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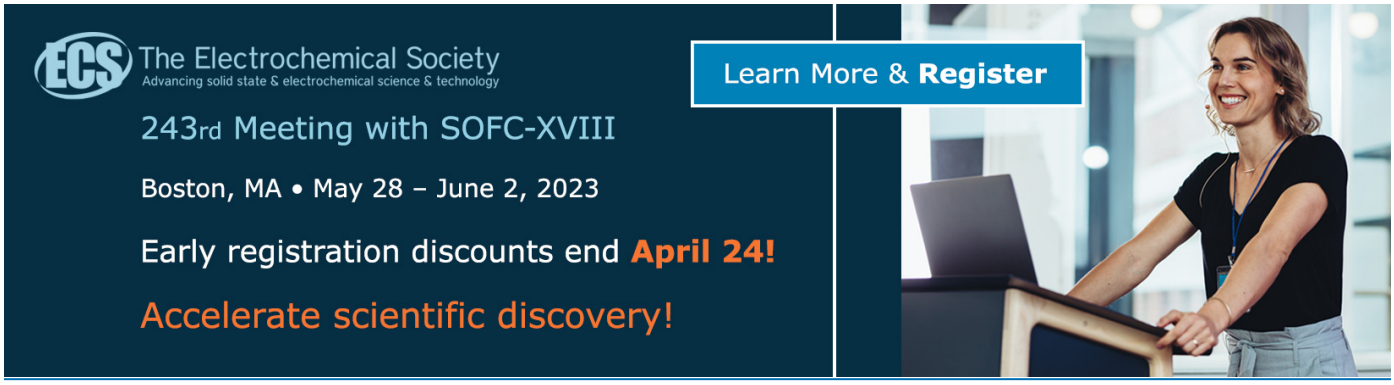

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Waste generation and characteristization: Case study of Seberang Takir, Kuala Nerus, Terengganu, Malaysia

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Abstract. Seberang Takir is a small town in Terengganu. In 2013, the rate of population in Kuala Terengganu was 375,481 people. The population in Seberang Takir gathered in 2013 was about 32000 people. From that numbers 64.5% were in urban area while remaining 35.5% residing in rural area. The generation of solid waste is associated with number of population. The problems associated with the inefficient of waste management in Malaysia are inadequate equipment used for waste collection, lack of effective legislation for waste management and technical constraint such as solid waste management planning and operation. The purpose of this study was to determine the rate of waste generation and its characteristics, the relationship between solid waste generations and total monthly income, the relationship between solid waste generation and family size as well as to determine the willingness of community towards new approach in solid waste management. Data was collected from the distribution of questionnaire from selected residential area and analysed using Statistical Package for Social Sciences (SPSS). This study have found that the dominant composition of solid waste were food waste, followed by plastic and paper. The generation rate for dominant composition of solid waste such as food waste, plastic and paper were in the range of 24 kg/month and above respectively. The other waste such as glass, tins and other wastes were in range of 0 to 6 kg/month respectively. The result of this research also showed that there was a strong significant relationship between family size and solid waste generation but in contrast there was no significant relationship between total monthly income and solid waste generation.

1. Introduction

Solid waste is wastes arising from human and animal activities for example residential, commercial and household activities that are discarded as useless or unwanted. Solid wastes are generally classified in three general categories which are municipal waste, industrial waste and hazardous waste. Municipal waste includes waste from residential, commercial, open area such as parks, streets,

playground and treatment plant waste while industrial wastes derived from industrial activities other than mining. Besides, hazardous waste are waste that a substantial danger immediately or over a period of time to human, plant or animal life. They are certain household waste can be classified hazardous, categorized as household hazardous waste. The examples of these wastes are solvents, paints, unused medicines, lamps, batteries and many more.

The factors influence the composition and characteristics of municipal solid waste are economic level, season, weather and culture of people living or doing business in the area the waste generation. According to [1], to date average Malaysian produced 1.64kg of solid waste a day, makes it above than the average worldwide generation of 1.2kg per person according to world bank report. Hence, this rate considered relatively high compared to other developing countries. The generation rate and composition of solid waste depends on many factors that must be taken into consideration when trying to explain waste generation, both general and site specific. Seasonal variation influences waste generation rate and waste characteristics for seasonal factors [2] while more food waste was generated in monsoon and summer seasons than in spring and winter seasons [3]. These societal changes influence the characteristic of given households, including family size, residential location and community status. Correlation between household solid-waste generation and composition and relevant socioeconomic parameters [4].

Generally MSW consists of around twenty different categories which are food waste, paper, cardboard, plastic, textile, wood waste, metals, diapers, news prints, high grade and fine paper, fruits waste, green waste, batteries, construction waste and glass these categories can grouped into organic and inorganic [5]. According to [6], the highest composition solid waste is organic waste. In Malaysia, with population of 30 million in 2014 the generation rate of 1.2 kg/per/day solid waste are relatively high compared to other developing countries. The Ministry of Housing and Local Government pointed out in 2005 that the amount of waste generation in Malaysia is projected to increase at 3.4% per year. Table 1 shows the estimated amount of waste generation until 2020. Urban area generates more paper and plastics waste compared to the rural area that generates more organic wastes.

Table 1 Estimated amount of waste generation in 1991, 1994, 2015 and 2020

Year	Population (million)	Estimated Waste (9tons/year)
1991	17 567 00	4.488 369
1994	15 917 739	5 048 804
2015	31 773 889	7 772 402
2020	35 949 239	9 092 611

Source: Ministry Of Housing and Local Government (2005)

2. Methodology

The study area was carried out at Taman Perumahan Telaga Daing (5°21'49.0"N, 103°07'26.0"E) and Taman Permint Perdana (5°20'43.8"N, 103°07'27.8"E) of Seberang Takir area.

Prior to the main survey a pilot study was carried out to test the authenticity of the questionnaires. For this study, 30 respondents took part in the pilot test. 238 respondents were participated in the actual survey selected from both study area. The total numbers of respondent was calculated based on the given equation:

$$n = \frac{N}{1 + Ne^2} \quad (1)$$

Where;

n the sample size
N the population size
e the level of precision (95 %; e= 0.05)

3. Results and discussion

3.1. Demographic of Respondents

238 respondents took part in this study. Respondents were consisted of 134 males (56.3%) and 104 females (43.7%). Male was more attracted to answer the survey compared to female. Majority of respondent were Muslim (100%) and Malay (100%) because they are the majority of population at Seberang Takir'district.

33.2% respondents had family monthly income which was ranged from RM600 to RM1200. This is because Seberang Takir is a small town and less developed area. 32.4% respondents had family income ranged from RM2000- RM3500. Only 3.8% respondents had monthly income which above RM3500. Hence we can say that the living standard in this area of study is considered medium.

3.2. Knowledge About Solid Waste

76.1% (181) of respondents stated that they have a knowledge about solid waste and the rest did not. This study showed that 117 of male respondents indicated having a knowledge on solid waste compare to female which was 64 respondents. The majority of respondents have heard about solid waste via television (86.1%) and the lowest percentage (13.1%) of respondents heard about solid waste when they were at school or university.

Meanwhile 45% of respondents practiced recycling while 55% of respondents did not. 67 males practiced recycling at their houses compared to female. The reasons that people did not recycle was because lack of facilities and the quantity of recycle material are varyingly uncertain [7]. Similarly in this study most respondent have responded that lack of facility was the significant reason averse them from practise recycling.

54.2% (129) households separate some of their waste while the rest (45.4%)(108) did not. By doing separation and segregation, one can earn additional income by selling the recyclables to the recyclers. The respondents also gave examples of sorted wastes into plastic bags, glasses, peelings (banana and potatoes). The relationship between income and waste separation is negative but significant at 5% confident level. This shows that households with high incomes are less likely to involve in separating waste. Thus, the majority of those who separated their waste were intended to earn some income. We can say that this activity is not important for high income household.

3.3. Characteristic of Solid Waste

Table 2 shows the percentages of waste characterisation generated as estimated by respondent. If we look at the highest generation which is above 24 kg per week, food waste (12.2 %) was the main type generated. The second largest component of solid waste was plastic with a value of about 2 %. This value is similar as reported by [8]. Generation of paper was 0.8% and none of the respondent estimated they generated more than 24kg for glass, tin and others.

Table 2 Generation of solid waste according to types

Solid waste generation per month (kg)	0	0-6	6-12	12-18	18-24	above 24
Food waste	0%	39.1%	22.7%	11.8%	10.9%	12.2%
Plastic	0%	58.0%	25.0%	9.2%	3.4%	2.0%
Glass	0%	67.2%	7.1%	2.0%	0.8%	0.0%
Paper	0.4%	58.0%	16.4%	8.4%	2.5%	0.8%
Tins	0%	58.4%	3.4%	0.8%	0.8%	0.0%
others	0%	50.8%	1.3%	0.8%	0.4%	0.0%

3.4. Generation of Solid Waste

3.4.1 Food Waste. As mentioned earlier food waste generation indicated the highest proportion among other types of solid waste. The production of organic waste was the tremendous one compared to other components because food is the essential needs for the people [9]. Respondents tend to throw organic waste rather than recycled it as compost, or used it for other usage. 10.9% (26) respondents composted food waste which is between 18 until 24 kg/month while 11.8% (28) respondents generate food waste which is between 12 to 18 kg/ month. 39.1% (93) respondents estimated that their food waste generation was in a range of 0 to 6 kg/month.

3.4.2 Plastic Waste. 2% (5) respondents estimated their plastic generation was 24kg/month and above while 3.4% (8) respondent generated plastic in a range of 18 to 24 kg/month. Plastic and paper composition was among the highest; this might be due to changes of the lifestyle where they prefer to buy variety of foods in packages [10]. A high number of respondents (53%) stated that they generated plastic in a range of 0 – 6kg.

3.4.3 Paper Waste. Similar trend with plastic waste, 58% (138) respondents stated that they generated paper in a range of 0 to 6 kg/month followed by second highest percentage (16.4%) for 6 – 12 kg. 8.4% (20) respondents generated paper between 12 to 18 kg/month while 0.8% (2) respondent estimated their generation rate of paper was 24kg/month and above. Paper found in this residential area in a form of paper scrapes, packing papers, discarded papers from people's activity.

3.5. Factors That Affect Solid Waste Generation

Rainy season and festive seasons were included as whether they were significant factors that affect waste generation. 35 % of respondents were not sure whether rainy season affect solid waste generation on the other hand the same amount of percentage 35% respondents agreed. Most of respondents were uncertain about rainy season affect solid waste generation. According to [11], the total waste generated in the dry season is similar to the waste generated during the rainy season. Organic waste, plastics, paper and metals generated in the dry season were also similar to amounts generated during the rainy season. Therefore, we can say that weather condition did not imply the difference in terms of waste generation.

A significant amount of 66 % (157) of respondents agreed that festival season affect solid waste generation while 31% (74) of respondents were not sure. This finding was also supported by study

done by [12] where composition of waste can be influenced by seasonal factors. The increase in the amount of plastics at the end of the festive month was observed [13].

3.6. Relationship between Solid Waste Generation, Total Monthly Income and Family Size

3.6.1 Correlation between Solid Waste Generation and Total Monthly Income. A negative correlation was found between the income and the generation of household solid waste ($r = -0.06$, $p<0.01$). Even though it is typically expected that a family with higher income tend to generate a higher quantity of solid waste each day, here in this research, the finding was totally the opposite. The low income was also generating high amount of MSW as this group tends to process and home cooked their meal rather than eating out, hence the generation of food waste is high.

3.6.2 Correlation between Solid Waste Generation and Family Size. A significant strong positive correlation ($r = 0.45$, $p<0.01$) was found between household waste generation and family size. This means that family size gave a significant relative with solid waste generation. The larger household size was presumed to generate larger quantity of waste since more individuals are included in the household unit [14].

3.7. Willingness to Participate

The level of awareness about recycling of respondents in Seberang Takir increased but the attitude did not resembled on the importance of recycling where the level was moderate. 30.3% respondents agreed on the governmental or NGO programs reduced food waste in their residential area while 59.7% disagree. This can be expected where citizens did not perceived the changes in recycling practise eventhough much awareness campaign were done to promote. However, 84.9% of respondents stated that they willing to take the initiative to separate the solid waste if the government or NGOs to provide the appropriate bins while a small percentage of 5.0% did not. A high percentage of 73.5% of respondents willing to join the campaign that organized by government or NGO while 22.3% of respondent were not sure. Therefore, the government and NGOs should continuously take the initiative to attract public in campaign to attract and strengthen recycling practice among citizens.

4. Conclusion

The dominant composition of solid waste in this study was food waste followed by plastic and paper. There were a strong significant between family size and solid waste generation in Seberang Takir community but in contrast there are no significant between income level and solid waste generation. Lack of facilities remained a strong factor of low recycling practice. Special management should be considered in tackling amounting solid waste generation during festive seasons that can promote vectors disease and negative aesthetic values due to uncollected waste.

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