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Waste Segregation through Recycle and Composting Activities in Urban and Suburban Areas

N Kasmuri[1,2*], S N A Razak[2], Z Yaacob[1], M F Miskon[3] N H Ramli[4] and N Zaini[2]
[1]Pusat Asasi, Universiti Teknologi MARA, Cawangan Selangor, Kampus Dengkil 43800, Selangor, Malaysia
[2]School of Civil Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, 40450 Selangor, Malaysia
[3]Oceanography and Maritime Studies (INOCEM), Kulliyyah of Science, International Islamic University Malaysia, Bandar Indera Mahkota, 25200 Kuantan, Pahang Malaysia
[4]Fakulti Teknologi Kejuruteraan Kimia dan Proses, Universiti Malaysia Pahang, 26300 Kuantan, Pahang, Malaysia

E-mail: *norhafezahkasmuri@uitm.edu.my

Abstract. The number of wastes generated in Malaysia is increasing every year. Eighty per cent of solid waste in landfills comes from recycled material, and food waste production has risen to around 15 000 tons per day. Recyclable waste and food waste are the highest waste produced in landfills. Recycling and food composting are two solutions that can reduce waste and slow down the rate of garbage received at the landfill. This research aims to determine the knowledge and awareness of waste segregation through recycling and composting. This paper also identifies the constraint of respondents on performing waste segregation. Here, an online questionnaire has been distributed to the community in urban and suburban areas in Selangor and Johor. A total of 125 respondents participated in this study. Analysis from the survey found no significant difference in the knowledge of waste segregation through recycling and composting between urban and suburban areas. It can be denoted that the respondents have a basic understanding of awareness on waste segregation, although only a few have not practised recycling due to several highlighted constraints. Therefore, some recommendation has been emphasized based on this finding, such as installing reverse vending machines (RVM), organizing campaigns, and providing more information on waste segregation. These suggestions have been the top choices to encourage waste segregation in the community. Moreover, further study needs to be extended to the household group in other states and assessing the effectiveness of RVM will elucidate the segregation behaviours among the community.

Keywords: Composting, recycling, waste management method, waste segregation

* To whom any correspondence should be addressed.

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1. Introduction

Malaysia has been recognized as one of the countries undergoing rapid economic development. Moreover, the rising technology and population growth can lead to an increment in waste production. It can be estimated that the amount of waste produced in Malaysia in 2017 was 2.02 million tons. This volume had increased to 31,000 tons in 2020 [1]. It can be presumed that the quantity of waste generated currently is very high compared to the time taken for decomposing these materials. Furthermore, waste management practices in Malaysia need to be enhanced as the landfills have been filled and are towards the end of their lifespan. By 2030, over 80% of this landfill's areas will reach their full capacity, which will cause a total shutdown [2].

It can be denoted that; waste management has become a greater challenge to the developing countries due to the high maintenance cost of waste handling, especially in urban areas [3]. Improper waste management can lead to environmental problems for humans and the surrounding ecosystem. Furthermore, inadequate waste management practices will significantly affect people's health by spreading infectious diseases and polluting the environment [4]. Moreover, limited space and excessive spending to buy land would prevent the construction of new landfill sites [5].

Towards the Sustainable Development Goals, the key role of Goals No 11 is that sustainable cities and communities must be put in place [6]. Community awareness is an important aspect that needs to be considered. Separation at source is necessary; if this practice is not implemented, the waste thrown away will become comingle. It will create a problem for the authority to separate them due to the cost of handling them before the unwanted materials end up in the landfill. According to the National Solid Waste Department, the biggest component in waste composition is food waste. It can be good practice for the community to compost food waste. Here, recycling activities and food composting are two of the best solutions to reduce waste and eventually slow down the rate of this garbage to the landfill. The authority has done many initiatives for the awareness programme. However, the public's acceptance is still low [7]. Department of Statistics Malaysia has stated that the recycling rate in 2018 was 24.6%, and this value has increased by 3.5% in 2019, which is 28.1%. Even though the rate has risen compared to other countries, Malaysia's recycling rate is minimal.

Adapting to a new norm on segregation and waste separation at the source will take more time and effort. This habit needs to be improved to be a better community. However, some challenges the urban areas face are a lack of storage space for recycling items and the place to do composting. For example, if these people live in an apartment, they do not have space or a backyard for composting. While in the landed property, only one area has been designed to place a dustbin, which is not enough. Therefore, it must be considered that the designer should create more space to place the recycling and garbage bins side by side to make collection easier [8].

Therefore, this paper has discussed the level of knowledge and awareness of recycling and composting activities in the community. From the survey, the research highlighted the constraints of the respondents for not applying waste segregation and the methods to encourage participation.

2. Methodology

This research has focused on the suburban and urban communities in Puncak Alam and Shah Alam, Selangor, and the communities in Batu Pahat and Johor Bahru, Johor, Malaysia. This area has been chosen due to the vast development in the region.

The research study began from October 2020 to July 2021. There are 29 questions in the online survey. This questionnaire consists of three sections: demographic information, the reason for not applying waste segregation, and the method to encourage community in waste segregation: section A, the demographic information comprised of respondent's background information in multiple-choice questions. For sections B and C, the Likert's scale questions are from 1 (strongly disagree) to 5 (strongly

agree) on community reasons for not applying waste segregation and the method to encourage the community in doing waste segregation.

The sample size for this research is based on the cluster sampling technique. This sample is randomly selected from the population-based on non-zero probability. The minimum sample size is 119. In this research, the final sample size obtained is 125 respondents. The online questionnaire has been given in google form to the community in Johor and Selangor via google form link forwarded in social media and WhatsApp groups. After the sample collection, the responses from the questionnaire were analyzed. The data has been presented in a bar chart and pie chart and summarised in the table form. Statistical analysis has been done to interpret the findings from the respondents [9].

3. Results and Discussion

3.1. Demographic composition of sample

Section A consisted of twelve multiple questions on the demographic composition of the respondents. of 125 respondents, the majority are females which is 80% and males, 20%. It can be denoted that most of the data focused on the female respondents' contributions compared to males [10]. From the survey, about 74% were aged between 18 to 24 years old, followed by 25 to 34 years old (14%), 35 to 44 years old (6%), 45 to 54 years old (4%), and the rest are at the aged of 55 to 64 years old (2%). Higher respondents from the younger age probably due to more exposure to the internet and are more responsive to the online questionnaire than older people who prefer conventional methods such as non-web mode of interviews [11].

From the analysis, 66% of respondents were students, full-time work about 27%, part-time work was 4%, housewife around 2% and 1% was retired. Most respondents came from the student category, which is more familiar with the online tools, and this group of people can be considered tech-savvy. The proportion of household income illustrated that most respondents have a household income of less than RM1500 per month, which was 35%, while 17% gained RM 1501 per month to RM 2500 per month. Household income of RM2501 per month to RM 5000 per month and more than RM 5000 per month had the same proportion of respondents, 24%, respectively.

Most respondents from the survey live in urban areas, which is 54% compared to suburban areas (46%). Therefore, the urban lifestyle of the respondents contributes to the higher generation of waste [12]. The respondents who predominantly participated in the survey came from residential areas of terrace houses, semi-D, or bungalow houses, contributing to 58%. At the same time, villages, apartments, flats, or condominiums had the same percentage of respondents, 21%. The household sizes with more than three persons were about 80%, household living consisting of one person and two persons are 10% each. This result showed that a high amount of waste generated is produced if no one in the household practices wastes segregation. Moreover, the yearly waste per capita has increased due to the growing population. From the previous study, waste generated in 2013 was 12.3 metric tons with a population of 30.2 million, and it increased to 13.9 metric tons in 2018 with a growth of the population of 32.4 million [13].

It can be estimated that the respondent generated around 0.5kg to 1.0kg of waste, approximately 38%, while the rest generated less than 0.5kg, around 11%. Here, most respondents accumulated a high percentage of waste. It is due to the population growth, current lifestyles, and dietary changes among the urban and suburban populations [14]. The estimated weight of waste in Pasir Gudang, Johor, is quite similar to the study of Kuala Selangor, Selangor. Pasir Gudang is an urban area which produces waste generation per capita of 1.13 kg/person/day, while in a suburban area in Kuala Selangor, the rate of household waste produced is 1.0 kg/capita/day [15][16]. From the result, the frequency of rubbish litter per week of more than three times is the highest, 61%, followed by two times about 30% and one time around 9%. The respondents produced many waste materials; thus, they needed to dispose of the bins more than three times. Various factors can influence these behaviours, such as family size, monthly income, employment status and consumption of goods, and socioeconomic relationships due to consumption expenditure [17].

The outcoming of the survey comprised that the highest method of disposing of the waste is in a dustbin provided which is 86%, followed by digging a pit around the housing area that is 16%, disposed of the waste by open burning about 13% and throwing the waste in open areas or roadside which was 7%. It can be observed that most of the respondents threw the waste into a proper bin, reducing pollution to the environment. However, practising open burning to eliminate and open dumping is forbidden and contaminates the air quality and ecosystem [18]. Moreover, improper garbage disposal by burying the waste would affect water quality as these unwanted materials can leach through the soil to the groundwater table [19].

3.2. The level of knowledge and awareness on recycling and composting

From the total of 125 respondents who took part in the survey, it can be observed that about 42% and 47% of the suburban and urban communities did give positive feedback on the concept of 3R (reuse, reduce and recycle). However, the rest of the participants did not know about the awareness programme. Through the analysis, the respondent's survey detected a lack of promotion of the concept of 3R. In other countries, many institutional mechanisms are created and implemented to encourage the recycling of major recyclable items. For instance, Singapore will penalize those who throw or discard any bottle, aluminium cans, food containers, wrappers, glass, and others in a public area [1]. This enforcement conducted in Singapore is very stringent [5]. Only 14% of suburban and 10% of urban participants have executed this practice for the segregation of recyclable waste to the distinctive dustbin. The rest of the community did not, whereas the population in urban has lower participation in waste segregation than the people living in suburban. Therefore, it is challenging to nurture the community in adapting waste segregation by separation at the source [20].

Moreover, the questionnaire did ask about the respondent's behaviour in recycling paper, plastic, and aluminium cans. From the results obtained, 30% of respondents from urban areas recycled paper, while most people in suburban areas recycled 26% of plastic. The activity of recycling aluminium cans has the smaller number of participations which is 18%. Based on the survey results, limited people practising the recycling activities [21]. It can be indicated that 29% of people in urban areas and 30% of respondents in suburban areas recycled items at home, while 10% recycled the materials in the office. The balance of the respondents did not do recycling. Thus, people need encouragement to participate vigorously in 3R activities [5].

Furthermore, the knowledge of waste composting is higher in urban (50%) than in suburban (35%). However, only a small portion is practising composting in their home, 27% in suburban and 24% in urban areas. Minimal participation in composting revealed that 60% of citizens consider composting not beneficial and a dirty job [22]. [23]The composting plants have been increasing worldwide, whereas, in Europe, less biodegradable waste has been brought to the landfill following the directive's policy and penalties along with high disposal costs [24]. According to the Ministry of Housing and Local Government, Malaysia, the percentage of recycled waste is 24% from 38,000 tons, while the remaining is disposed of [23].

3.3 The reason for not applying waste segregation

The result from the survey due to the reason for not applying waste segregation has been tabulated in table 1. The main constraint is that the recycling facility is far from the residential area and scored the highest mean of 4.06 and the standard deviation of 1.095. There are insufficient or no convenient recycling facilities, which impedes the recycling behaviour of the respondents. The result showed that most participants strongly agree that the recycling facility is far from their residential areas. This outcome is similar to [3], whereas a lack of drop-off and buy-back centres is one of the top reasons that hindered recycling practices. A collection centre near a residential area will encourage the residents to use the facilities and participate in the recycling program [25]. Moreover, suppose two dustbins are provided in the household area. In that case, one bin is for the food waste and the other for recycling items; it will be easier for the community as they can opt not to go to the recycling centre.

Table 1. The reasons for not applying waste segregation.

Reason	Mean	Standard Deviation
The recycling facility is far from the residential area	4.06	1.095
Limited space to do recycling or compost activities	3.99	1.004
Limited time to segregate the waste	3.62	1.021
Lack of knowledge about what and how to segregate waste	3.35	1.240
Limited waste material to be recycled and compost	3.22	1.133

The mean for limited space for recycling or composting activities is 3.99, while the standard deviation is 1.004. The result showed that major respondents agreed that limited space is one reason for not applying waste segregation. A similar study has been found in Melaka by which the factors of limited space and time-consuming to go to recycling centres from residential areas have been highlighted [25]. Limited space is considered one of the obstacles to waste segregation. This situation happens to the people who live in apartments, flats, or condominiums. They do not have a backyard or an area for segregating waste that needs separate bins, such as recyclable items and food waste. People tend to recycle if they have sufficient facilities to cater the segregation activities [26]. Here, the standard deviation, for this reason, is 1.24.

From table 1, the mean on limited time to segregate the waste is 3.62, while the standard deviation is 1.021. Many respondents agreed that limited time caused them not to segregate waste. The recycling participation rate among households is low due to external constraints such as time consumption [27]. Most Malaysians prefer to have fast and easy methods to dispose of the waste during their working hours and have a busy lifestyle. Due to that, they tend to mix the trash in one bin caused easier, and less time is needed than waste segregation [25]. When they combine the organic and inorganic waste in one dustbin, it will be hard to separate them. Thus, the time-consuming factor is one of the major barriers to achieving the recycling targets [28].

Next, the means for lack of knowledge on segregating waste is 3.35, and the standard deviation is 1.240. Table 1 shows that respondents have adequate knowledge of waste segregation. The community can find information on waste segregation on the news or the internet. It contradicted with [28], which claimed that a lack of understanding of the procedures for waste separation slows down the waste separation practices. As a result, more efforts should emphasize recycling activities, simultaneously reducing the burden of solid waste management and handling.

From table 1, the reason for limited waste material to be recycled and compost has a mean of 3.22 and a standard deviation of 1.133. Most respondents naturally agreed with this statement as they found limited items to be recycled. Moreover, they have only a basic knowledge of these recyclable items, hampered segregation. Therefore, the 'zero waste' concept must be highlighted to the population as most materials can be reduced, reused and recycled [3, 15].

3.4 Method that can encourage waste segregation

The result from the method that can encourage waste segregation has been tabulated and shown in Table 2. A reverse vending machine for recycling bottles should be installed near the residential areas, achieving the highest mean (4.34) with a standard deviation of 0.834 compared to another method. A Reverse Vending Machine (RVM) is a machine where people can return empty containers such as bottles and aluminium cans. In return, the end-user will get money or other forms of incentive. Therefore, low-income groups can earn money when they practice recycling. Based on the previous study, the incentives approach, defined by cash payback for recyclable items, can be the most accessible approach to changing people's behaviour toward sustainable waste management [29]. Furthermore, installing RVM in the right location can attract the community to participate in recycling activities [30].

Table 2. The method that can encourage waste segregation.

Method	Mean	Standard Deviation
A reverse vending machine for recycling bottles should be installed nearby the residential area	4.34	0.834
Provide more information on waste segregation through recycling and composting	4.32	0.736
The campaign by the authorized government and private agencies	4.26	0.764

Lastly, providing more information on waste segregation through recycling and composting had a means value of 4.32 and a standard deviation of 0.736. It means that most of the respondents strongly agreed with this statement. It is crucial to know the type of waste before the segregation process. The most successful strategy to encourage recycling participation is to provide enough information [3]. Hence, it can increase the full participation of the community.

On the other hand, exposure to waste segregation through recycling has been widely spread among the population; however, the action on composting activities is still limited. According to [22], a small group of people practised composting while the others were unaware of the activities due to lack of information[22]. Therefore, the well-structured mechanisms of this awareness programme can be enhanced [14].

Next, the method to encourage waste segregation is a campaign by the authorized government, private agencies, and public figures. A mean of 4.26 and a standard deviation of 0.764 has been displayed in table 2. The majority of respondent agrees that campaign by authorizing government, private agency, and public figures can help to encourage waste segregation. A good campaign should include a persuasive approach with various aspects to attract community attention. Nevertheless, some study has stated that participation from the community in waste segregation is still low even though much public awareness has been conducted through the years [31]. Moreover, marketing mediums such as posters, pamphlets, advertisements on television, radio, websites, billboards, and others do not significantly impact waste segregation behaviour [28].

Finally, issuing compound fines for those who have not yet separated their waste has the least mean of 3.52, while the standard deviation is 0.912. Many respondents agreed that the method of issuing fines to people who have not yet practised segregation could be encouraged to do so. However, penalties for those who fail to abide can be considered an excellent extrinsic motivator [32]. There is a shortage of enforcement to monitor the law's execution even though the government has introduced a mandatory law [33]. A more vigorous and proactive measure needs to be taken, such as appropriate supporting systems, facilities, and equipment to implement the law to achieve a higher target on the waste segregation among the communities.

4. Conclusion

It can be deduced that most disposal waste in landfills can primarily be recycled. Organic waste can be turned into compost. Moreover, the existing landfills have reached their life span; thus, reducing garbage in these facilities needs to be executed. Increasing participation from the people will help to reduce the burden of the solid waste management system. Generally, urban and suburban communities have adequate knowledge and awareness of waste segregation through recycling and composting. From the result, the top three reasons most respondents agreed were that recycling activities are still minimal due to the limited space and time allocation to do this practice. The government should add more recycling centres and improve these accommodations. Most respondents agreed upon the top three methods: installing Reverse Vending Machine (RVM), campaigns by the authorizing government, private sector, public figures, and others, and providing more information on waste segregation to the community. It

will change the population's behaviours toward a green and sustainable environment for a better future in line with the Sustainable Development Goals agenda.

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