligation was found positive and significant at 10%. This result is consistent with the expectation of this study.

Conclusions

Waste sorting at the source is one of the initial steps for the implementation of waste reduction scheme. The Government of Indonesia enacted the waste management law in 2008, which mandated that each person has an obligation toward waste sorting at the source. The enactment of this law was then followed by the government regulations concerning household waste management in 2012. Furthermore, the operation of waste infrastructure and facilities was set up under the regulation of public works ministry in 2013. Although the legal instruments concerning household waste have been enacted since 2008, waste sorting at the source is not yet practiced widely in Indonesian cities.

The objective of this study is to examine the factors determining the public receptivity regarding waste sorting at the source. Moreover, the factors influencing the understanding of waste sorting obligation were assessed. The results showed that household heads' years of education, family members, current sorting practices, and understanding of sorting obligations play significant roles in determining the public receptivity regarding waste sorting at the source. While the factors that determined the understanding of waste sorting obligation at the source are gender, monthly income, and current sorting practices.

To sum up, this study reports various results of the factors influencing public receptivity regarding waste sorting policy. The results are suggesting the more diverse strategy to be considered in formulating waste management policy. For example, the government can prioritize the implementation of waste sorting policy in the area where the people have higher environmental awareness, so that the policy will be supported by citizens. The significant relationship between gender and understanding of waste sorting obligation imply that gender is an important factor to be considered to increase understanding of waste sorting obligation. This study shows evidence that waste sorting obligation is more understood by females. Therefore, as an implication, the government shall recognize the role of females to disseminate information both in their family and in their community. Overall, the findings of this study provide a useful insight for the local government to develop corresponding mechanisms for the implementation of waste sorting at the source, as a part of the waste reduction program.

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Author's contributions
The author is responsible for the conception and design of the study, data collection, analysis and drafting the article. The author read and approved the final manuscript.

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Availability of data and materials
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Competing interests
The author declares that she has no competing interests.

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