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RESEARCH ARTICLE

Assessing the role of knowledge in shaping household solid waste management practices: A study in Kota Bharu Kelantan

Ain Munirah Satimin[1], Siti Aisyah Nawawi[1,4,*], Amal Najihah Muhamad Nor[1,4], Rabihah Nawawi[2], Julaina Baistaman[2], Siti Hajar Ya'acob[1], Wan Nur Fazni Wan Mohamad Nazarie[3]

[1]Faculty of Earth Sciences, Universiti Malaysia Kelantan, 17700, Jeli, Kelantan
[2]Faculty of Business and Management, UiTM Cawangan Kota Bharu, 15050, Kota Bharu, Kelantan
[3]Faculty of Economics and Muamalat, Universiti Sains Islam Malaysia, Bandar Baru Nilai, 71800, Nilai, Negeri Sembilan
[4]Environment & Sustainable Development Research Group, Faculty of Earth Science, Universiti Malaysia Kelantan, 17700, Jeli, Kelantan

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☒ * **CORRESPONDING AUTHOR**
Siti Aisyah Nawawi
Faculty of Earth Sciences, Universiti Malaysia Kelantan, 17700, Jeli, Kelantan
Email:aisyah.n@umk.edu.my

ABSTRACT

Solid Waste Management (SWM) is a crucial aspect of environmental sustainability, requiring active participation from households to ensure effective implementation. This study aims to assess the level of knowledge and practices related to Household Solid Waste Management (HSWM) and examine the association between knowledge and practices, as well as the influence of demographic factors. Data were collected using structured questionnaires distributed to selected households and analysed using SPSS 26 software. The sampling technique used was convenience sampling. Descriptive and inferential statistical methods, including T-tests, and Chi-square tests, were employed. Results indicated significant differences in knowledge and practices based on gender. Furthermore, a significant association was observed between knowledge and practices across all components of HSWM ($p < 0.001$). The findings suggest that demographic factors play a meaningful role in shaping household waste management practices. Enhancing knowledge and promoting targeted educational strategies can further improve community engagement in sustainable waste practices.

1. INTRODUCTION

Solid waste management (SWM) is a long-standing issue that reflects the development of human civilisation, from early prehistoric societies to modern urban life. Activities driven by human needs continue to contribute to waste problems (Mapa et al., 2022). Globally, SWM faces serious challenges due to outdated infrastructure, financial constraints, and rapid urbanisation (Kaza et al., 2018). In Malaysia, managing household solid waste (HSW) remains an ongoing concern, especially in communities with limited resources.

Knowledge and practices are two important elements that can help improve SWM systems. A practice is an activity that is based on the beliefs and understanding of the community. In contrast, a habit is knowledge, which could be facts, information, a description, or a skill about a certain subject that has been acquired through education or experience through observation, study, or discovery. Knowledge and practices influence how society and its members behave (Sari et al., 2012). Understanding solid waste management is essential for tackling environmental issues and advancing sustainable practices. Research highlights the importance of acquiring knowledge in early infancy for environmental education, emphasising how knowledge at an early age affects waste management behaviours (Akìntunde et al., 2023). Furthermore, studies highlight the significance of knowledge, attitude, and practice (KAP) levels in solid waste management, demonstrating how education can enhance social norms and practices, particularly for the elderly and those in particular professions (Giao & Thien, 2022). Additionally, a study conducted in Somalia highlights the beneficial association between solid waste management knowledge, attitude, and practice, showing that higher knowledge improves waste management techniques and yields favourable environmental results (Isak, 2022).

Poverty is a key issue in Kelantan, particularly in areas like Mukim Kota Bharu (Ali, 2019). Research has shown that B40 communities in urban zones such as *Program Perumahan Rakyat (PPR)* Kota Bharu generate large amounts of household waste, often due to limited income and

poor access to services (Hasbi et al., 2022). One major problem is the lack of effective waste collection, with the Kota Bharu Municipal Council (KBMC) struggling with financial limitations (Fadhullah, 2022).

This study aims to examine household solid waste management (HSWM) by focusing on three main aspects: the differences in knowledge between male and female respondents, the variations in waste management practices (reuse, reduce, recycle, segregation, and disposal) across genders, and the association between household knowledge and their actual practices. By analysing these dimensions, the study provides insights into how gender influences awareness and behaviours, and how knowledge levels shape sustainable waste management practices at the household level.

2. MATERIALS AND METHODS

A cross-sectional study was conducted from February 2024 to January 2025 in Mukim Kota Bharu, Kelantan, Malaysia.

2.1. Study Area

This study was conducted in Mukim Kota Bharu, one of several subdistricts located within the Kota Bharu District. Among these, Mukim Kota Bharu is recognised as one of the poverty-affected areas in the district. Kota Bharu serves as both the capital and royal seat of Kelantan, a state situated in the northeastern region of Peninsular Malaysia. It lies near the mouth of the Kelantan River at coordinates 6.133°N latitude and 102.250°E longitude, encompassing a total area of approximately 11,500 hectares. The geographical context of the study area is illustrated in Figure 2.1, which includes: (A) Mukim Kota Bharu, (B) Kota Bharu District, (C) Peninsular Malaysia, and (D) Kelantan State.

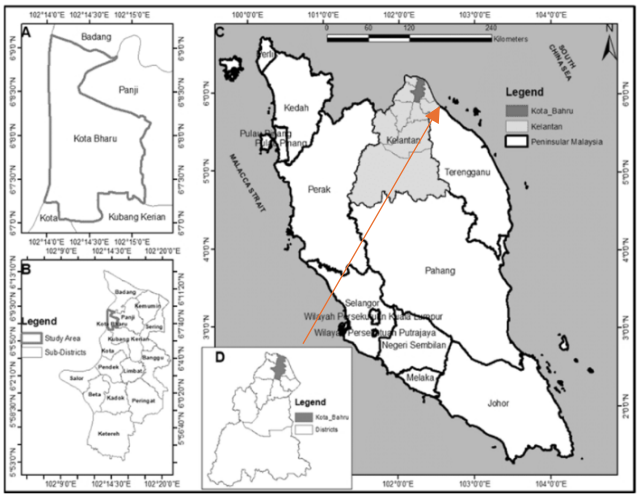

Figure 2.1: Map of the study area: (A) Mukim Kota Bharu, (B) Kota Bharu District, (C) Peninsular Malaysia, and (D) Kelantan State. Source: (Kaoje et al., 2021).

2.2. Data Collection

Primary data was used in this study. This study was conducted using a survey that distributed questionnaires directly to households in Mukim Kota Bharu. The questionnaire consists of three sections. Section A is about the demographic characteristics of the participants, such as gender, age, race, religion, educational level, marital status, monthly income, occupational and residential house type, and the number of residents living in the house. Section B consists of ten questions about households' knowledge of HSWM. Section C consists of five parts of questions, which were classified into reuse, reduce, recycle, segregation, and disposal regarding the practices of households on HSWM. The instrument that was used in Section A is the nominal scale, which is commonly used in categorical data. Meanwhile, for sections B and C, a Likert scale was used where participants express how much they agree or disagree with a statement in a questionnaire, such as strongly do not know, do not know, not sure, know, and strongly know for section B, while a statement such as never at all, never, unsure, ever, and very often for section C. The statement for sections B and C used the value scale of 5, 4, 3, 2, and 1.

The population of Mukim Kota Bharu was 43,515 in 2024. Therefore, the sample size of the population was 381 households. The sample size of 381 was determined by using a formula and referring to the Krejcie and Morgan Table (Chuan et al., 2006). The sampling technique used in this study was convenience sampling, where the researcher selected respondents in Mukim Kota Bharu based on their accessibility to the researcher. This involved surveying by directly giving questionnaires to respondents who were easily accessible.

2.3. Data Analysis

Both descriptive and inferential statistics were used to examine the data using the Statistical Package for the Social Sciences (SPSS) version 26.0. The general weighted average was used to determine households' level of knowledge and practices regarding HSWM in poverty areas in Kota Bharu District. The following illustrates the Likert scale used to assess the level of knowledge and practices among households regarding HSWM, in support of the study's objectives. The scale that was used to assess the level of knowledge and practices of households on HSWM is given below:

Value	Status
4.20-5.00	Very High
3.40-4.19	High
2.60-3.39	Average
1.80-2.59	Low
1.00-1.79	Very Low

2.3.1. Inferential Statistics

Inferential statistics, such as an independent t-test and a chi-square test, were used to examine the relationship between household knowledge and practices on HSWM. The hypothesis statement was shown in Table 2.1.

Table 2.1: Hypothesis statement with statistical test

Hypothesis	Hypothesis statement	Method
HA 1	There is a significant difference between male and female households in Mukim Kota Bharu regarding their knowledge of HSWM.	T-test
HA 2	There is a significant difference between male and female households at Mukim Kota Bharu in HSWM practices in terms of reuse, reduce, recycle, segregation, and disposal.	T-test
HA 3	There is an association between knowledge and practices among households regarding HSWM.	Chi-square test

3. RESULT AND DISCUSSION

The frequency and percentage for each variable category for each variable were listed under each socio-demographic characteristic of the households (Table 3.1). The demographic characteristics of this study consist of gender, age, race, educational level, occupation, household income, number of residents living in the house, house type, and home status. This study comprises 381 households from Kota Bharu district, where 187 (49.1%) were male and 194 (50.9%) were female, respectively. Among the households, the least represented age group is those under 35 years, known as 'Youth,' with 67 households (17.6%). The majority of households fall within the 35-60 age group, known as 'Adults,' with 238 households (62.5%), followed by those over 60 years, known as 'Elderly,' with 76 households (19.9%). Most of the households were Malay, comprising 320 households (84.0%), followed by Chinese with 61 households (16.0%).

Based on the educational level of households, the majority had an SPM qualification, with 265 households (69.6%), followed by 35 households with an STPM qualification (9.2%), 70 households with a Diploma/Degree (18.4%), and 11 households with other qualifications which are individuals who either lack formal education or have advanced qualifications beyond a degree: Master's/PhD, (2.9%). For household occupation, the government and private sectors had 42 households (11.0%). The majority were self-employed, with 159 households (41.7%), followed by unemployed households with 101 households (26.5%), and 37 households in other occupations which retired (9.7%). The majority of households, 371 (97.4%), had an average income below RM4,849, categorised as B40, while 10 households (2.6%) were under the range of RM4,850-RM10,959 which categorised as M40.

For the number of households living in the house, 151 households (39.6%) lived with 1–3 households, followed by 180 households (47.2%) lived with 4–6 households, and 50 households (13.1%) lived in with more than 6 households. There were three types of houses. The majority of households, 222 households (58.3%), lived in village houses, followed by 151 households (39.6%) lived in terrace houses, and only 8 households (2.1%) lived in bungalows. For the home status, the majority of households, 303 households (79.5%) lived in their own house, and 78 households (20.5%) lived in rental houses.

Table 3.1: Descriptive statistics of socio-demographic characteristics.

		Frequency (n)	Percentage (%)
Gender	Male	187	49.1
	Female	194	50.1
Age	<35 years (Youth)	67	17.6
	35-60 years (Adults)	238	62.5
	>60 (Elderly)	76	19.9
Race	Malay	320	84.0
	Chinese	61	16.0
Education	SPM	265	69.6
	STPM	35	9.2
	Diploma/Degree	70	18.4
	Others (lack education / higher education)	11	2.9
Occupation	Government sector	42	11.0
	Private sector	42	11.0
	Self-employed	159	41.7
	Unemployed	101	26.5
	Others (retired)	37	9.7

The purpose of this study was to gain a comprehensive understanding of household solid waste management (HSWM) in the Kota Bharu District by assessing gender differences in household knowledge, examining gender variations in household practices (reuse, reduce, recycle, segregation, and disposal), and determining the association between knowledge and practices. By utilising reliable data collection instruments with high internal consistency (Cronbach's Alpha ≥ 0.80), this study effectively captured accurate and relevant data with Cronbach's Alpha=0.90 , enabling the achievement of its objectives.

There were 10 items used in this study to determine the level of household knowledge on HSWM (Table 3.2). The interpretation of all items was above 3.40, interpreted as high. The highest general weighted average (GWA) was 4.23 for item 'I know that proper waste management practices can guarantee cleanliness in the home area', while the lowest GWA was 3.41, categorised as average for item 6, 'I know the steps that can be taken to encourage recycling practices at home.' The average GWA among all items was 3.99, which was considered high. This shows that the household demonstrated a high level of knowledge regarding HSWM.

In terms of practices, the average level of household practices on HSWM in terms of reuse is interpreted as high, with 3.50 of GWA. The highest GWA for reuse was 4.21, which was categorised as very high for item 1, I reuse my grocery store shopping bags', while the least GWA was 2.87, which was categorised as an average for item 2, 'I reuse our kitchen scraps as compost for my gardening use.' Moreover, the level of household practices on HSWM in terms of reduce, all four items were interpreted as high with an average of 3.70 GWA.

The highest GWA was 3.99 for item 1, I carry a reusable bag to the grocery store instead of using a plastic bag', while the lowest GWA was 3.42 for item 2, 'I use washable food containers instead of buying disposable food containers.' Next, the average level of household practices on HSWM in terms of recycling was 3.12. The highest GWA was 3.43 for item 3, 'I collect household waste and recycle items that can still be repaired', while the lowest GWA was 2.91 for item 2, 'I convert old waste materials into new products.' Other than that, regarding the level of household practices on HSWM in terms of segregation, all items were categorised as high since the average GWA was above 3.40.

The highest GWA was 3.68 for both item 3, 'I segregate hazardous waste in appropriate plastic waste' and item 4, I separate electronic items into containers suitable for disposal or recycling'. Meanwhile, the lowest GWA was 3.47 for item 2, I separate recyclable waste and non-recyclable'. The level of household practices in terms of reuse on HSWM showed that high GWA scores for practices such as reusing grocery bags indicated strong adoption of simple and easy practices. However, lower scores for activities such as composting kitchen waste highlighted areas where practices are less common, likely due to limited knowledge. According to a Mangaluru survey, 73.8% of families had moderate waste management practices, while 52.5% of households had moderate awareness (Madhushree & Baptist, 2024).

Besides that, the results indicated that among the practices in terms of reduce, carrying a reusable bag to the grocery store is the most commonly adopted, reflecting strong household engagement in reducing plastic bag usage. In contrast to use washable food containers instead of buying disposable food containers, suggests that while this practice is still categorised as high, it is less widely adopted, potentially due to convenience or accessibility factors. This highlighted varying levels of commitment to sustainable practices among households. Despite being aware of the environmental problems associated with single-use containers, many consumers are still in the pre- actional stage-willing to change but not yet take action (Moussaoui et al., 2023).

Furthermore, the result of the level of household practices in terms of recycle indicated that households were more inclined toward simpler recycling activities that involved minimal effort or skill, while converting old waste materials to new products highlighted lower levels of practice for more complex recycling practices, potentially due to a lack of resources, knowledge or accessibility. Recycling initiatives may be discouraged by high preparation and transportation expenses (Poulsen, 2013). In addition, according to GK & Kannan (2023), in Chennai, only 43% of people adopted appropriate segregation, despite 89.2% understanding trash categories. The results indicated that households were part of the 43% who understood trash categories and actively practised proper segregation. Lastly, the results of the level of household practices in terms of disposal suggested that the most common practice among households was placing waste in the correct bin, as indicated by the highest GWA, whereas burning waste in a safe area was less preferred, with the lowest GWA.

The statistical analysis revealed a significant difference in household knowledge of HSWM between male and female respondents, as shown in Table 3.3. A T-test value of 1.311 with a p-value less than 0.001 confirms that gender plays a role in knowledge levels. The positive mean difference of 0.773 indicates that male respondents displayed a higher level of knowledge regarding HSWM than their female counterparts. This result supports the findings of Dagadu et al. (2024), whose research in Greater Accra found that men generally better understand hazardous waste management issues than women.

An independent samples T-test was conducted to examine gender differences in household practices related to solid waste management (SWM), specifically reuse, reduce, recycle, segregation, and disposal. The results, summarised in Table 3.4, indicate there were no statistically significant differences in reuse (T-value = -1.104, $p = 0.270$), reduction (T-value = -0.008, $p = 0.994$), and segregation (T-value = 0.956, $p = 0.339$) practices, suggesting that these practices are relatively consistent across genders. In contrast, recycling and disposal practices demonstrated significant variation between male and female respondents. The analysis revealed that males were more likely to participate in recycling activities ($t = 3.406$, $p < 0.001$), with a positive mean difference of 0.303. This finding is supported by Soomro et al. (2022), who reported that men in Saudi Arabia displayed more environmentally proactive behaviour in recycling and reselling. Furthermore, Oztekin et al. (2017) argued that learned attitudes often shape male recycling practice, while women tend to hold intrinsic environmental values.

Regarding disposal practices, the results showed a significant difference favouring female respondents (T-value = -3.657, $p < 0.001$), with a mean difference of -0.220. This suggests that females are more actively involved in proper

waste disposal. The outcome resonates with previous findings by Aboelmaged (2020), who identified strong internal and external motivations among women in sustainable e-waste management, and Sonnenberg et al. (2018), who observed that women in South Africa frequently make decisions related to clothing disposal with an emphasis on recycling and donation. Similarly, Onyemelukwe et al. (2020) found that Nigerian women play a central role in household waste management decisions. Taken together, these findings indicate that males exhibit greater participation in recycling, while females demonstrate stronger commitment to disposal responsibilities. Such gender-specific insights offer practical implications for tailoring SWM programmes to better align with behavioural tendencies among different household demographics.

Table 3.2: Level of Knowledge and Practices on HSWM

Item: Knowledge of Household Waste Management						
	Very Low	**Low**	**Average**	**High**	**Very High**	**GWA**
I know the waste disposal location in my residential area.	0	122	33	174	52	3.41
I know about the benefits of recycling household waste.	2	56	29	241	53	3.75
I know about the practice of 3R (Reuse, Reduce, Recycle).	2	61	18	237	63	3.78
I know the right way to dispose of waste at home.	1	28	37	278	37	3.85
I know that recycling methods can reduce the amount of waste.	2	28	37	253	61	3.9
I know the steps that can be taken to encourage recycling practices at home.	6	88	80	168	39	3.38
I know that bad waste management will have a negative effect on the place of residence.	0	0	26	252	103	4.13
I know about waste segregation practices.	1	35	6	281	58	3.94
I know about the difference between organic waste and inorganic waste.	2	42	74	229	34	3.66
I know that proper waste management practices can guarantee cleanliness in the home area.	0	0	19	237	125	4.23
Average						3.99
Item: Practices(Reuse)						
	Very Low	**Low**	**Average**	**High**	**Very High**	**GWA**
I reuse my grocery store shopping bags.	2	9	0	265	105	4.21
I reuse our kitchen scraps as compost for my gardening use.	34	162	25	138	21	2.87
I bring my own drinking bottle instead of buying drinking water in plastic or disposal bottles	21	152	15	141	51	3.18
I reuse old materials	15	54	2	261	49	3.72
Average						3.5
Item: Practices(Reduce)						
	Very Low	**Low**	**Average**	**High**	**Very High**	**GWA**
I carry a reusable bag to the grocery store instead of using a plastic bag to shop.	5	35	0	260	81	3.99
I use washable food containers instead of buying disposable food containers.	3	122	22	179	55	3.42
I repair broken furniture instead of throwing them away.	12	92	24	219	34	3.45
I give leftover food to the animals around my housing.	8	48	0	225	100	3.95
Average						3.7
Item: Practices(Recycle)						
	Very Low	**Low**	**Average**	**High**	**Very High**	**GWA**
I recycle paper, bottles, cans and other waste materials for reuse.	16	137	26	167	35	3.18
I convert old waste materials into new products.	17	166	54	123	21	2.91
I collect household waste and recycle items that can still be repaired.	12	108	12	204	45	3.43
I produce recycling bins for recyclables.	19	153	62	124	23	2.94
Average						3.12
Item: Practices(Segregation)						
	Very Low	**Low**	**Average**	**High**	**Very High**	**GWA**
I separate the waste before throwing it in different bins.	10	102	16	203	49	3.52
I separate recyclable waste and non-recyclable waste.	12	100	22	192	55	3.47
I segregate hazardous waste in appropriate plastic waste.	6	74	9	240	52	3.68
I separate electronic items into containers suitable before disposal or recycling.	12	71	8	227	63	3.68
Average						3.59

A chi-square test was conducted to assess the association between household knowledge and solid waste management (SWM) practices, as summarised in Table 3.5. The results revealed statistically significant relationships for all five key practices: reuse ($\chi^2 = 313.171$, $p < 0.001$), reduce ($\chi^2 = 136.101$, $p < 0.001$), recycle ($\chi^2 = 155.477$, $p < 0.001$), segregation ($\chi^2 = 213.979$, $p < 0.001$) and disposal ($\chi^2 = 144.799$, $p < 0.001$). These findings demonstrate that levels of household knowledge are positively associated with more frequent and effective SWM practices.

Overall, all the practices in terms of reuse, reduce, recycle, segregation, and disposal have statistically significant

association between household knowledge and practices on HSWM with a significant value less than 0.001. It showed that households in Kota Bharu district have good knowledge on HSWM practices. The consistent significance across all domains highlights the influence of knowledge in shaping sustainable waste management practices among households in Mukim Kota Bharu. Furthermore, studies highlight how education can enhance social norms and practices, particularly for the elderly and those in particular professions (Giao & Thien, 2022).

Table 3.3: The level of households' knowledge on HSWM based on gender

Knowledge	T-test	Significant value	Mean difference
	1.311	<.001	0.773

Table 3.4: The level of households' practices on HSWM based on gender

Practices	T-test	Significant value	Mean difference
Reuse	-1.104	0.270	-0.079
Reduce	-0.008	0.994	-0.004
Recycle	3.406	<.001	0.303
Segregation	0.956	0.339	0.092
Disposal	-3.657	<.001	-0.220

Additionally, a study conducted in Somalia highlights the beneficial association between solid waste management knowledge, attitude, and practice, showing that higher knowledge improves waste management techniques and yields favourable environmental results (Isak, 2022). Research has shown that career and education are important indicators of waste management knowledge and attitude (Badrum & Mapa, 2020). Additionally, it has been discovered that treatments aimed at advancing practices and understanding are successful in enhancing the handling of trash habits at the home level (Widiyanto et al., 2019). Better waste management practices, like composting, recycling, and segregation, have been linked to high levels of knowledge and positive attitudes. This finding highlights the significance of income and education in affecting waste management behaviours (Gunasiri & Senadheera, 2019).

Table 3.5: Significance of the association between knowledge and practices of households on HSWM

Practices	Chi-square value	Significant value
Reuse	313.171	<.001
Reduce	136.101	<.001
Recycle	155.477	<.001
Segregation	213.979	<.001
Disposal	144.799	<.001

4. CONCLUSION

This study provides an in-depth understanding of household solid waste management (HSWM) in poverty-stricken areas of the Kota Bharu District by examining levels of knowledge, practices, and demographic influences. Despite socioeconomic challenges, households demonstrated commendable awareness and engagement in sustainable waste practices. Statistical analyses confirmed significant associations between knowledge and all five categories of waste management practices—reuse, reduce, recycle, segregation, and disposal—indicating that higher knowledge levels lead to more effective management. Gender-based differences revealed that males were more engaged in recycling, while females were more involved in disposal activities, reflecting behavioural patterns consistent with both local and international studies. These findings suggest that urban exposure and community resilience can foster positive waste management behaviours even in economically constrained settings, highlighting the importance of inclusive and demographically sensitive programmes to sustain environmental practices.

This study is limited by its geographical scope, which focuses solely on the Kota Bharu District, potentially restricting the generalizability of the findings to other regions. Moreover, the reliance on self-reported and cross-sectional data may introduce bias and limit causal interpretation of the relationships between knowledge, demographic factors, and practices. The findings imply that local authorities should enhance the frequency and coverage of waste collection services, particularly in rural areas, to minimize improper disposal such as burning or burying waste. Providing affordable alternatives—such as compost bins and small-scale eco-friendly incinerators—and implementing targeted awareness campaigns can further strengthen sustainable household waste practices. Future research should evaluate the effectiveness of such interventions across different housing types and districts. Overall, this study contributes to advancing environmental sustainability and supports Sustainable Development Goal (SDG) 12: Responsible Consumption and Production, by promoting knowledge-based and community-driven waste management initiatives.

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