

**A STUDY ON THE EFFECTIVENESS OF  
SOLID WASTE AND PUBLIC CLEANSING  
MANAGEMENT ACT 2007 IN GAMBANG  
AND TAMAN TAS REGION**

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CLEANSING MANAGEMENT ACT 2007 IN GAMBANG AND TAMAN TAS  
REGION

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## ABSTRAK

Sejak manusia mula hidup dalam kumpulan atau koloni, sisa yang dicipta oleh manusia kerap menjadi masalah besar yang mempengaruhi kehidupan kita. Kajian ini bertujuan untuk menyiasat keberkesanan tindakan orang awam terhadap pemisahan sisa pepejal isi rumah mengikut jenis seperti sisa kitar semula (sisa kering) dan sisa tidak boleh dikitar semula (sisa basah). Tindakan ini akan meningkatkan keberkesanan pengurusan sisa pepejal oleh agensi-agensi yang mengutip sisa pepejal dari kawasan perumahan kediaman yang disasarkan dan mengurangkan kadar pembaziran ke atas barangan kitar semula yang dibuang ke dalam tapak pelupusan sampah. Hasil penyelidikan adalah mengenai mempromosikan kesedaran pihak berkuasa awam dengan membentangkan data statistik sebenar tentang betapa buruknya pelaksanaan pengurusan sisa pepejal sekarang, dengan mengedarkan kaji selidik dan soal selidik yang ditetapkan. Penyelidikan ini juga menyediakan platform untuk agensi-agensi kerajaan mengkaji semula dan mencerminkan penguatkuasaan mereka terhadap undang-undang tertentu yang diumumkan mereka untuk kebaikan orang ramai. Kajian ini menggunakan soal selidik sebagai sumber data utama. Survei diedarkan kepada Taman Tas dan Gambang, Kuantan untuk mengumpul data tingkah laku tentang kesedaran orang ramai mengenai tindakan menyusun sisa pepejal. Selain itu, sampling sampah telah dilakukan untuk menentukan komposisi sisa isi rumah dan tahap pemisahan sampah yang dilakukan oleh penduduk. Skala Likert yang digunakan dalam soal selidik akan disusun dan disusun, oleh itu dibentangkan di meja dengan kebaikan Chi-square ujian yang sesuai, untuk menentukan hubungan antara ciri-ciri tingkah laku dengan maklumat latar belakang orang (Analisis Demografi). Hasil yang diharapkan akan memfokuskan pada menentukan hubungan, dan keberkesanan sebenar skim pengurusan sisa. Semua soalan dibina semula-dibina berdasarkan langkah-langkah dan langkah berjaga-jaga yang disediakan oleh pihak berkuasa pengurusan sisa, termasuk AlamFlora dan SWcorp. Bahagian analisis akan membincangkan betapa rapat hubungan antara faktor-faktor yang menggunakan statistik membuktikan, dan mengkuantifikasi bukti-bukti yang terdapat sepanjang kajian.

## ABSTRACT

Ever since human started to live in group or colonies, the waste created by us is always a great trouble affecting our living. The solid waste management act, named Solid Waste and Public Cleansing Management Act 2007 is introduced to improve and enforce the current waste management system in Malaysia. This research is basically investigating the effectiveness of public action towards household solid waste separation according to type such as recyclable (dry waste) and non-recyclable (wet waste). This little act of separation will boost up the effectiveness of solid waste management by agencies that collecting the solid waste from targeted residential housing area and reducing the rate of wastage on the recyclable items being dumped into landfill. The outcome of the research is concerning about promoting the awareness of public authorities by presenting the actual statistical data on how bad the execution of solid waste management is going now right now, by distributing designated survey and questionnaire. This research also provides a platform for government agencies to review and reflect their enforcement on the particular law they announced for the good of the public. This research used questionnaire as the main data source. 1000 surveys are distributed to Taman Tas and Gambang, Kuantan to collect behavioural data about the people`s awareness on the solid waste sorting action. Besides, waste sampling has been done to determine the household waste composition and the degree of waste separation being done by the residents. The Likert-Scale used in the questionnaire will be sorted and arranged, hence presented in table with the Chi-square goodness of fit test, to determine the relationship between behavioural characteristics with the people`s background information (Demographic Analysis). The expected results are focusing on determining the relationships, and the actual effectiveness of the waste management scheme. All the questions are reversed-engineered based on the steps and precautions provided by the waste management authority, including AlamFlora and SWcorp. The analysis part will be discussing about how close the relationship among the factors using statistical proves, and quantifying the evidence found throughout the study. Chi-squared test will be carried out to measure the relationship between background information with the current solid waste management effectiveness.

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## LIST OF SYMBOLS

$H_0$	Null Hypothesis
$H_1$	Alternative Hypothesis
$\sigma$	Standard Deviation
$\sigma^2$	Variance

## **LIST OF ABBREVIATIONS**

CFC	Chlorofluorocarbon
HCFC	Hydrochlorofluorocarbon
MSW	Municipal Solid Waste
SAS	Separation at Source
SOP	Standard Operating Procedure
SWCorp	Solid Waste Management and Public Cleansing Corporation
SWM	Solid Waste Management

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background

Solid waste is one of the major environmental concern created by human being in the planet Earth and is recognised as a global problem. Based on National Strategy for Solid Waste Management Malaysia, there are 17,000 tonnes of municipal solid waste generated in Peninsular Malaysia daily in 2005. This is estimated to increase to more than 30,000 tonnes in the year 2020. However, Malaysian households can produce 42,672 tonnes of waste every day in 2017, already over the estimated 30,000 tonnes of waste by 2020 (Sato and Shibuya, 2013).

Solid waste management is the process of collecting, treating, and disposing of solid waste (Samsudin and Mat Don, M, 2013). Department of Environment stated that solid waste is garbage, refuse, sludge arising from animal and human activities that are no longer useful and other discarded materials from industrial, commercial, mining and agricultural operations, as well as from community activities. Waste can be categorized based on material, such as plastic, paper, glass, metal, and organic waste (Lau, 2004). Categorization may also be based on hazard potential, including radioactivity, flammability, infectiousness, and toxicity.

Kuantan produces around 500 tonnes of waste every day, which consists of 300 tonnes of domestic and 200 tonnes of industrial and construction waste (Zaini, S, 2011). Most of the solid waste will be disposed at Jerangau Jabor Landfill (Moh and Manaf, 2017). The high volume of incoming solid waste is causing the landfill space to decrease at a rapid pace.

## **1.2 Problem Statement**

Currently, based on the legislative scheme released by the Malaysian Government, residents are required to separate their solid waste into paper, plastics, and others. The Urban Well-Being, Housing and Local Government Ministry began enforcing Act 627 of the Solid Waste and Public Cleansing Management Act 2007, aiming to push the recycling rate to 22% by 2020 (El-Fadel et al, 1997). This scheme has been taken up by Selangor, Pahang, Johor, Melaka, Negeri Sembilan, Perlis and Kedah. The following are the problems encountered that reduce the effectiveness of the government scheme on waste separation.

Even though the government had proposed a sustainable way to treat the current household solid waste problem, the service providers do not seem to discharge their duties to the full extent. The dump truck that comes to collect the solid waste did not separate by type the waste that had been separated by residents, all the bags of rubbish are just dumped together into the same dump truck, hence seeming to waste the effort being made by the public to help in managing the overwhelming mass of solid waste.

Moreover, the level of understanding of household solid waste sorting by resident is below average, hence creating worries for the efficiency of waste sorting in Pahang state. Most of the people do not understand about the system being implemented to separate waste at source. Based on observations, some of them do not even know that this law is enforced in Pahang state. The public awareness being observed and studied at Taman Tas and Gambang residential area is at a worrying state, hence actions must be taken to improve the current situation.

This study will focus on analysing the root cause being faced by the current waste management sorting system using the data collected via questionnaire, interview and weight sampling. The findings are used to propose some way to improve the flaws found in the current waste management system.



### **1.3 Objectives of Study**

The objectives of this study are:

- i. To collect statistical data on the effectiveness of the waste separation at household level via waste weighing and questionnaire on targeted areas of resident.
- ii. To quantify the level of waste separation by analysing the data collected in order to determine the effectiveness of waste separation at Taman Tas and Gambang, Kuantan.
- iii. To identify the problems encountered by authorities on the waste separation and propose improvements to increase the rate of waste separation, eventually helping to raise the waste recycling rate to the desired level.

### **1.4 Scope of Study**

As a measure of solid waste management effectiveness, total of 9 streets in the sample area will be selected, and 2 sample spots for each street. All together of 1000 sets of questionnaires will be distributed to the targeted sample area. The respondents accepted to answer the questionnaire will be asked again to involve in the short interview section.

The questionnaire respondents will be asked to have a detailed interview section to answer some questions, which are designed to determine their daily practice of household waste management, and how they apply the legislative scheme on waste separation at source. The area of study covered on the Taman Tas and Gambang, Kuantan, Pahang.

The focus of this research is the effectiveness of waste sorting at residential area, hence no sample will be taken from the commercial areas in both Taman Tas and Gambang. This is because the solid waste composition of commercial and residential will likely have big differences, and the ratio of wet and dry waste will have a big contradiction if not analysed separately. The data collected will be further analysed using Descriptive Analysis method, including Chi-square goodness of fit test.

## **1.5 Significance of Study**

This study will offer a new analysis on the effectiveness of the waste sorting at source in the study areas. Other than simply gathering and analysing the classification of solid waste generated, this research will emphasise on the importance of solid waste sorting at source and how this action can improve the current recycling rate. The more detailed sorting of the solid waste, the lesser the waste need to be treated.

On top of that, this research will provide a more in-depth look at on the effectiveness of the current waste management to the relevant authorities. Action must be taken to improve the rate of recycling rate at Pahang state because it is now at a low level (15% by 2018) if compared to the targeted 22% recycling rate. (Moh and Manaf, A, 2017)

By gathering enough data from the residents living in Gambang and Taman Tas area, we can analyse the relationship between several factors introduced by government within the waste management scheme and the efficiency of the actual waste separation progress. The benefit from this research is to provide a very first database towards the analysis of solid waste management systems. The preferences and behavioural data on how people choose to manage their daily household waste will be very useful towards the improvement of the solid waste management effectiveness.

Besides, the actual weight sample of collected can be used to determine the amount of waste being dumped daily and the type of waste can be determined during the data collection. This information will be useful for this research in introducing a new method to improve the current waste separation level by focusing on the major waste type being found in the sampling area.

## CHAPTER 2

### LITERATURE REVIEW

#### 2.1 Introduction

Ever since human civilization started to live in group or colonies, the waste generated has always affected the living. Villages and tribes accumulated food waste everywhere they liked, during the old days. The food wastes hence led to the breeding of harmful rodents and fleas. This phenomenon eventually led to the greatest plague in human history – The Black Death, that killed half of the Europeans during the 14<sup>th</sup> Century (Ole, 2005). Statistically, the plague reduced the human population by estimated 350 million in 14<sup>th</sup> Century (*A&E Television Network*, 2018), and this number took the European population two centuries to recover from.

After recognising the danger of leaving unwanted waste littering everywhere, the government at that time finally realised the importance of health control by putting effort into waste management, and this developed into a higher tier of organising the waste separation. This process requires the household waste producer to separate the household waste by type: recyclable and non-recyclable. By taking the experience from the past plague outbreak, people now are more likely to have an organized way to manage their waste, including organic and inorganic waste (Sakai *et al.*, 1996).

The process of waste separation being made by residents will help in improving the effectiveness of waste processing. This little act of dividing the waste according to type will greatly reduce the amount of useful or recyclable waste being dumped as otherwise non-recyclable waste, increasing the public health quality by making the waste processing much more organised and effective.

## 2.2 Municipal Solid Waste

Municipal solid waste is commonly known as trash, garbage, and rubbish (Chiemchaisri, Juanga and Visvanathan, 2007). The waste is usually a mixture and combination of varieties of unwanted material including food waste, paper, garden trim, etc. Municipal solid waste can be further classified into three types: commercial, industrial and household waste, which differentiates the sources of waste by dividing the area of sources into industrial area, commercial area and housing residential area. These terms are widely used in waste management industry. The following is the main classification of solid waste.

Table 2.1: Solid Waste Classification

1	Organic	Inorganic
2	Burnable	Non-burnable
3	Recyclable	Non-recyclable

### 2.2.1 Wet Waste

Wet waste is biodegradable waste and includes food, fruits, vegetable peels, garden trims, and other organically decomposable waste (Jain and Jain, 2015). Wet waste is also known as the category of waste with high biodegradability and must be separated from low biodegradability items (e.g: paper, wood planks) to prevent the contamination of recyclable waste with wet waste.

Wet waste is also commonly known as organic waste, which can be found easily within our reach. They are usually made up of living organisms or biodegradable cellulose fibre. The high biodegradability is the reason that organic waste must be treated carefully, because they attract harmful insects and animals such as fly and rodents which carrying the source of diseases, hence leading to the sickness and disease outbreak in human living areas (Staley and Barlaz, 2009).

This kind of waste does not create much problem in the past as most of the waste are being placed in soil or water, which will help in decomposing the waste at a faster pace. For urban cities, all the garbage is accumulated and treated in larger scale, while most of the wet waste deteriorate in large quantity, resulting in the early stage of disease outbreak by the microorganisms grouped during the decomposition process.



Figure 2.1: Accumulated Organic Waste

Source: (Syarafina, S, 2018)

#### **2.2.1.1 Biodegradability**

Biodegradability is the ability of organic substances and materials to be broken down into simpler substances through the action of enzymes from microorganisms. If this process is complete, the initial organic substances are entirely converted into simple inorganic molecules such as water, carbon dioxide and methane (Cesaro and Belgiorno, 2014).

High biodegradability in solid waste means the garbage can decompose over time by natural processes. This kind of waste is generally categorized as wet waste, which must be separated from other recyclable waste to help in improving the effectiveness of the subsequent waste treatment. Mixture of wet waste with other recyclable items will lead to contamination and reduce the reusability of the recyclable item (Song *et al.*, 2009).

Meanwhile, items with low biodegradability means they undergo very slow process of decomposition. These materials are generally cellulose-made materials such as paper and wood planks. They are mostly recyclable materials and must not be contaminated by wet waste before undergoing the treatment to become usable material.

The purpose of discussing material biodegradability is because most of the solid waste management divides into three general types: wet, dry and hazardous waste. The

origin of solid waste management is due to the disease brought by the decomposition of organic waste, hence bringing in the awareness of proper management of solid waste, named as solid waste management (*Science Learning Hub*, 2008).

With the help of the current level of technology, most of the dry waste (mentioned as low in biodegradability) are now being improvised and used to recreate decomposable materials. Those products are usually single-use items such as drinking straws, single-use food utensils and plastic bags. The accumulation of these polymer-based material created a huge trouble on post-usage treatment. The usable space for landfill is becoming lesser, and landfill is the least desirable method of solid waste management. Hence the importance of awaking the awareness of the public against waste management, as well as campaign to promote the bad side of single-use materials.

### 2.2.2 Dry Waste

Dry waste is typically defined as any waste that will not rot or disintegrate over time and has little or no moisture content. Dry waste can also be described as inorganic or non-biodegradable waste given its lack of food products. Materials classified as dry waste are usually chemical-inert and degrade at very minimum rate (Zhang, Tan and Gersberg, 2010).

The waste minimization and reduction usually take place at this type of waste. All the dry solid waste can be reduced by using variety of methods: reducing packages, bring own cutlery and lunch box when eating outside, use recycle bag instead of plastic bag etc (Bernstad Saraiva Schott and Andersson, 2015).

Most dry waste is recyclable and Table 2.2 is a list of common dry waste items:

Table 2.2 Types of Treatment Process for Solid Waste

Types of Dry Waste	Best Treatment Process
Metal	Re-Smelting
Glass	Recycling
Plastic	Recycling
Wooden Objects	Reprocess
Fabric/Textiles	Reprocess
Paper & Cardboard	Reprocess



Figure 2.2: Types of Dry Waste

Source: (*Dry Mixed Recyclables / Irish Waste*, 2018)

### 2.2.3 Hazardous Waste

Hazardous waste is waste that has substantial or potential threats to public health or the environment. Characteristic hazardous wastes are materials that are known or tested to exhibit one or more of the following hazardous traits which are ignitability, reactivity, corrosivity and toxicity. The common household hazardous waste that can be found in residential area are batteries, electronic chip boards, paintings, pesticides etc (Delgado, Ojeda-Benítez and Márquez-Benavides, 2007).

The SOP of disposing household hazardous waste must be followed very carefully to avoid contamination and exposure. The chemical found in the hazardous product could harm the ecosystem in various ways. A common example in the past is CFC, which promote chain-reaction towards the breaking of ozone particles. This is the main reason why CFC products are now strictly banned and being replaced with HCFC to prohibit the spreading of ozone breakdown.

Other than CFCs, electronic items are categorized as hazardous waste because they are potentially harmful to the environment if left untreated. Chemical cells (or commonly known as dry batteries) contain harmful substances that will corrode the surrounding if leaked. There are certain cases where children accidentally swallowed dry battery and their trachea were found to be severely irritated. Such cases will still stand a chance to cause fatality if ignored. (Bolaji and Olaleken, 2005)

As a summary, anything that will cause harm to public health or environment will be grouped as hazardous waste, and it can be found everywhere within our reach.

Basically, they are ranked based on their ignitability, reactivity, corrosivity, as well as toxicity. If they are left untreated or there is any huge leakage of the hazardous waste, it will become a catastrophic disaster to public health and the environment.



Figure 2.3: Sample of Hazardous Waste

Source: (*Cornell Cooperative Extension / Household Hazardous Waste Collection Day, 2017*)



## 2.3 Waste Management

### 2.3.1 Hierarchy of Waste Management

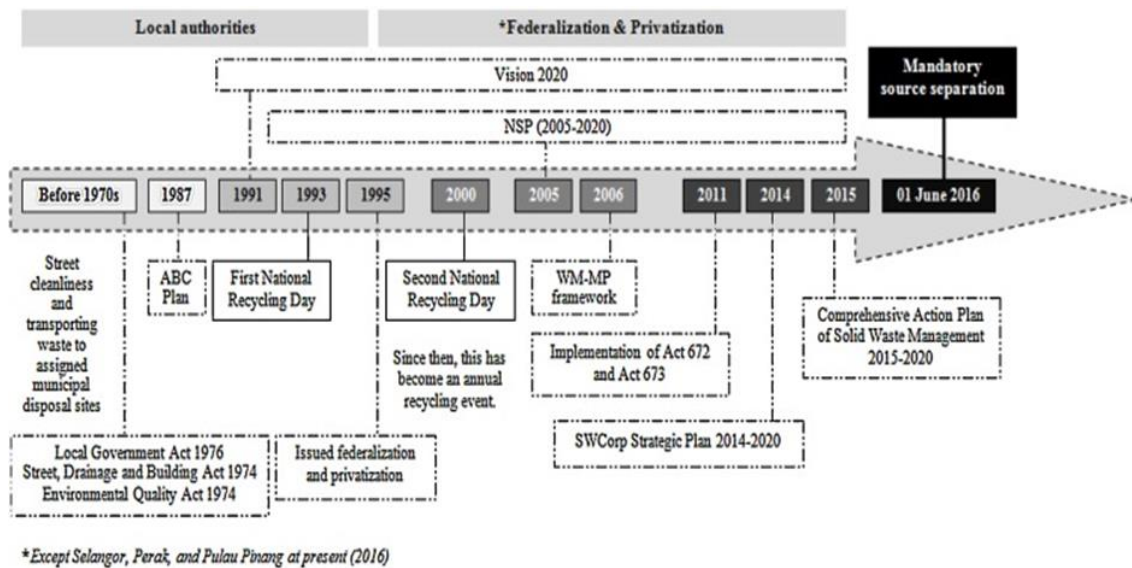


Figure 2.4: Timeline of Development of Waste Management System

Source: (Rosen, Halbach and Swanson, 1993)

Waste hierarchy is a kind of measurement on how well the method serves on improving the solid waste issues. The objective of this arrangement based on the effectiveness of practical benefits on waste management is to determine the best method of minimizing the amount of waste being treated (waste minimization). The designated level of waste management can be arranged as follow, from the minimum to maximum efficiency:



Figure 2.5 Waste Hierarchy  
 Source: Environmental Media Group, 2019

A proper action and management of the ways listed in the hierarchy can have their own benefits if applied correctly. A good waste management system will eventually help in improving the level of pollution, reduced production of greenhouse gases, conserving resources, and stimulating the development of environmental-friendly technologies.

### 2.3.1.1 Waste Recycling

Recycling is the process of converting waste materials into new materials and objects. It is an alternative to "conventional" waste disposal that can save material and help lower greenhouse gas emissions. Recycling can prevent the waste of potentially useful materials and reduce the consumption of fresh raw materials, thereby reducing energy usage, air pollution (from incineration), and water pollution (from landfilling).

This is currently the most reliable step to reduce the amount of solid waste being dumped into landfill, by transforming used items into the something new. This process is facing great challenges because most of the people are not aware of the importance of conserving the environment. The long-practiced habit is the reason why people do not pay much attention to the waste treatment and conservation.

Recycling starts in household, which is called as Separation at Source, where people who produced the rubbish are going to separate the rubbish before sending them

to the treatment process plant. People need to have high concern and awareness level to do this volunteering as most of the people do not pay attention to this topic.

### **2.3.2 Solid Waste Management and Public Cleansing Corporation**

Solid waste management corporation, the Solid Waste and Public Cleansing Management Corporation (PPSPPA) set up on 1st Jun 2008, where the responsibilities in all aspects of solid waste and public cleansing management along with other related matters has been transferred from Kuala Lumpur City Hall (DBKL). (Municipality, 2009). This agency was formed under the jurisdiction of the Ministry of Housing and Local Government (*Official Portal of Kuala Lumpur City Hall*, 2014).

Solid Waste Management and Public Cleansing Corporation Act 2007 is a Malaysian law which enacted to provide for and regulate the management of controlled solid waste and public cleansing to maintain proper sanitation and for matters incidental thereto.

The roles of PPSPPA are to ensure that the management of solid waste and public cleansing become more efficient and integrated other than providing more satisfaction to consumers in delivering the service of solid waste and public cleansing management.

### **2.3.3 Separation at Source (SAS)**

Effective 1st September 2015, the government of Malaysia has made it compulsory for several states to separate their waste at source, under the Solid Waste and Public Cleansing Management Act 2007 (Jonathan, E, 2016). SWM is actively promoting the SAS initiatives through on-ground activities, promotional materials and public road shows.

SAS basically guides the public to separate their waste when they decide to throw away the unused items. As compared to massive waste sorting at the waste treatment factory, it is far more effective if everyone who throws can help in the little act of waste sorting. This will greatly reduce time and human power on massive sorting at the factory. (*Ministry of Housing and Local Government*, 2016)

Malaysia`s government had proposed a pathway for the public to follow whenever they want to throw something, by categorizing solid waste into different type of groups,

enhancing the effectiveness of waste sorting when all the well-sorted garbage is delivered to the treatment plant.

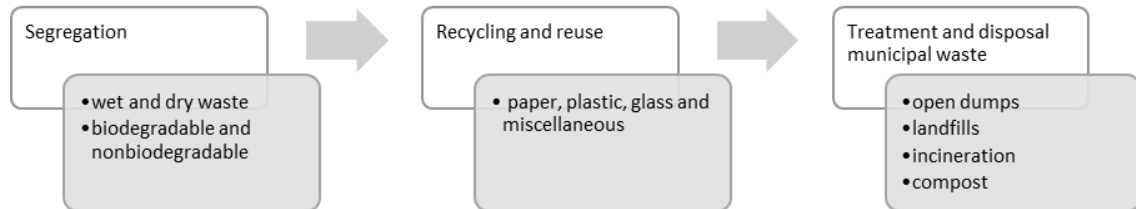


Figure 2.6: Waste Sorting Process

### 2.3.4 Public Awareness

Public awareness means how concerned is the public towards the current solid waste management problems and issues. This can be used as a reflection to determine how well the authorities are carrying out the action. If the public is aware and concerned about the issues, this means they understand the importance and how severely the issue will affect their lives.

The level of understanding of Pahang residents towards the waste management scheme is at a dangerous level. Most of the people do not understand and are not aware about the importance of waste separation, and household waste is being clumped together without being divided and separating accordingly. Authorities are required to act on enforcing the rules being applied by the state government, and penalties must be applied to those who do not follow the rules.

## **2.4 Previous Findings**

One of the purposes of proposing the municipal solid waste cleansing act by the Malaysian government is to reduce the number of landfills. The most sustainable way to treat solid waste is minimization, by promoting the awareness everyone to reduce the usage of non-recyclable materials. Based on studies (Moh and Abd Manaf, 2017), there are many types of landfill being used to discard the non-recyclable waste in different states of Malaysia.

The usage of landfills is not a sustainable way to solve the massive problem created by municipal solid waste. Hereby the Malaysian government is now promoting and enforcing the waste separation at source, to reduce the amount of recyclable waste being dumped. Step-by-step, Malaysia government is trying to minimize the usage of landfill by implementing more effective way to deal with the MSW. Other than the enforcement being made by government, the public must put full effort together to reach the goal.

The statistical chart tabulating the number of landfills in Malaysia is being shown in Table 2.3.

Table 2.3: Number of Landfill Site in Malaysia

State	Operating non-sanitary landfill sites	Operating sanitary landfill sites	Non-operating landfill sites	Total
Johor	12	2	23	37
Kedah	8	1	6	15
Kelantan	13	0	6	19
Melaka	2	0	5	7
Negeri Sembilan	7	0	11	18
Pahang	16	0	16	32
Perak	17	0	12	29
Perlis	1	0	1	2
Pulau Pinang	2	0	1	3
Sabah	19	0	2	21
Sarawak	46	6	14	66
Selangor	5	4	14	23
Terengganu	8	0	12	20
Federal Territory of Kuala Lumpur	0	0	7	7
Federal Territory of Labuan	1	0	0	1
<b>TOTAL</b>	<b>157</b>	<b>13</b>	<b>130</b>	<b>300</b>

Source: (Supporting Report-1 Additional Information EX CORPORATION MINISTRY OF HOUSING AND LOCAL GOVERNMENT THE STUDY ON NATIONAL WASTE MINIMISATION IN MALAYSIA JULY 2006 MALAYSIA, 2006)

## **CHAPTER 3**

### **METHODOLOGY**

#### **3.1 Introduction**

Methodology in research proposal is important as an explanation and clarification of the methods and ways for researcher to run the analysis. In this research, questionnaire and interview will be used to gather relevant data before being processed and quantified into comparable data. A well-organized data collection process will greatly boost the accuracy of the collected data.

Data collection in this research will be divided into several parts: questionnaire distribution and interviewing the residents to obtain the feedback and behaviour data on their daily practice on solid waste management and their understanding of the benefit of the waste separation at source.

By collecting physical samples from the sample are, the composition of the household solid waste can be determined and examined further. Meanwhile, the level of waste sorting will be calculated as well during the sample waste collection. This data can be used to reflect the actual effectiveness of current waste management system.

#### **3.2 Study Area**

The selected areas of study are Gambang and Taman Tas. The reason for choosing these 2 areas is because they have higher density of population among the Pahang region. Gambang town is known as one of the developed education cities sat with Universiti Malaysia Pahang and Universiti Teknologi Mara. The main attraction, Bukit Gambang Resort City encouraged even more resident living here.

Taman Tas is a partially-developed town with enough self-sustainable goods of supply. The ease of obtaining goods at this town lead to the concentrated population in this area. This means more variety of solid waste will be produced and waste management must be enforced more properly to reduce the amount of unwanted waste.

### 3.3 Flow Chart of Work

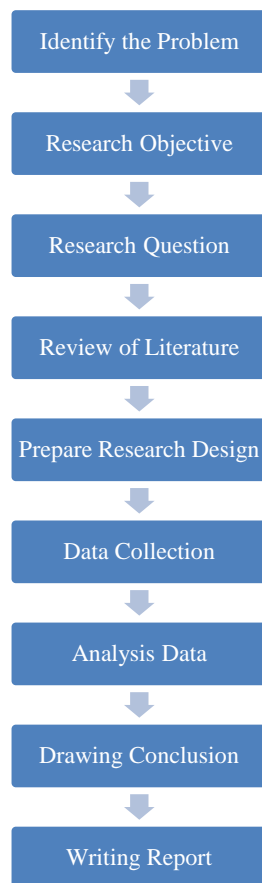


Figure 3.1 Flow Chart of Work for Research Paper



### 3.4 Method of Study

The methods being used for the data collection in this research are:

1. Questionnaire
2. Interview
3. Waste sample weighing

Questionnaire is a series of survey questions, mainly focusing on the behaviour data based on their daily practice on how to manage their household solid waste. The statistical value can be obtained to study the trend of the people on how they manage the waste. This information will be very useful when it comes to the data analysis part, the number of people who are doing the separation at source can be studied and how well they understand about the character of the solid waste they produced. (*How to Design a Questionnaire - iMotions, 2017*)

Interview is the next part of the data collection. As mentioned and similar with above method, a series of subjective questions will be designed, but focusing on the targeted residence on their understanding and knowledge about the scheme being released by Pahang State Government. From their responses, the level of awareness can be determined and quantified based on how well they aware and concerned about the current issue caused by excessive untreated solid waste in our country.

Waste sample weighing is related to the real sample collection and weighting data will be collected. Based on how well the residence participate in the questionnaire and interview, a few samples from the two sample areas (Gambang and Taman Tas) will be collected to reflect on how true the responses given by the participant. The solid waste will be studied and weighed by types: wet waste, recyclable waste and burnable waste (waste that are non-recyclable and no reuse value).

### **3.5 Questionnaire and Interview**

In this research, the method being used to collect the related data from the residence is using questionnaire and interviewing. Since there is only minimum reliable data being analysed and collected by authorities, that means all the information must be collected using the manual methods. People will be asked to answer a series of questions on their behaviour and habits on managing their daily household waste. These are the examples and ideas on how the question to be designed.

- i. How many times throwing waste
- ii. Income categories
- iii. Number of family members
- iv. How many times dump truck visiting the area per week
- v. How frequent eating outside per week
- vi. Knowledge on waste sorting
- vii. Do you separate waste at home by type?
- viii. Did the dump truck ask for the separated waste before collection?

#### **3.5.1 Questionnaire Design**

The aim of all the questions is to measure the relationship between the behaviour of the residence and the effectiveness of the waste management scheme, and each of the questions contribute their data in the analysis of the effectiveness. For example, the frequency of people throwing the collected rubbish represents the gross amount of waste they generated per day. This can be used to neutralise some of the outliers in case, for certain families, they are running food business and prepare their product at home. Thus, generating more organic waste is still acceptable by excluding the amount of waste to the analysis, because they are generating way too much household waste (or can be indicated as they are not household waste, since they are running businesses).

In statistical analysis, outliers will be treated more heavily in the data distribution because they are located far away from the mean value. Hence, all the questionnaires are purposely designed to avoid such cases that will lead to the large spreading of the final analysis. Progressive options in the questionnaire (scaling from 1 to 5, depending on how

well the candidate agree with the statement) will be used to measure the effectiveness of the waste management scheme, by analysing the sample candidate`s behaviour data, as well as their actual amount of household waste being generated for months will be collected as reference. The designated questionnaire will be attached in Appendix A (*QuickMBA, 2017*).

### 3.6 Sample Collecting

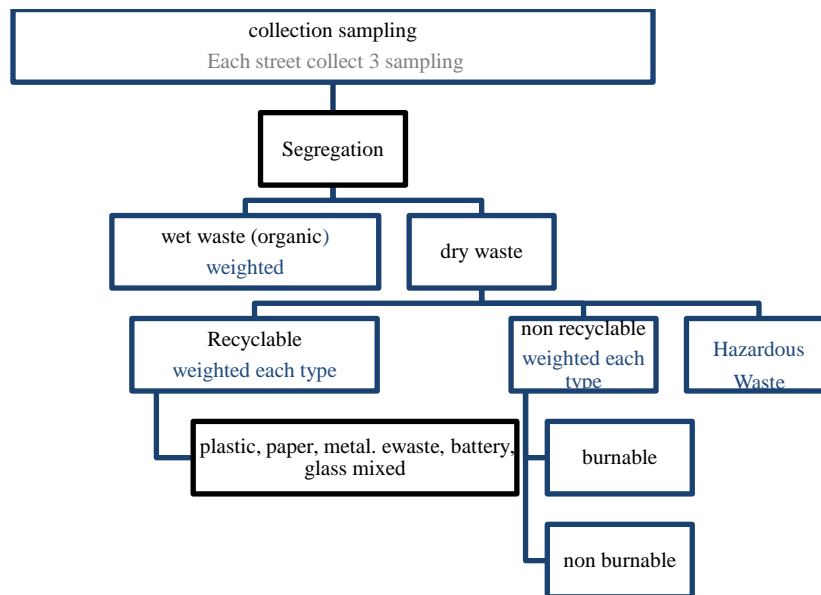


Figure 3.2: Process of Sample Collection

Waste sample collecting is one of an analogue way to determine the level of separation and sorting of household solid waste. The targeted sampling area, Taman Tas and Gambang, Kuantan, Pahang will be visited, and waste weighting sample will be collected based on the waste classification type: recyclable and non-recyclable waste. Further analyzation will be carried out to determine the level of separation to be compared with the limitation fixed by Pahang state government.

The purpose of this step of sample collection is to measure the weight composition of different type of waste could be found in the targeted residential area, and all type of waste classification will be weighted and recorded for further analysis. During the sample collection, when the wet waste and other organic contaminated waste is separated, observation and classification of waste will begin. The recyclable, non-recyclable and hazardous waste will be further divided and weighted separately to measure the level of

separation by targeted household. The assumption being made here is most of the resident do not separate their waste in different packages, and food/organic waste will predominant towards all other types of waste.

### **3.6.1 Percentage of Waste Sorting**

During the waste sampling, the level of waste separation made by residents will be further classified into sorted waste and unsorted waste. This parameter is very important to reflect the actual action made by respondents and the claims made when they answered the questionnaire. All of waste collected which is properly sorted will be used to divide with the total mass of the household solid waste, resulting in a percentage of waste sorting measured and recorded.

### **3.6.2 Sample Classification**

During the collection, all the solid waste will be classified into classes for further analysis. This is to measure the degree of separation by type according to the Public Cleansing Scheme, and to what extent the people are following. The following are the major classes of solid waste classified.

#### **1. Residual Waste**

They are being collected twice a week as scheduled and must be packed firmly into plastic bags inside a trash bin. They include: kitchen waste, food waste, contaminated materials, disposable consumables and most organic waste.

#### **2. Recyclable Waste**

They are required to be separated into groups because they come in various types of recyclable materials that need to be separated to prevent contamination.

Table 3.1: Category of Recyclable Waste

Paper/Fibrous	Boxes Bills/Receipts Magazines Juice Boxes Newspapers
Plastic	Plastic Bags Bottles Plastic Pails Food Containers
Glass/Ceramics	Plates Soy Sauce Bottles Jam Containers Water Bottles Ceramic Vases
Metal/Steel/Aluminium Cans	Kitchen Utensils Food Cans Food Bottles Aluminium Food Containers Soft Drink Cans
Electronic Waste/Appliances	Light Bulbs Batteries Electronic Appliances
Rubber/Fabric	Shoes Leather Bags Gloves Cloths
Hazardous Waste	Aerosol Cans Poison Paint Containers Spray Bottles
Bulky Waste	Beds Sofas Big Furnitures/Electronic Appliances
Garden/Farm Waste	Leaves Branches Grass/Sapling Trims Flowers

Source: (*SEPARATION-AT-SOURCE*, 2016)

### **3.7 Method of Analysis**

In this engineering research, different layers of analysis will be carried out based on the feedback data obtained. The main goal of this research is to study the effectiveness of the scheme on waste separation, hence the first part of the analysis is about data gathering.

Two types of data will be collected manually: questionnaire feedback and actual weighing of the household waste generated by residence. The questionnaire will be distributed to all the residents in the targeted sample area, and the survey will be collected back within 3 days from the date of distribution or taken back directly when questions are fully answered.

The waste sample will be measured twice a week, for one-month period, to observe the level of waste separation before judging whether they are following the correct scheme. This data will be used as a final reference on whether they are doing the waste separation or not. From the previous data of feedback, the behaviour and attitude for the residents towards their care on waste separation can be analysed, and the sample collection will indicate they are really doing the separation. The following sections in this chapter describes the standard procedure for quantitative data analysis adopted in this study.

### **3.8 Raw Data Processing**

#### **3.8.1 Data Grouping and Visualising**

When the raw data are collected, the first steps is always likely to be group and sorting. Data will be separated and categorise up every single data into their data sets group, for a better line up before proceeding with data analysis. Homogeneous data group will be formed based on the data collection, such as age, height, income range etc.

After grouping and sorting, visualise the data using diagram-aided methods. Graphs are the most common and suitable way for us to tabulate and visualise all the data we sorted based on their types. The presented graphs, such as line plots, bar charts, pie

charts are functioning in same way to visualise and present the collected data with a more attractive and understandable.

### **3.8.2 Beginning of the analysis: Average Value**

Right after grouping the raw data, start grouping of data as homogeneous data sets. They are grouped by their attributes on different purposes and will be used in the following analysis. The first thing is to start measurement of average value. As what we know, average represents the evenly distributed number of data, and measure the flat and fair value being obtained by every target sampler. Summing up the quantitative data and divide by the total number of sample participant to obtain average, or statistically known as mean.

There is some advantage and disadvantage upon the usage of mean calculation. We can obtain quick data by simply using the mean data to represent the average value from all sample participant, but this value will behave inaccurately very often by the influences of outlier in the raw data. An outlier means an excessively deviated data from all the average data being obtained during the data collection. They will cause the average value to be distorted towards an undesired direction, hence misdirecting the accurateness of the analysis.

## **3.9 The spreading of the data: Variance, Range, Standard Deviation**

### **3.9.1 Range**

Up next of the analysis will take part in the measurement of spreading of the data. The spread of the data symbolises the quantity or quality range of the received feedback, and how large the extend and variation being obtained from the data. For example, the height of the sample participant collected in area X is around 150 to 178cm, meaning 150-178 is the range for the collected data, with a value of 28cm range.

### 3.9.2 Interquartile Range

To better interpret on the value of the range, *Interquartile Range* is introduced to divide the group of data into different level of ranges. Each range is having increment of 25%, meaning that 1<sup>st</sup> quartile is having 0-25% (lower quartile) of the arranged data, 25% to 50 % for second quartile (also known as median value), 3<sup>rd</sup> quartile measuring from 50% to 75%, while 4<sup>th</sup> is representing 75% to 100% (upper quartile).

### 3.9.3 Standard Deviation $\sigma$

This is the parameter being used to measure how is the pattern of spreading of data around the mean. The larger the value, indicating the data is more widely spread against the mean value. It can be used to determine the behaviour of collected data on how different every single sample collected against each other. Smaller value of standard deviation means most of the data behaving similar to each other, or they deviate lesser compared with higher standard deviation data.

### 3.9.4 Variance $\sigma^2$

Variance is also the measurement of the spreading of the data, or the other words, interpreted from the *Squared Standard Deviation* mentioned above. The purpose of this parameter is most likely similar, but the reason to square up the standard deviation is to heavily amplify the effect of the **Outliers**. Hence, we can measure the overall data more effectively depending on the spreading, average, accurateness based on Variance parameter.



### **3.10 Measurement of factors affecting the data spread (Chi-squared Test)**

#### **3.10.1 Significance Level**

Significance level is known as the probability, or the acceptable error of margin towards rejecting of the null hypothesis. It can be fixed at any desired value between 0 to 1.00, as the value fits with the hypothesis acceptable range. The standardized value for significance level for Chi-square test is normally 0.05, representing 5% of acceptable region to reject the null hypothesis.

For example, when the Chi-square goodness of fit test comes out with P-value of 0.04, lesser than the significance level of 0.05, the null hypothesis is now theoretically and statistically rejected due the enough evidence by the sample data analysed using Chi-square test.

#### **3.10.2 Hypothesis Statement**

Stating a hypothesis before the Chi-square test is a very important step. It decides the direction and the types of relationship to be determined in the analysis. A Null Hypothesis (H<sub>0</sub>) will be stated as no relationship between the factors. The decision will be made by the calculation of the P-value, while comparing with the significance level to decide whether it is accepted or rejected.

#### **3.10.3 P-value**

P-value is also known as the Probability Value, is a term widely used in statistical analysis. In Chi-square test, this parameter will be used to decide whether the statement fulfils the requirement of the significance boundary. By comparing the expected and observed value using Microsoft Excel in-built function, P-value will be calculated.

### **3.11 Expected and Observed Values**

For observed value, this is the data we gathered and tabulated, usually collected using observations, records, feedbacks, opinions and calculations. It represents the current observed situation in a controlled environment. For expected value, this is a value that represents an unbiased environment in any situations. No difference will be found for each data sets because all criteria has made equal to each other.

For example, the test is carried out to determine whether there is relationship between gender and the cloth colour preferences. The actual number of cloth purchase by male and female, including the colour they purchased is recorded, representing observed value. Meanwhile, the expected value is supposed to be unbiased condition, where equal number of different colour of cloths will be purchased equally by male and female.

#### **3.11.1 Likert Scaled Assessment (5-point)**

The Likert-scale is widely used to determine and represents people`s opinion and attitude towards a specific topic. Progressive and scaled answers will be provided for the respondents to answer their questions by choosing the most relevant answer they feel at the moment. This research used 5-point scale from Strongly Agree, Agree, Neural/Undecided, Disagree and Strongly Disagree as objective answers to be chosen.

## CHAPTER 4

### RESULTS AND DISCUSSION

#### 4.1 Introduction

This chapter will be focusing on the discussion of the analytical data from the collected sample contributed by the respondents. By evaluating the sorted data and relating back to the objective of this research, assumptions and conclusions can be made based on statistical data. All of the data collected is grouped, sorted, and analysed using Microsoft Excel modules and functions.

The efficiency of the solid waste management in the sample area is measured from two different perspectives: from the public who are enjoying the services of waste management cooperation, and the authority who are managing the whole solid waste management system. The reason for dividing the perspectives is because this research carried out by the collection of ideas and opinions from different parties. To generate an unbiased data from two different parties, both analyses must be carried out to obtain a subjective view of the current situation.

From the questionnaire, two parts (Demographic and Likert-scale) are both performing different tasks. Demographic information will be used to carry out hypothesis statement, by using *Chi-square goodness of fit test*. Meanwhile, the data generated from Likert-scale will be responsible for representing people`s understanding towards the waste management system, and the actual scheme and law currently running to enforce the actions.

## 4.2 Likert-Scale Assessment

As mentioned before, the questionnaire is separated into two parts, and the later part is called Likert-Scale Assessment. The mechanism of this Likert-Scale is actually very simple: by answering the designated questions, the marks scored by respondents will be used to represent the understanding of the importance of the solid waste separation.

All the questions are designed to have better understanding scale (Strongly Agree) and scaled progressively to do not understand (Strongly Disagree) as multiple-choice questions for the respondents. On the other hand, all the demographic data will be linked directly to this assessment, for further analysis on whether there is any relationship between background information such as age, income range, and education level, to affect the level of understanding towards solid waste separation act.

In addition, all the assessment questions directly reflect on the solutions provided by SWcorp and AlamFlora on how to improve the effectiveness of the separation at source. Hence, all these questions are qualified to represent the understanding, at the same time to measure the effectiveness of these steps provided by the waste management authority.

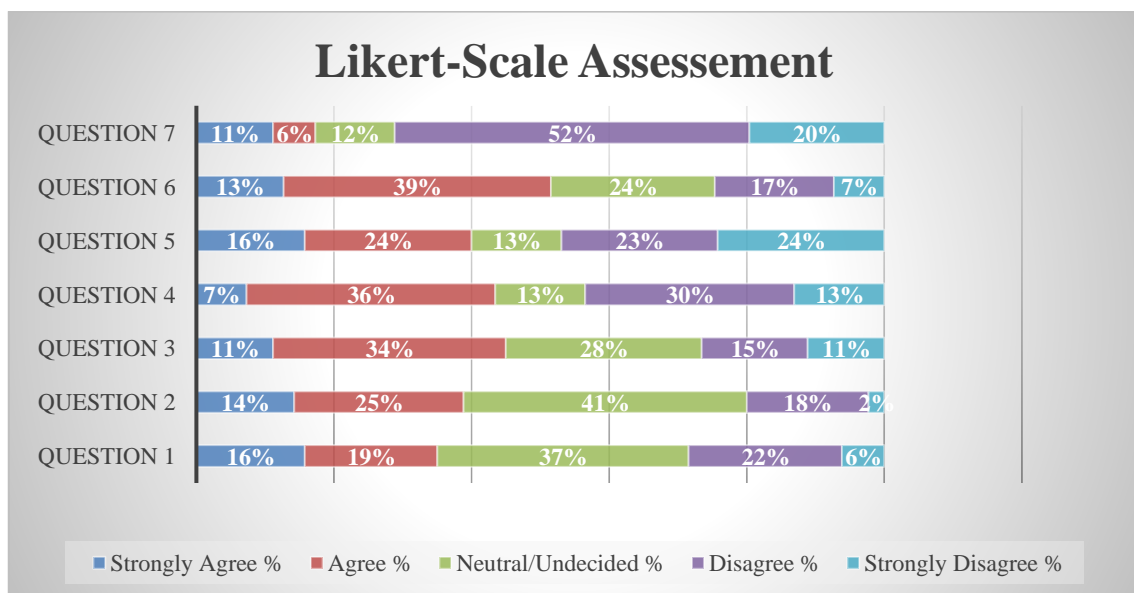


Figure 4.1: Likert-Scale Assessment Feedbacks

- iv. This is the tabulated data from all 260 respondents towards their level of understanding of the solid waste separation. In this assessment, answering Strongly Agree scores 5 points, Agree scores 4, Neutral/Undecided scores 3,

Disagree scores 2, and Strongly Disagree scores 1 point. The higher the overall points scored reflect better understanding towards solid waste separation act.

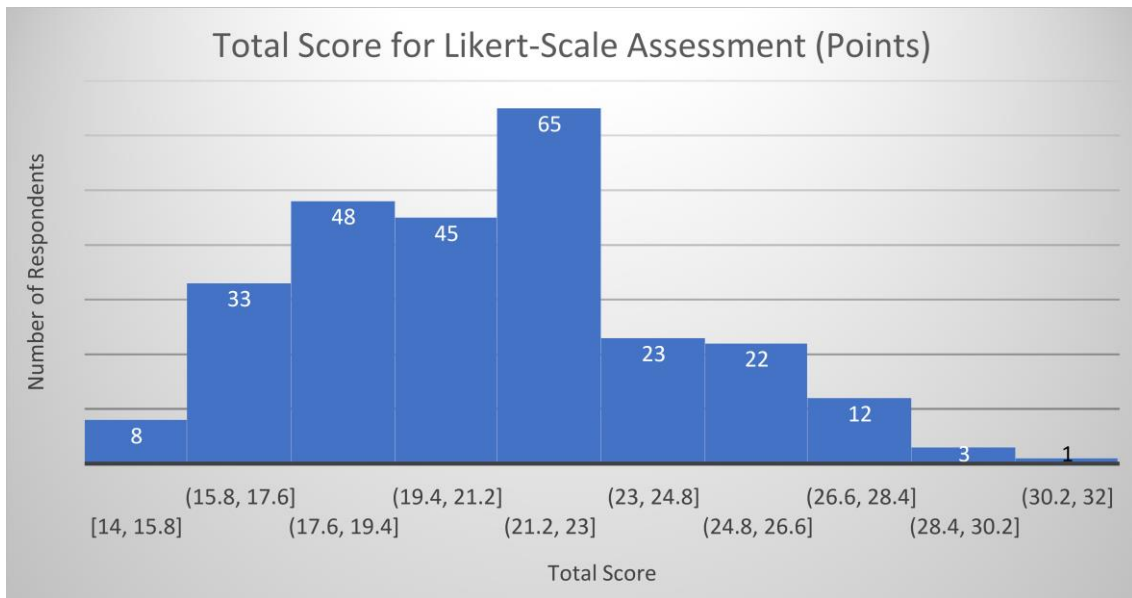


Figure 4.2: Total Score for Likert-Scale Assessment (Points)

The chart in Figure 4.2 represents the total score made by all 260 respondents. From the histogram, it can be deduced that most of the people still do not fully understand the actual steps and acts to effectively improve the current situation of waste management system. The graph is positively skewed and behave in normal distribution, showing that most score weightage lies at lower quartile, which is not preferable or wanted as a result of introducing the solid waste management act.

Furthermore, in this analysis, the score obtained by respondents is 7 questions x 5 marks each, with the maximum of 35. By assuming the average score by everyone, regardless of any background, will be half of the 35, equal to 17.5. This mark will be used as a threshold and benchmark used in the chi-square test analysis, technically known as the Expected Outcome.

## 4.3 Demographic Analysis

### 4.3.1 Number of Family Members

In the demographic questionnaire, first question is about the number of family members in the respondent's house. The reason of collecting this information is to obtain an average value on the weight of solid waste generated per person. During the collection of waste sample, it is found that some of the family is generating way too much volume of solid waste. The unusual amount of waste lead to some assumptions, trying to avoid extreme outliers in the statistical data:

- a) With more family members, it is assumed to generate more amount of solid waste, in general. The total amount of waste can be divided among the number of family member to obtain the average value of solid waste generated. Data accepted.
- b) With less family members that generated very large amount of solid waste, we can deduce that the solid waste could not considered as municipal household solid waste anymore, the family might be running business by producing their products at home, hence generating large amount of waste compared with other family. Data rejected.

From all the sample waste and questionnaire being collected, only <2% of outliers being found and rejected using this assumption. All the data is tabulated on the number of family members from all accepted across 260 respondents.

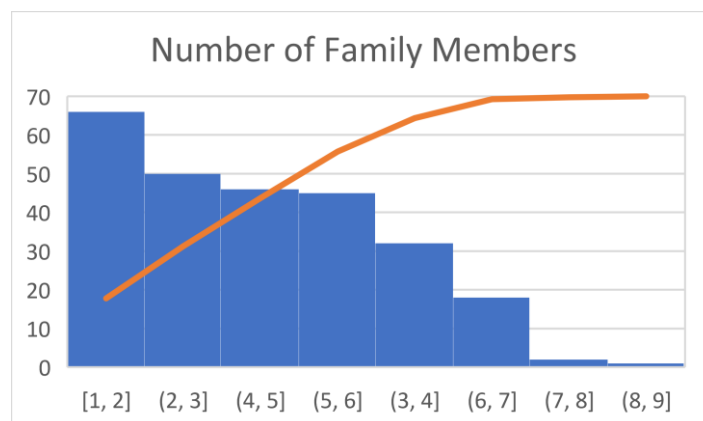


Figure 4.3: Number of Family Members Across 260 Families

### 4.3.2 Age

The purpose of collecting this data is to study if there is any relationship between people's age towards the level of awareness and understanding towards solid waste separation and management. By analysing the expected score of 17.5 against age groups, we can generate a technical P-value to represent whether these two criteria are behaving in predictable pattern or any relationships among them.

In this research analysis, the acceptable significance level is standardized at 0.05, meaning of 5% error margin will be accepted to declare the Null Hypothesis ( $H_0$ ) is correct.

Table 4.1: Relationship Between Age with the Understanding of Waste Management

Age	Observed	Expected
<30	20.4893617	17.5
31-40	21.56666667	17.5
41-50	21.078125	17.5
>50	21.14473684	17.5
P-Value	0.399970941	>0.05

All the age groups are divided into 4 different categories: <30, 31-40, 41-50, and >50. From the table above, we can see the observed score for age group below 30 is 20.489 in average, slightly higher than the expected 17.5. For age group 31-40, the average score is 21.567, without obvious difference from previous age group. 41-50 scored 21.078 in average, slightly lower than 31-40 but higher than less than 30 age group. For age group above 50 (>50), the average score is 21.145. Based on the table, without any technical analysis, we can observe the average score for each of the age group seems similar, and the fluctuation of the data is not predictable as well.

Hypothesis:

---

$H_0$ : There is no relationship between age group and the understanding of waste separation act.

$H_1$ : There is a relationship between age group and the understanding of waste separation act.

---

Null hypothesis is being made. By applying Chi-square test, comparing the observed and expected value using Microsoft Excel built-in function, the P-value generated is 0.39997, with a significance difference with the acceptable margin of 0.05. From the comparison between the P-value and significance level, we can deduce that there is no enough evidence to prove that there is relationship between age and the understanding of the waste separation act. Null hypothesis ( $H_0$ ) is accepted.

### 4.3.3 Education Level

Many researches declare that education level has important linkage with the effectiveness of the waste separation act. Government is currently promoting Separation at Source to improve the effectiveness of the waste sorting process by advertising through banner, TVs and social medias. They are responsible to spread and teach people on how to do the waste sorting. However, not everyone in the targeted sample area are able to read and write in advanced level, and the education level decided if all the advertisement is doing the job correctly to the targeted audiences.

By applying Chi-square test, assumptions have been made that there is no relationship between education level and the level of understanding towards solid waste separation.

Table 4.2: Chi-square Analysis of Education Level

Average Scoring	Observed	Expected
Primary	17	17.5
Secondary	21.1862069	17.5
Diploma/Degree	21.09722222	17.5
Master/Phd	25.30434783	17.5
P-Value	0.171020629	>0.05



Hypothesis:

---

H<sub>0</sub>: There is no relationship between education level and the understanding of waste separation act.

H<sub>1</sub>: There is a relationship between education level and the understanding of waste separation act.

---

From the table, we can see that the observe value is having increment as the education level increases. When Chi-square test is applied, the P-value for this sets of factors is 0.171, which is higher than the significance level of 0.05, proving that there is enough evidence for this sets of data to prove the null hypothesis, there is no relationship between education level with the understanding of the solid waste separation act.

However, studies proven that actually these two factors connect firmly. With higher level of education, people tend to understand better on what should they do to improve the current situation of waste management. They will give their co-operations towards the scheme or act being introduced by government for the good of the environment. Further studies in the sample area must be made to clarify the previously proven studies with this research approach.

#### **4.3.4 Income Range**

Income range is one of the factors affecting the total amount of solid waste generated by the person. For an example, people who has higher income tend to purchase highly refined products, such as food in smaller portions as exactly needed. Such products are usually

The steps will be pretty similar with previous analysis. Expected outcome is measured as 17.5 marks, indicating there will be no relationship for income range with the level of understanding towards solid waste management by scoring the Likert-Scale Assessment for 17.5 marks. Significance level used is 0.05.

Table 4.3: Chi-Square Analysis of Income Range

Average Scoring	Observed	Expected
Below RM1500	14.5328	17.5
RM1500-RM2500	21.7843	17.5
RM2500-RM3500	21.1348	17.5
Above RM3500	27.4611	17.5
P-Value	0.046493	<0.05

- v. From the table, the average scoring from 4 different income ranges varies from one another. For income range group below RM1500, the observed score is 14.5328, significantly lower than the expected value of 17.5. For RM1500-RM2500 and RM2500-RM3500, the observed score is 21.7843 and 21.1348. Income range group above RM3500 scored 27.4611, which is highest among all 4 categories. The data behaves with increment with each subsequent raise of the income by the respondent.

Hypothesis:

---

H<sub>0</sub>: There is no relationship between income range and the understanding of waste separation act.

H<sub>1</sub>: There is a relationship between income range and the understanding of waste separation act.

---

- vi. The P-value of Chi-square test analysis among the two factor is 0.046493, which is smaller than the significance level of 0.05. This inequality indicates that the expected value and observed value behaves in some sort of relationship, not by randomised outcome. Hence, we can deduce that there is enough evidence to prove that the null hypothesis is rejected: there is relationship between income range with the understanding of the solid waste management.

#### 4.3.5 Waste Collection per Week at the Sample Area

Based on the approaches and aim by the SWcorp, they organised a system of 2+1 waste collection, with 2 times per week for normal household waste, while 1 for recyclable waste within the week.

Unfortunately, from the likert scale questionnaire being distributed to resident, there are no sightings for the dump truck came to the place and gather the waste as declared by swcorp. The maximum times observation for the truck came to the place is 2 times per week, yet there are no such recyclable waste gathering station being setup and utilised.

Number of waste collection referred to the trips or returns made by the waste collecting company to the sample area per week.

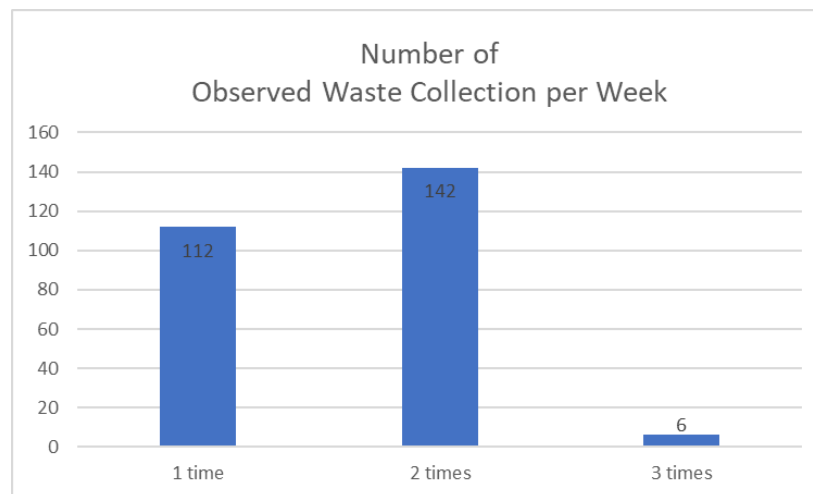


Figure 4.4: Number of Observed Waste Collection per Week

From the histogram, we can see that sightings for 3 times per week collection only 6 out of 260 number of respondents. This data can be used to reflect how well the effectiveness is the 2+1 system being introduced. If the company never took action based on their claiming, no matter what kind of strategy, penalisation or warning could work against the current effectiveness of waste sorting.

From different perspectives, 2 assumptions can be made to clarify the sorted data findings:

- a) The authority, including SWcorp and Alamflora do not act according to their claim of 2+1 collection system. This situation must be improved in order for people who are really following the scheme to return their sorted waste packages to the processing plant.
- b) The sightings and reports from respondents are inaccurate. People living in the sample are not aware of the 2+1 system introduced, while ignoring the act of waste sorting. The waste collection truck came on time at the right spot, but resident do not utilise the services and gave feedback about no such action being made by authority.

#### 4.3.6 Waste Composition and Level of Sorting

Other than collecting behavioural and opinion data from the questionnaire, this research also conducted the waste sample weighing at both sample area Taman Tas and Gambang. Total of 9 streets has been chosen in both area, and 2 sample each street. The waste composition and the level of waste sorting has been measured and recorded continuously for 8 weeks. All the household solid waste is weighted using digital spring balance, with accuracy of  $\pm 10g$ .

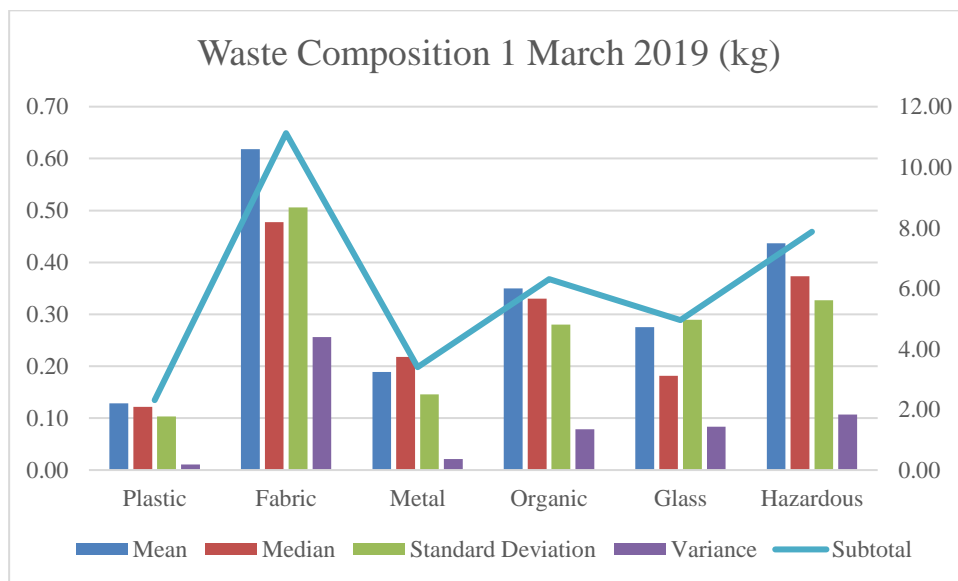


Figure 4.5: Waste Composition 1 March 2019

On 1<sup>st</sup> March 2019, the waste composition collected at Taman Tas and Gambang contains mostly organic, hazardous and fabric waste. Other than fabric, all other waste material collected are average in their mass.

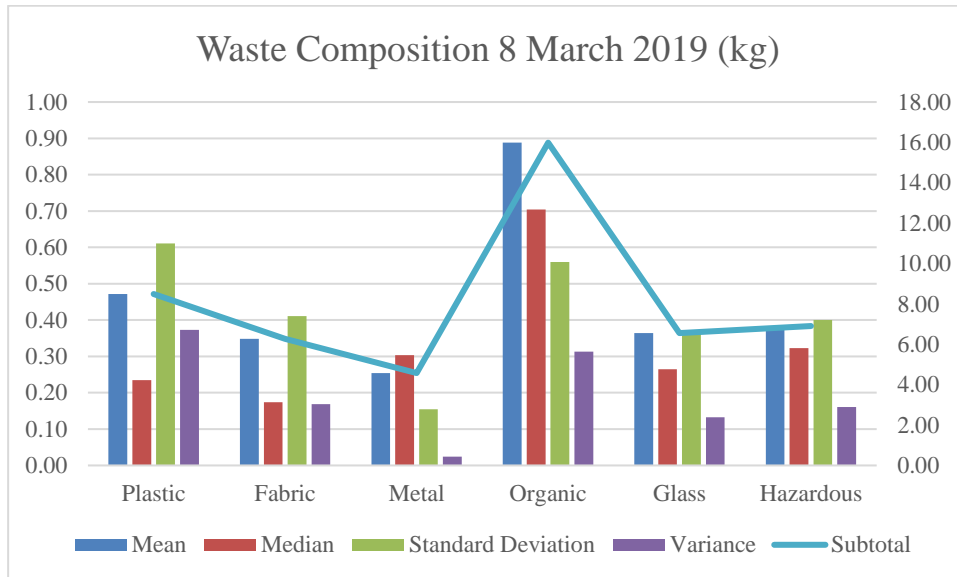


Figure 4.6: Waste Composition 8 March 2019

vii. On 8<sup>th</sup> March, the composition collected are mostly organic, which reaching 0.90kg in mean for all the houses sampled. Percentage of plastic and fabric followed up right after the organic waste.

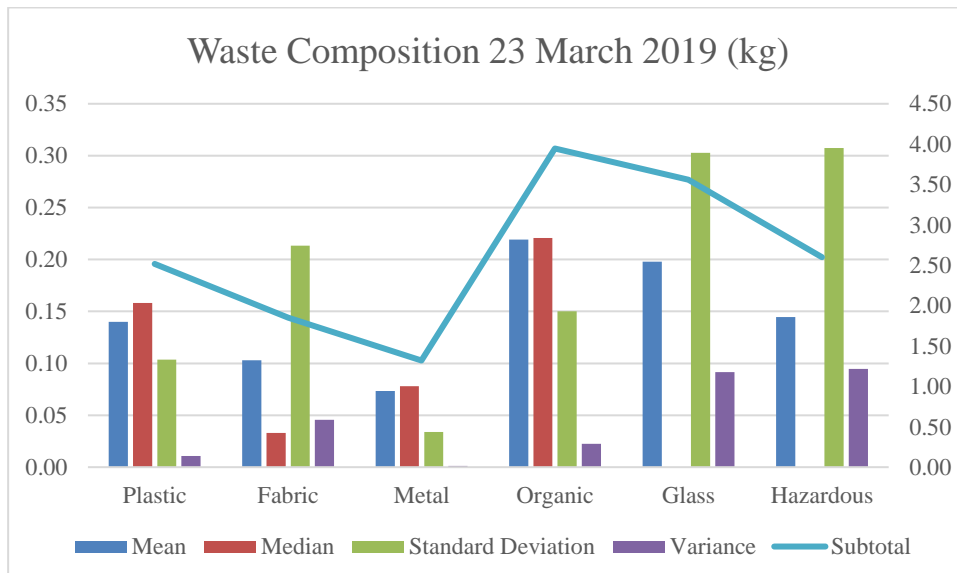


Figure 4.7: Waste Composition 23 March 2019

For 23<sup>rd</sup> March 2019, the largest total amount of waste type is contributed by organic and glass. The high value in standard deviation meaning that the sampled data are varying in a very large level, some of the houses do not contribute to glass and hazardous waste while some of the houses contributed most of the glass and hazardous waste throughout the week.

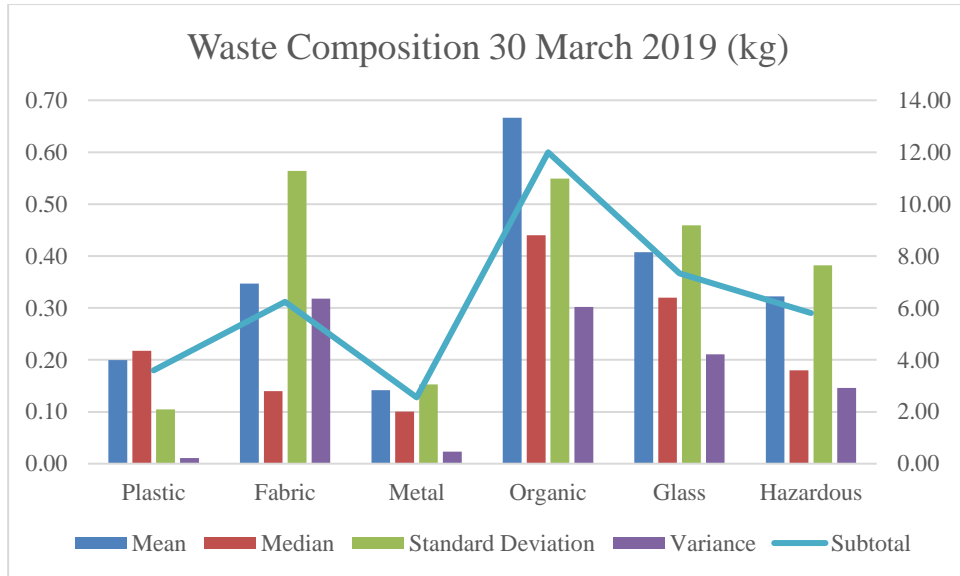


Figure 4.8: Waste Composition 30 March 2019

- viii. On 30<sup>th</sup> March, the pattern seems stable, with largest amount of organic, followed by glass, fabric and plastic. The amount of fabric waste should be one of the main concerns if further studies is carried out. The variation during all 8 weeks found that the pattern of fabric behaves unpredictable.

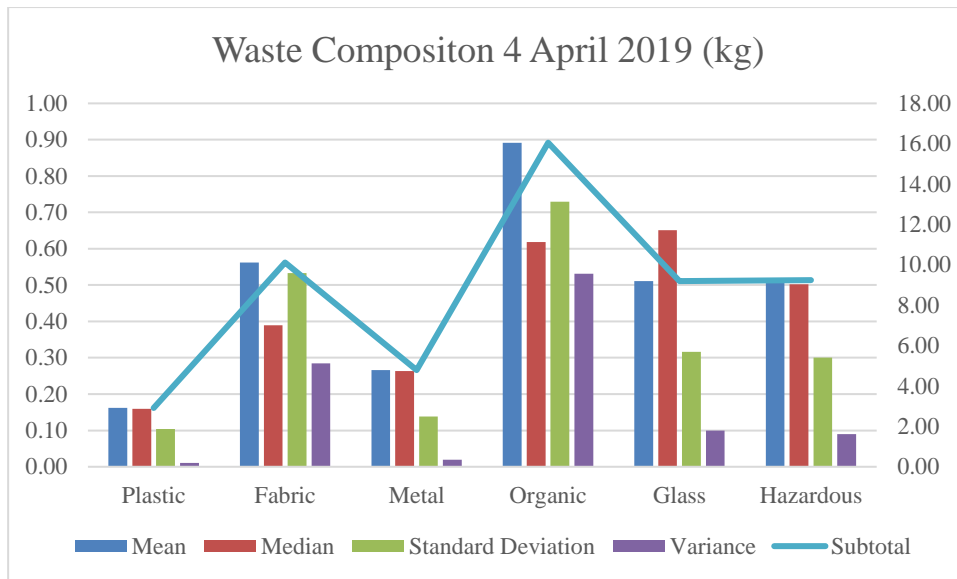


Figure 4.9: Waste Composition 4 April 2019

- ix. 4 April 2019 is the 5<sup>th</sup> week of sampling, organic waste is still the largest composition of all types of waste. Glass and fabric contributed almost same in amount of weight.

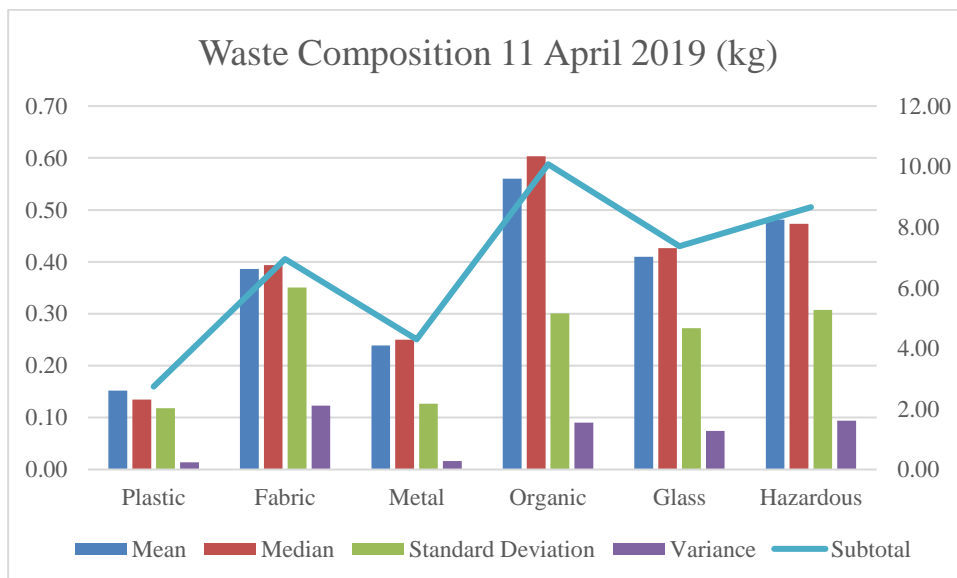


Figure 4.10: Waste Composition 11 April 2019

- x. As usual, on 11 April 2019, organic waste weighted at 0.60kg in average for all 18 sample spots. The total amount of all types of waste is decreased compared with previous weeks. Based on observation, the weight deviation during this week is significant lowered, indicating the amount of waste generated by all houses are fluctuating lesser.

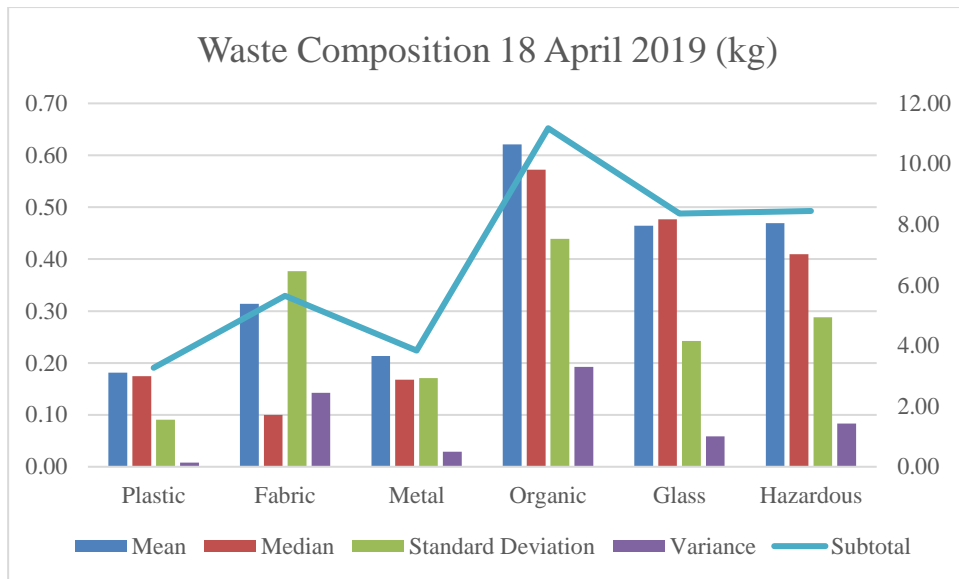


Figure 4.11: Waste Composition 18 April 2019

- xi. On 18 April 2019, the total amount of waste is lowest among the observed 8 weeks. Organic waste weighted 0.63kg in mean, while plastic for 0.18kg, fabric weighted 0.32kg. Metal is still the lowest contributor to the total amount of waste because most of the people still aware to exchange metal into valuables by recycling, as the value per gram for metal is significantly higher compared with other materials.

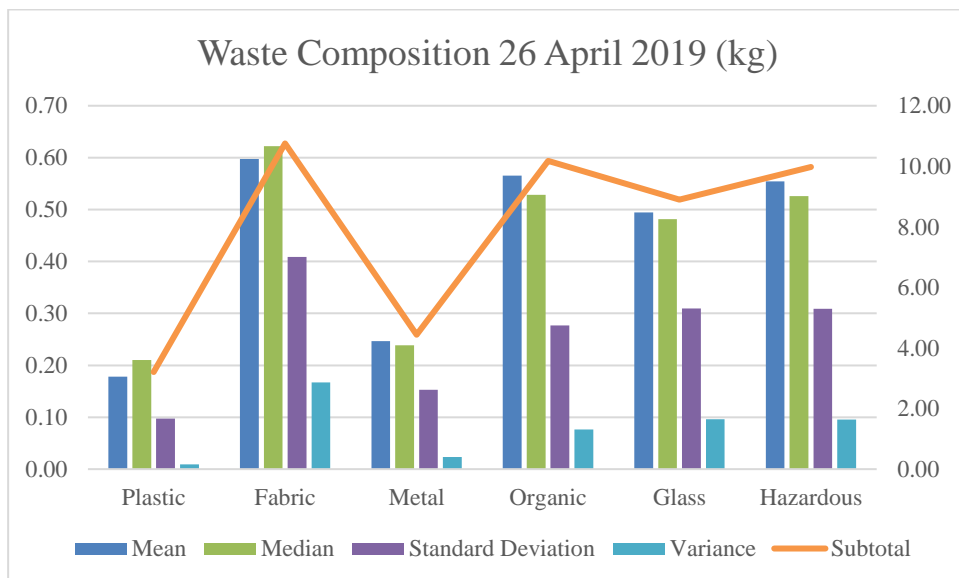


Figure 4.12: Waste Composition 26 April 2019

- xii. 26 April 2019 is the last week of waste sampling. From the graph, we see that fabric contributed up to 0.60kg. Metal and plastic are two minor contributors to



the total amount of waste, as metal is usually recycled, and plastic do not contribute much in term of mass.

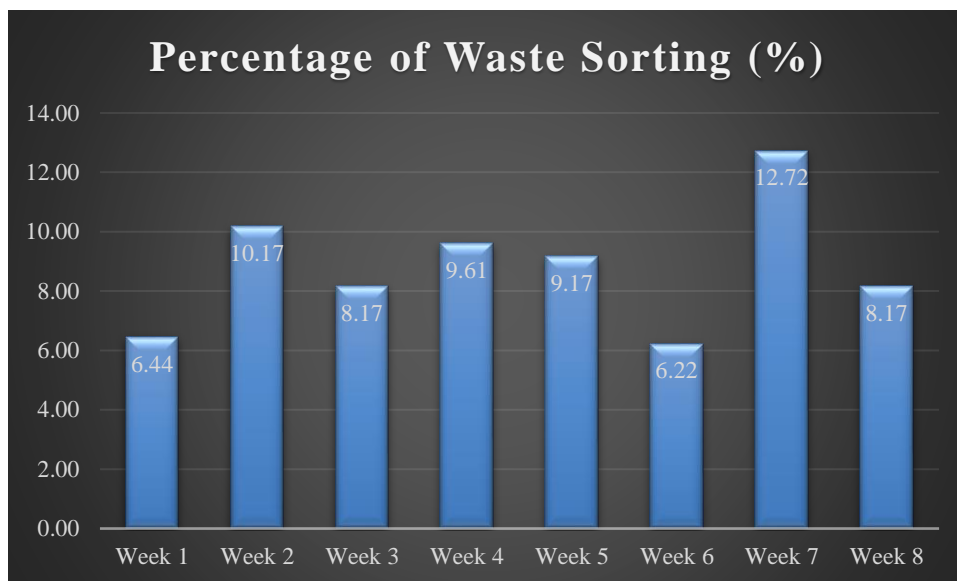


Figure 4.13: Percentage of Waste Sorting (%)

Percentage of waste sorting represents the level of waste separation made by the residents throughout the observation period. The total mean level of waste separation is only 8.33%, significantly lesser than the targeted aim for 22%. This is currently most reliable data to represent the actual effectiveness on the waste management scheme. If people follow step by step according to the suggestion implemented, this situation can be avoided.

#### **4.4 Discussion**

Throughout the study, it is found that some of the data collected did not perform as expected during the collection of data. In the questionnaire, there were 2 questions not included in the data analysis, hence the data collected is not fully utilized. Those data are expected to remove the outliers when the questionnaire are designed. From statistical study point of view, outliers are weighed much heavier and the value is squared on top of the standard deviation. The purpose is to penalise the value of outlier more heavily, to generate a more accurate data based on how the data varies. The two questions were not included in the analysis is because there were no outliers found in that particular category of data. It is a good sign for the whole data analysis but wasting the part of the data out from the analysis.

During the waste sample collection, all the 9 street and the 2 spots for waste sampling are remained the same for all the 8 weeks of study. However, it is found that due to the lack of waste sorting, most of the household solid waste are contaminated with other materials, such as polystyrene food casing with organic residues which cannot be removed easily, paper packaging for soft drinks containing large amount of liquids, all of these additional weights are somehow included in their material category, resulting in a less accurate data. The most obvious case found in this study is the weight of the fabrics during waste sample collection. Most of the fabrics are soaked and contaminated with liquids and other materials which cannot be removed using bare hands. Due to the hygiene consideration, the contaminated materials are not removed and weighted all together with the attached material, resulting in excessively large amount of fabric collected during the data collection.

## **CHAPTER 5**

### **CONCLUSION**

#### **5.1 Introduction**

This chapter is going to give a summary or concluding of this whole research. As all the findings and studies are discussed, analysed and interpreted using Descriptive Analysis. The conclusion will be divided into two perspectives of view: from public and from service provider/authorities.

Throughout the study, we found that there are many factors are affecting the actual effectiveness of the waste management scheme. Evidence has been provided in the data analysis part regarding to the factors affecting the current effectiveness of the scheme. By collecting raw data from sample area Taman Tas and Gambang, analysis and studies are carried out successfully to predict and measure what are the main criteria affecting the level of awareness towards the waste separation act. The collection of percentage of waste sorting obtained the mean value of 8.33%, considered far behind the targeted threshold of 22%. Hence, justification can be made that the current effectiveness of household solid waste sorting system is not effective as expected.

Questionnaire data collection method has been chosen because this is currently the best possible method to gather and collect data about the awareness opinion from the people. There is no related researches or analysis being done on this topic yet, hence the data collection must be made manually. The collected data showed excellent result towards what has been expected and predicted. There are certain factors that actually have close relationship between the level of awareness about the current waste management issues. All the respondents are sorted according to their attributes, and analysis has been made to prove the hypothesis is correct.

During the data collection, it is found that most of the people do not aware about the solid waste separation act. People are sorting their waste less frequently as expected, and the reason is because the authority is not enforcing the act accordingly. Most of the respondents reflected that they never receive any warnings or penalties on top of their act of not sorting the household waste. This situation must be resolved for people to follow rules and schemes better. Meanwhile, the service providers must obey what has been asked by the authority. From the data collection about the number of trips for dump truck came, it is observed that most people reported that no sighting of the collection of recyclable waste as what AlamFlora claimed. The service provider should put more effort into this topic to improve the current situation of waste sorting level.

## **5.2 Recommendations**

Throughout the data collection and data analysis, several problems are encountered and affected the accuracy of the data. Even though the errors are practically negligible, but it is always better to avoid them at any means. The question being designed in the survey form do not perform as what this research expected. They can be designed to collect not only behavioural or opinion data because the data collection for this research is only limited to these 2 types of data. Such collected data require high and complex level of analysis to transform them to become quantifiable. Meanwhile, the successfully quantified data is still subjective: They depend on the perspective and the angle of view made by the observer, hence cannot be considered as solid result. By providing a framework and idea about how actually the government concern about environmental issue, people will now put more effort into the co-operation with the service provider to improve the effectiveness of waste sorting system.

Meanwhile, the types of data analysis are also debatable. There is a long theory about which type of analysis is better suited to the Likert-Scale analysis: Chi-Squared goodness of fit test, or a rather basic t-test. No matter which type of data is collected from the Likert-scale, there are always some diverged opinions about which test you should carry out. This research chose Chi-square goodness of fit test, on the other hand looking for t-test being carried out in future studies. Comparison can be made against this research result to obtain more interesting findings.

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**APPENDIX A**  
**QUESTIONNAIRE SAMPLE**



## Waste Separation Analysis Questionnaire

[Faculty of Civil Engineering & Earth Resources]

Demographic Questionnaire

### Solid Waste and Public Cleansing Management Act 2007 (Act 672)

The purpose of this questionnaire is to collect experiences, feedback and behavioral data on how people manage their daily solid waste. The collected result will be used to improve the understanding on how solid waste management will give impact to the environment.

No personal data will be published, and the result will be only used for engineering research.

Please fill in the blanks or place an X or check mark next to the word or phrase that best matches your response.

Date:

1. How many family members are living together?

---

2. What is your age?

---

3. What is your education level?

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

Primary School  
Secondary School  
Degree Level  
Master/Ph.Doctor

4. What is your income range?

<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>
<input type="checkbox"/>

Below RM1500  
RM1500-RM2500  
RM2500-RM3500  
Above RM3500

5. How often your family having meal outside per week? (in Days)

---

6. How many times dump truck collect waste per week in your area?

- |                          |                   |
|--------------------------|-------------------|
| <input type="checkbox"/> | 1 time            |
| <input type="checkbox"/> | 2 times           |
| <input type="checkbox"/> | 3 times           |
| <input type="checkbox"/> | More than 3 times |

7. How many times you collect and throw the rubbish from your home? (per Day)

- |                          |                         |
|--------------------------|-------------------------|
| <input type="checkbox"/> | Once per two days       |
| <input type="checkbox"/> | Once per day            |
| <input type="checkbox"/> | Twice a day             |
| <input type="checkbox"/> | More than twice per day |

8. How often your house members having meal outside each week? (in average)

- |                          |                          |
|--------------------------|--------------------------|
| <input type="checkbox"/> | Never eating outside     |
| <input type="checkbox"/> | Once per week            |
| <input type="checkbox"/> | Twice per week           |
| <input type="checkbox"/> | More than twice per week |

## Waste Separation Analysis Questionnaire

**[Faculty of Civil Engineering & Earth Resources]**

Interview Question

The questions are specially designed to measure on how well the public understand about the **Solid Waste and Public Cleansing Management Act 2007 (Act 672)**, and to what extent are the people really applying it in daily life while managing their daily household solid waste.

No personal data will be published, and the result will be only used for engineering research.

Please fill in the blanks with phrase that best matches your response.

1. Do you know what is waste separation?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

2. Do you have basic knowledge on how to separate waste at home?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

3. Do you have time to do the separation at home?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

4. Do you have enough space at home to do waste separation?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

5. Do you know that there is an act enforcing waste separation in Pahang?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

6. Based on your observation, did the dump trunk come and collect the waste as what they scheduled?

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

7. There are specific points for the separated waste to store provided by the authority.

Strongly Agree	Agree	Neutral/Undecided	Disagree	Strongly Disagree
----------------	-------	-------------------	----------	-------------------

