PROGRESS IN ENGINEERING APPLICATION AND TECHNOLOGY
e-ISSN: 2773-5303

PEAT

Vol. 5 No. 2 (2024) p. 751-759
https://publisher.uthm.edu.my/periodicals/index.php/peat

Household Waste Separation and 3R Practice: Comparison Between the Urban and Rural Communities in Ipoh, Perak

Heo Ruoh Jau[1], Roslinda Ali[1*]

[1] *Faculty of Engineering Technology*
UTHM, Hab Pendidikan Tinggi Pagoh, KM 1, Jalan Panchor, 84600 Panchor, Johor, MALAYSIA

*Corresponding Author: linda@uthm.edu.my
DOI: https://doi.org/10.30880/peat.2024.05.02.078

Article Info

Received: 28 December 2023
Accepted: 17 January 2024
Available online: 25 November 2024

Keywords

Waste, household, urban, rural, recycling, awareness, knowledge, facilities

Abstract

Solid waste management is a global concern that presents a significant challenge to every nation when it comes to environmental deterioration. Malaysia is one of the countries grappling with challenges in solid waste management due to the substantial generation of waste and the waste disposal practiced over the years. This research intends to investigate the household waste separation and 3R practice of urban and rural communities in Ipoh, Perak. Tambun and Menglembu are chosen as the urban and the rural research areas respectively. A questionnaire survey was distributed to the residents who stayed in these areas. A total of 202 questionnaires were returned and the data was analysed by using the Package for Social Science (SPSS) software. The analysis carried out includes descriptive statistics, cross-tabulation analysis, and correlation tests. The findings revealed that there is a correlation between residential areas and 3R practice. Urban and rural communities have moderate awareness levels and knowledge concerning 3R, although rural communities still lag behind urban communities. However, the results indicated that the urban communities (55 respondents, 55.0%) tend to practice waste separation and 3R better in contrast to the rural communities (31 respondents, 30.4%). In addition, the availability of 3R facilities contributes to the tendency to practice waste separation and 3R among urban communities and difficulty in engaging in 3R practices among rural communities. Overall, it can be concluded that the objectives of this research have been successfully achieved.

1. Introduction

In the year 2021, Malaysia produced a total of 38,427 metric tonnes of solid waste per day in parallel with the growing population which reached 32.8 million, and this increased to 39,936 metric tonnes in 2022 [1][2]. Approximately 82.5% of the solid waste generated was disposed of in landfills other than incineration and recycling. This resulted in 174 landfills in Malaysia being closed due to full capacity [1]. Over the years, many studies have been conducted by scholars to investigate the separation at source and 3R practice, as well as alternatives to resolve the waste management issues [3][4][5]. This research is interested in investigating how far the environmental knowledge on waste segregation and 3R practices is affecting the urban and rural household dwellers' recycling behaviour in Ipoh, Perak. A few objectives are formulated to achieve the aim of this research, namely, the knowledge and practice of waste separation and 3R between the respondents in both

the urban areas; and the factors contributing to or preventing the respondents from practising waste segregation and 3R in their daily activities.

2. Literature Review

Over the years, much research has been carried out worldwide regarding solid waste management and 3R practice. From the previous research conducted, a few factors have been identified as factors that motivate or prohibit the respondents from practising waste segregation and 3R in their daily activities. The identified factors are i) awareness level, ii) knowledge, and iii) 3R infrastructure and facilities. These factors are further elaborated in the following sub-sections.

2.1 Awareness Level

Awareness level is the first stage that serves as a prerequisite for potential behaviour change and effective education regarding environmental issues, as public attitude toward 3R practice significantly attributes to environmental awareness [6][7]. Studies have proven that motivation to carry out 3R practice is substantially and positively correlated with awareness [8]. Residents with high awareness levels regarding environmental issues are more willing to practice 3R compared to those with low awareness levels.

Ignorance is also another factor that impedes the adoption of the 3R practice [9]. Communities that are not exposed to practical knowledge related to waste separation and 3R do not feel apologetic for neglecting the 3R practice and environmental health. The absence of 3R awareness-related programmes in the communities makes them feel uninterested and lazy to engage with the 3R practice, although they admit that the 3R practice brings environmental benefits [9][10].

2.2 Knowledge

Environmental knowledge is another major factor that affects the public environmental behaviours toward waste separation and 3R practice. The correlation between knowledge and practice is significantly positively strong [11]. In other words, the degree of engagement in waste management is directly correlated to the environmental education level [12]. Environmental education develops a society with a strong sense of concern for the environment by acquiring knowledge, abilities, and dedication to address waste management issues [8][13]. Communities with higher environmental education levels are more likely to participate in household waste management practices, such as waste segregation, recycling, and composting [12][14].

However, education alone is still not strong enough to be a stimulator for waste separation behaviour among the communities. This is because education alone does not inevitably lead to a change in behaviour although the public gained relevant environmental knowledge [6][15][16]. The communities in Malaysia are knowledgeable about the proper waste disposal method for recyclable waste [17]. Despite the high level of environmental education as well as the attitude, the communities do not show a positive impact on their behaviours toward the 3R practices [7][17].

2.3 3R Infrastructure and Facility

Another factor that influences waste separation and 3R practice is the 3R infrastructure and facilities. Studies have shown that a lack of recycling facilities poses a low motivation and support in engaging in 3R practices [7][9][11]. It is a fundamental issue that impacts waste management [6]. The lack of well-constructed roads and recycling bins results in poor efficiency and difficulty in handling the waste collection process [9][14].

Nevertheless, in some residential areas in Malaysia, though the local government does not provide recycling bins, household dwellers are still willing to participate in the 3R activities as long as there are recycling centres located near their residential areas where they can still send and sell their recyclable waste [8][14][16]. The convenience brought by the 3R infrastructures, such as recycling bins and the waste collection services provided, may motivate households to be involved in recycling activities indirectly as they can gain some profits by selling their recyclable waste to centres.

3. Methodology

Ipoh is chosen as a study area because it has been identified as the third largest city in Malaysia. Tambun and Menglembu were chosen as the urban and rural research areas, in which 100 questionnaires were distributed to each area respectively, which brings to a total sample size of 200 respondents in this research.

The questionnaire survey consists of three parts. Part 1 emphasizes the background of the respondents. Part 2 on the other hand, is designed to identify the factors that motivate the respondents in practicing waste segregation and 3R while Part 3 is on the factors prohibiting the respondents from practicing waste segregation

Progress in Engineering Application and Technology Vol. 5 No. 2 (2024) p. 751-759

and 3R. The survey is conducted through online mode by distributing Google form link and QR code to the respondents. The overall methodology carried out in this research is illustrated in Figure 1.

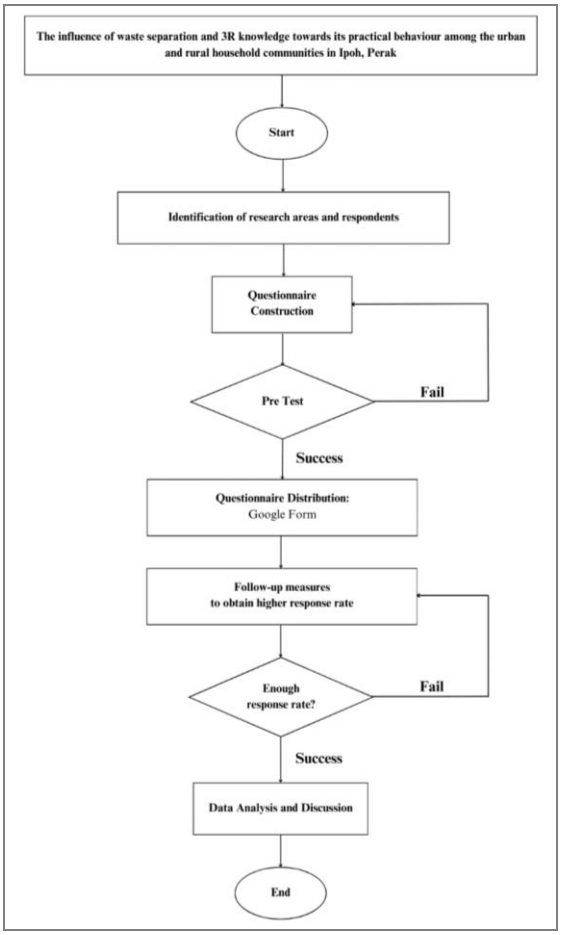


Figure 1: *Research Methodology*

4. Result and Discussion

The data are analyzed by using descriptive statistics, such as frequency distribution and cross-tabulation. The data are also further analyzed by utilizing a correlation test to examine the relationship between two factors.

4.1 Background of Respondents

The survey garnered responses from a comprehensive sample of 202 participants. The background statistics of the respondents obtained from the questionnaire response are shown in this section.

4.1.1 Demographic Profile of Respondents

The respondents were requested to provide their demographic profile which includes information such as age, gender, educational background, level of income and job status. The results are shown in Table 1.

Table 1: *Demographic profile of respondents*

Item		Frequency (n)	Percentage (%)
Residential areas	Sunway City Ipoh	100	49.5
	Taman Menglembu Impiana	102	50.5
Age of respondents	Below 30 years old	86	42.6
	30-39 years old	73	36.1
	40-49 years old	13	6.4
	50-59 years old	12	5.9
	60 years old and above	18	8.9
Gender	Male	106	52.5
	Female	96	47.5

Educational background	No educational background	9	4.5
	Primary school	29	14.4
	Secondary school	76	37.6
	Tertiary education	88	43.6

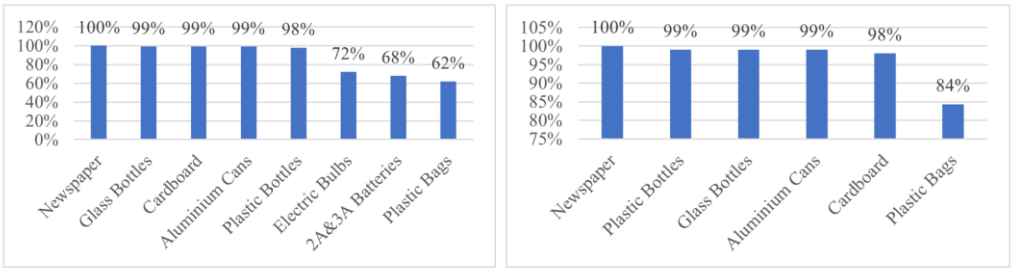
In general, from Table 1, it can be summarized that a total of 202 respondents participated in the study, with 106 males and 96 females. The distribution based on residential areas shows 100 respondents from urban areas and 102 from rural areas. In terms of educational status, 9 respondents had no educational background, 29 attended primary school, 76 had a secondary school education, and 88 had tertiary education.

4.1.2 Respondents' Background Knowledge of Waste Separation and 3R

The respondents' knowledge of waste separation and 3R is tested to examine the respondents' comprehension of waste separation at source and 3R knowledge. In terms of the 3R logo, the majority of the respondents, whether live in urban or rural residential areas, successfully identified the 3R logo. Only a small fraction of respondents do not recognize the 3R logo, with only 1 respondent (1.0%) from Sunway City Ipoh and only 2 respondents (2.0%) from Taman Menglembu Impiana respectively.

In terms of the 3R definition, most of the respondents, regardless of whether they reside in urban or rural areas, were able to correctly identify the definition of 3R, 97.0% (97 respondents) and 99.0% (101 respondents) respectively. The respondents were also asked about the importance of waste segregation and 3R practice. In general, 89 respondents (89.0%) and 78 respondents (76.5%) from both urban and rural areas respectively had successfully answered the question correctly. However, the total number of respondents who answered incorrectly is higher in the rural residential area (24 respondents, 23.5%) compared to the urban residential area (11 respondents, 11.0%).

The respondents were also tasked with identifying the recyclability of listed items by indicating whether they were recyclable or non-recyclable materials. The respondents' knowledge regarding the recyclability of different items was assessed by identifying if the listed 15 items are recyclable or non-recyclable materials. In Sunway City Ipoh, the respondents correctly identified the recyclability of 12 out of 15 listed items (Refer to Figure 2a) while the respondents who stayed in Taman Menglembu Impiana only managed to identify the recyclability of 10 out of those 15 listed items correctly (Figure 2b). The overall correctly identified recyclable items are presented in Figure 2.



(a) Sunway City Ipoh (b) Taman Menglembu Impiana

Figure 2: *Percentage of correctly identified recyclable items*

Overall, respondents from both areas successfully differentiated recyclable and non-recyclable items. Among the items that they cannot identify include cigarette butts, garden waste, and tissue. The findings also revealed that there is a misconception concerning food waste and cigarette butts. Food waste is an item that is suitable to be used in 3R practices, which is composting. Food waste is not a recyclable item, yet it is a compostable item. In addition, cigarette butts are categorized as recyclable items. Composted organic waste from cigarette butts can be extracted and used as fertilizers, while the microplastics from cigarette butts can be recycled to produce toy keychains, cushions, and insulating material for jackets [18].

This lack of awareness might be attributed to a potential unfamiliarity with composting as a 3R practice, as evidenced by the low percentages of respondents identifying food waste and garden waste as compostable materials. Past scholars pointed out that there is limited adoption of composting in Malaysia due to ignorance and skill deficiencies [9]. The findings emphasize an opportunity for targeted educational initiatives to bridge the knowledge gap and foster a more comprehensive understanding of 3R practices, particularly concerning organic waste materials.

Last but not least, the respondents were queried if they practice waste segregation and 3R in their daily lives. From a total of 202 respondents that answered the survey, 86 out of 100 respondents (42.6%) responded they practice waste separation and 3R in their daily activities, while 116 respondents (57.4%) claimed that they do not practice 3R in their daily lives.

Progress in Engineering Application and Technology Vol. 5 No. 2 (2024) p. 751-759

A correlation test is carried out to examine the relationship between residential areas and 3R practice. Results from the test showed that there is an association between where the respondents stayed and their 3R behaviour as the *p*-value is much lower than the significance level as shown in Table 2. This suggests there is a significant difference between those who stayed in urban and rural areas concerning their willingness to practice waste segregation and 3R in their daily lives.

Table 2: *Correlation between residential areas and the practice of waste separation at source and 3R (n=202)*

Correlations			
		Residential areas	Do you practice waste separation at source and 3R in your daily life?
Residential areas	Pearson Correlation	1	.249**
	Sig. (2-tailed)		.000
	N	202	202
Do you practice waste separation at source and 3R in your daily life?	Pearson Correlation	.249**	1
	Sig. (2-tailed)	.000	
	N	202	202
**. Correlation is significant at the 0.01 level (2-tailed).			

4.2 Perception of Respondents That Practice Waste Separation and 3R

A few factors that motivate individuals to practice waste segregation and 3R include i) awareness, ii) knowledge, and iii) 3R infrastructure and facilities. This will be discussed in detail in the following sub-sections.

4.2.1 Awareness Level and Its Relation Towards Willingness to Practice Waste Segregation and 3R

In terms of awareness level, there are 8 statements prepared to investigate the level of agreement of the respondents. The overall results are presented in Figure 3.

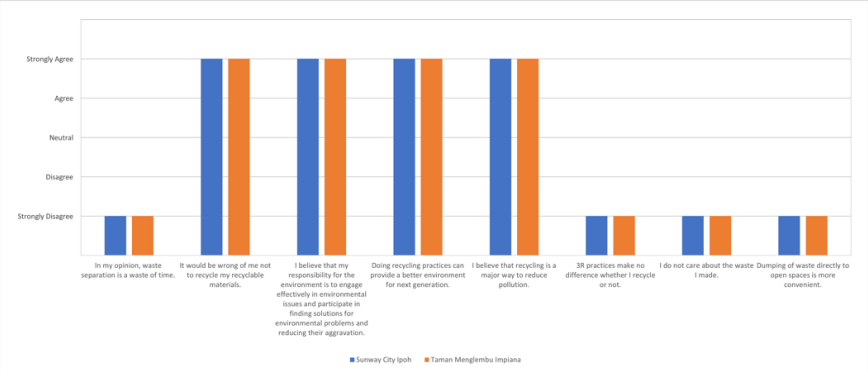


Figure 3: *Overall Result Between Awareness and Respondents' Willingness to Practice Waste Segregation and 3R*

In general, from Figure 3, it can be concluded that although respondents from both residential areas deliver the same answer for the level of agreement, there are differences between these two residential areas. Residents in Sunway City Ipoh demonstrate a stronger awareness level as evidenced by higher percentages strongly agreeing with the responsibility of engaging in environmentally friendly practices, belief in the positive impact of recycling on the environment, and rejection of the notion that individual efforts in 3R make no difference (43 respondents; 78.2%) compared to residents in Taman Menglembu Impiana with only 15 respondents (48.8%) deny that their engagement in 3R practices makes no difference. The rural residents display a positive attitude overall as well, but they still consistently lag behind their counterparts in Sunway City Ipoh across these key indicators. This is supported by Fadhullah et al (2022) who stated that households in Malaysia are highly aware of the importance of proper waste management, which conserves the environment [16]. This result is also in line with the outcome of a study by Pan (2020) that indicated households living in urban areas are more likely to adopt clean waste disposal strategies because they are more aware of cleanliness and emphasize the high quality of life [19].

4.2.2 Knowledge and Its Relation Towards Willingness to Practise Waste Segregation and 3R

In terms of knowledge, there are 9 statements prepared to investigate the level of agreement of the respondents. The overall results are presented in Figure 4.

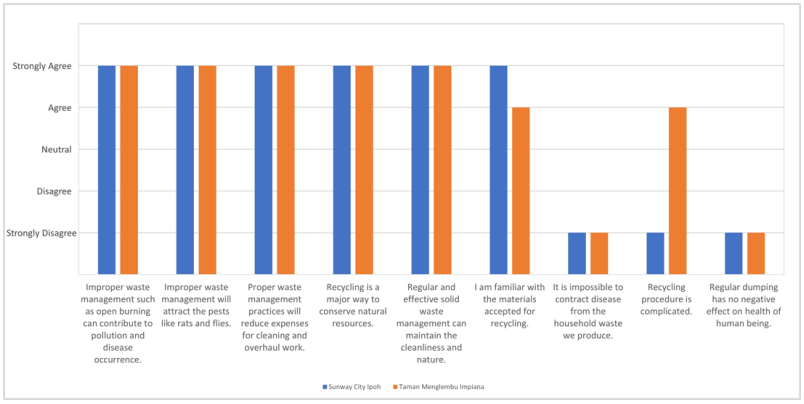


Figure 4: *Overall Result Between Knowledge and Respondents' Willingness to Practice Waste Segregation and 3R*

From Figure 4, it can be summarized that the responses given by the respondents indicate the environmental knowledge of respondents in both residential areas. Respondents from Sunway City Ipoh demonstrate a high level of awareness and positive perceptions towards waste management and recycling practices, for instance, with 45 respondents (81.8%) agree that regular and effective solid waste management can maintain cleanliness and nature. Meanwhile, Taman Menglembu Impiana exhibits a more varied range of opinions, with a remarkable portion expressing neutral or differing views with only 17 respondents (54.8%) agreeing that cleanliness and nature can be maintained by effective solid waste management. These findings are supported Ridzuan et al (2022) and Mohd Zabidi et al (2023) that claimed households who are highly concerned about the importance and benefits of proper waste management in environmental conservation are keen to engage in waste separation and 3R practices [12][14].

4.2.3 3R Facilities and Its Relation Towards Willingness to Practise Waste Segregation and 3R

In this section, a total of 4 statements were prepared to investigate how far the 3R facilities influence the respondent's willingness to practice waste segregation and 3R. The overall results are presented in Figure 5.

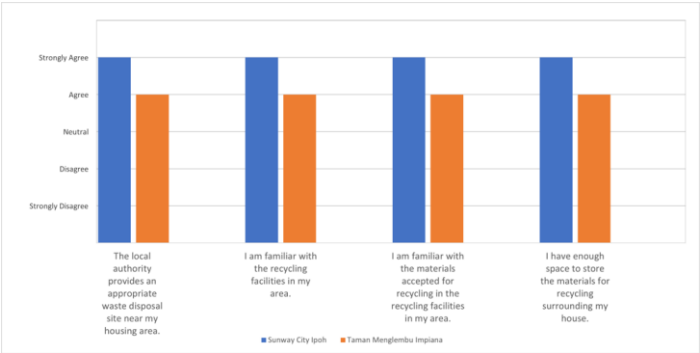


Figure 5: *Overall Result Between 3R Facilities and Respondents' Willingness to Practice Waste Segregation and 3R*

From Figure 5, these results highlight key factors contributing to the higher recycling rate in Sunway City Ipoh compared to Taman Menglembu Impiana. Respondents from Sunway City Ipoh exhibit higher levels of agreement and satisfaction with waste disposal sites (41 respondents; 74.5%), recycling facilities (42 respondents; 76.4%), confidence in material knowledge (39 respondents; 70.9%), and availability of space for recycling materials (42 respondents; 76.4%). These factors contribute to a higher waste segregation and recycling rate in Sunway City Ipoh compared to Taman Menglembu Impiana (55.0% and 30.4% respectively), emphasizing the need for targeted improvements and support in the latter residential area. The findings are in line with a study conducted by Pan (2020) that pointed out proper waste management is predominantly a communal decision shaped by local infrastructures rather than individual behaviour [19]. It is also supported by

Progress in Engineering Application and Technology Vol. 5 No. 2 (2024) p. 751-759

Juliana et al (2022) that identified the accessibility of recycling facilities has the most substantial direct impact on recycling behaviour [7].

4.3 Perception of The Respondents' Refusal to Practise Waste Separation and 3R

In this section, the respondents were asked about their refusal to participate in waste segregation and 3R. The factors that can be related to their refusal include i) awareness level, ii) knowledge, and iii) 3R facilities. This will be discussed in detail in the following sub-sections.

4.3.1 Awareness Level and Respondent's Refusal to Practice Waste Segregation and 3R

In this section, a total of 8 statements were prepared to investigate how far does the awareness level influence the respondent's refusal to practice waste segregation and 3R. The overall results are summarized in Figure 6.

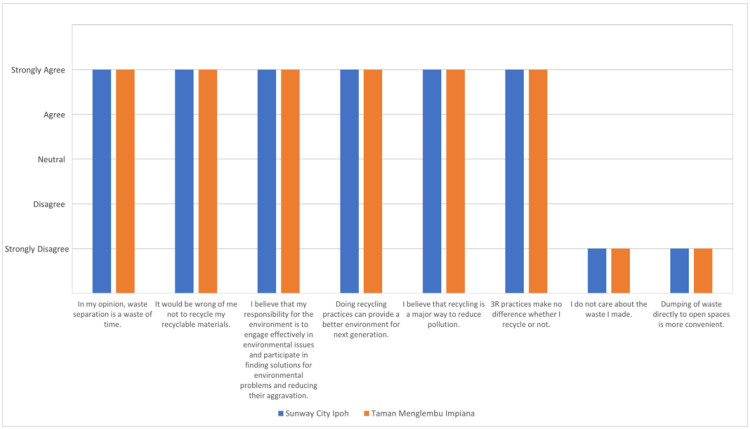


Figure 6: *Overall Result Between Awareness and Respondents' Refusal to Practise Waste Segregation and 3R*

The overall results in Figure 6 indicate that both respondents demonstrate a high level of awareness and positive attitudes toward waste separation and 3R practices. A significant majority still acknowledge their responsibility and believe in the environmental benefits of recycling although they express a lackadaisical attitude toward waste separation and 3R. For instance, respondents from both urban and rural areas strongly agree that recycling practices are the major way to reduce pollution (33 respondents, 73.7% and 60 respondents, 84.5% respectively). Nevertheless, despite their awareness level, they still do not practice separation at source and 3R in their daily lives. This result is in line with the studies conducted by Salleh et al (2022) and Susanto et al (2019) that communities, who admit the environmental benefits of 3R practice, may still feel uninterested and lazy to engage in the 3R practices due to several factors such as lack of 3R awareness programmes [9][10].

4.3.2 Knowledge and Respondent's Refusal to Practice Waste Segregation and 3R

In this section, a total of 9 statements were prepared to investigate how far knowledge influences the refusal of respondents to practice separation at source and 3R. The overall results are summarized in Figure 7.

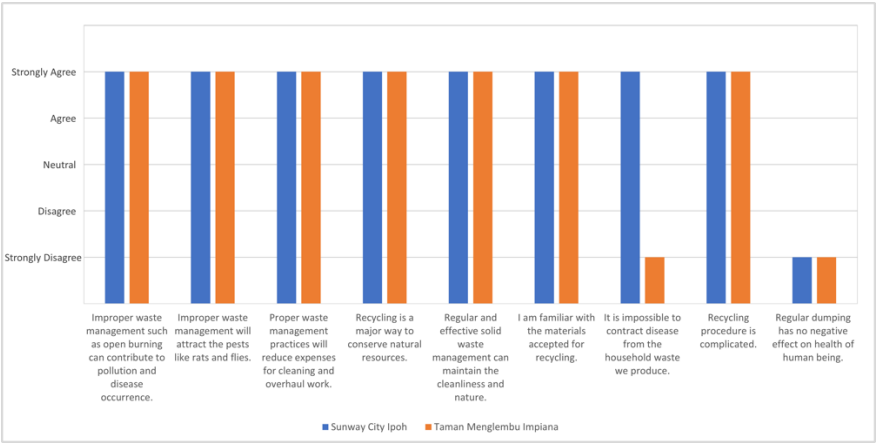


Figure 7: *Overall Result Between Knowledge and Respondents' Refusal to Practise Waste Segregation and 3R*

The findings in Figure 7 illustrate respondents tend to have a slightly higher level of knowledge regarding 3R practices, showcasing a more comprehensive understanding of both the positive and negative environmental effects of waste management although they do not practice 3R practices in their daily lives. For instance, 33 respondents (73.3%) from urban areas and 62 respondents (87.3%) from rural areas strongly agree that effective solid waste management can maintain cleanliness and nature. The obtained result is corroborated by previous scholarly research of Juliana et al (2022) and Lukman et al (2022) that exhibited negative impacts on the behaviours of communities in Malaysia toward the 3R practices despite the high level of environmental knowledge [7][17].

4.3.3 3R Facilities and Respondent's Refusal to Practice Waste Segregation and 3R

In this section, a total of 5 statements were prepared to investigate how far the 3R facilities influence the respondent's refusal to practice separation at source and 3R. The overall results are presented in Figure 8.

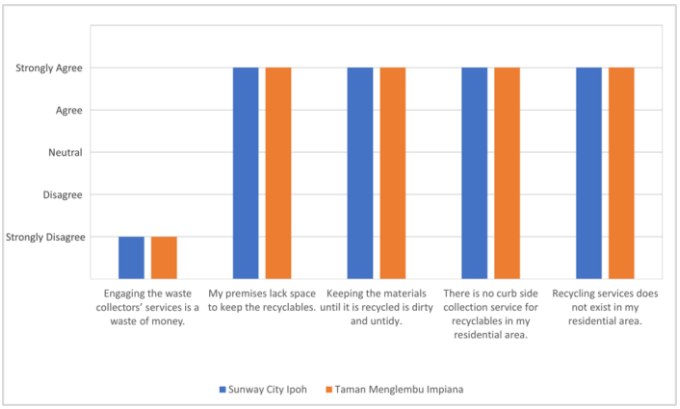


Figure 8: *Overall Result Between 3R Facilities and Respondents' Refusal to Practise Waste Segregation and 3R*

In general, it can be said that the primary challenges related to space constraints and the perceived untidiness of keeping materials until recycling, coupled with the apparent absence of convenient recycling services, contribute to the lower recycling rates observed in Taman Menglembu Impiana compared to Sunway City Ipoh. For instance, only 30 respondents (66.7%) from Sunway City Ipoh claimed that their premises lacked space to keep the recyclables, while there are 58 respondents (81.7%) claimed about this circumstance. Addressing these external factors and enhancing infrastructure support in both areas may prove instrumental in fostering a more conducive environment for recycling practices. A lack of recycling facilities is a primary issue that poses low motivation and support as well as poor efficiency and difficulty in engaging in 3R practices [6][7][9][11][14]. People often use the lack of recycling facilities as an excuse for not engaging in 3R practices. People would like to engage in recycling activities as a spontaneous behaviour for their advantages, such as selling reusable products to recycling centres, although there is a lack of 3R facilities in their housing areas [14].

5. Conclusion

In general, this research had successfully achieved the research objectives. It can be concluded that most respondents, both urban and rural, possess general knowledge. However, there is limited awareness about the recyclability of specific items such as food waste, garden waste, cigarette butts, and tissue. Besides, this study showed that while awareness and knowledge have limited implications, the presence of 3R infrastructure significantly impacts the 3R behaviours of both urban and rural communities. Lastly, this study reveals that urban communities are more likely to practice waste separation at source and 3R compared to rural communities due to the factors of awareness level, knowledge and 3R infrastructure and facilities. A few recommendations are proposed for the future works, such as longer duration is given to the respondents to answer the survey for a higher response rate, and interview session is conducted to explore unexpected factors.

References

[1] Shahril, M. (2022). Waste to Energy for A Sustainable Future - MIDA | Malaysian Investment Development Authority. MIDA | Malaysian Investment Development Authority. https://www.mida.gov.my/waste-to-energy-for-a-sustainable-future/

[2] Roslan, M. B., & Mohd Said. (2022). QUESTION MARK OVER MALAYSIA'S HOPE OF ACHIEVING 40 PERCENT RECYCLING RATE BY 2025. BERNAMA. Retrieved March 14, 2023, from https://bernama.com/en/b_focus/news.php?id=2060298

[3] Daim, N. (2022). No land left if waste not reduced, warns expert. New Straits Time. Retrieved March 28, 2023, from https://www.nst.com.my/news/nation/2022/07/814550/no-land-left-if-waste-not-reduced-warns-expert
[4] Razi, H. H. M., Roslly, K. A., Jurimi, S., & Sharkawi, S. (2022). Why does waste Separation at Source Initiative (SSI) did not fully commission in Malaysia? An exploratory preliminary study. Journal of Entrepreneurship, Business and Economics, 10(2), 86–109.
[5] Rashid, F. H. (2023). Waste-to-energy: The preferred approach for Malaysia's waste management. The Malaysian Reserve. https://themalaysianreserve.com/2023/01/09/waste-to-energy-the-preferred-approach-for-malaysias-waste-management/#:~:text=Hence%2C%20the%20government%20is%20encouraging,disposed%20of%20at%20sanitary%20landfills.
[6] Debrah, J. K., Vidal, D. G., & Dinis, M. a. P. (2021). Raising Awareness on Solid Waste Management through Formal Education for Sustainability: A Developing Countries Evidence Review. Recycling, 6(1), 6. https://doi.org/10.3390/recycling6010006
[7] Juliana, N., Lada, S., Chekima, B., & Adis, A. A. (2022). Exploring Determinants Shaping Recycling Behavior Using an Extended Theory of Planned Behavior Model: An Empirical Study of Households in Sabah, Malaysia. Sustainability, 14(8), 4628. https://doi.org/10.3390/su14084628
[8] Mohd Noor, N. H., Soleman, N. A. F., & Khairul Azuan, A. S. (2023). To Recycle or Not to Recycle? Factors Affecting Malaysian Residents' Intention for Recycling E-Waste. Malaysian Journal of Social Sciences and Humanities (MJSSH), 8(2), e002102. https://doi.org/10.47405/mjssh.v8i2.2102.
[9] Salleh, N. A., Shafiei, M. W. M., Anwar, A., Zulhumadi, F., & Hubadillah, S. K. (2022). Sustaining the Environment: Critical Success Factors and Barriers of Solid Waste Management through Composting Practices by Rural Communities in Malaysia. Sustainability, 14(20), 13541. https://doi.org/10.3390/su142013541
[10] Susanto, N., Davidesyta, L., Nurkertamanda, D., & Putranto, T. T. (2019). The influence of behavioral prediction factors and intention in improving 3R (reduce, reuse, recycle) household behavior in Tanjung Mas, Semarang, Indonesia. In Nucleation and Atmospheric Aerosols. American Institute of Physics. https://doi.org/10.1063/1.5112406
[11] Zain, N. M., Anua, S. M., Marzuki, N. S., & Rahman, H. A. (2022). A Comparative Study on the Effectiveness of 3R (Reuse, Reduce and Recycle) Programme among Primary School Students in Tumpat, Kelantan. International Journal of Academic Research in Business & Social Sciences, 12(14). https://doi.org/10.6007/ijarbss/v12-i14/15823
[12] Mohd Zabidi, F. S., Mohd Kasim, N. A., Ahmad, S., & Miskan, N. H. (2023). FACTORS INFLUENCING WASTE MANAGEMENT IN MALAYSIA. Journal of Business Innovation, 7, 100–107. https://kuim.edu.my/journal/index.php/JBI/article/download/1287/1041
[13] Ardoin, N. M., Bowers, A. W., & Gaillard, E. (2020). Environmental education outcomes for conservation: A systematic review. Biological Conservation, 241, 108224. https://doi.org/10.1016/j.biocon.2019.108224
[14] Ridzuan, M. B., Zani, A. B. M., Rahman, N. N. A., Rabun, M. N. B., & Yaacob, N. A. (2022). Solid Waste Management And Recycling Practices Among PPR Sri Pantai Residents: A Move Towards Sustainability. International Journal of Academic Research in Business & Social Sciences, 12(9). https://doi.org/10.6007/ijarbss/v12-i9/14757
[15] Dai, X., Han, Y., Zhang, X., Hu, W., Huang, L., Duan, W., Li, S., Liu, X., & Wang, Q. (2017). Comparison between students and residents on determinants of willingness to separate waste and waste separation behaviour in Zhengzhou, China. Waste Management & Research, 35(9), 949–957. https://doi.org/10.1177/0734242x17715096
[16] Fadhullah, W., Imran, N. I. N., Ismail, S. N. S., Jaafar, M. H., & Abdullah, H. (2022). Household solid waste management practices and perceptions among residents in the East Coast of Malaysia. BMC Public Health, 22(1). https://doi.org/10.1186/s12889-021-12274-7
[17] Lukman, N. L. M. M., Halim, N. S. A., Ling, W. H., Wee, S. T., & Abas, M. A. (2022). Solid Waste Disposal Practices Among Rural Community in Pasir Mas, Kelantan, Malaysia. IOP Conference Series, 1102(1), 012081. https://doi.org/10.1088/1755-1315/1102/1/012081
[18] George, M. A., & Khadtar, R. (2022). Review on recycling of microplastics in cigarette butts. IOP Conference Series, 1084(1), 012027. https://doi.org/10.1088/1755-1315/1084/1/012027
[19] Pan, Z. (2020). How Waste Is Managed in Urban and Rural Areas: Evidence from China. IOP Conference Series, 566, 012009. https://doi.org/10.1088/1755-1315/566/1/012009