UNIVERSITI PUTRA MALAYSIA

ASSESSING KNOWLEDGE, AWARENESS & WILLINGNESS OF UNIVERSITY STUDENTS IN SELANGOR ON THE IMPLEMENTATION OF POLLUTER PAYS PRINCIPLE AND ITS HEALTH IMPACT

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BY

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Thesis submitted in fulfilment of the requirement for the degree of Bachelor Science (Environmental and Occupational Health) from the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

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ABSTRACT

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Introduction: Reduction of waste is the top in the waste management hierarchy, and polluter pays principle is one of the preventive measure in reducing waste production. Polluter Pays Principle (PPP) has been internationally adopted by many developed countries such as Japan and Singapore in managing solid waste, but yet to be implemented in Malaysia. **Objective:** This study aims to determine the knowledge, awareness and willingness on the implementation of polluter pays principle among university students in Selangor and how this practice can reduce health risk. **Methodology**: A cross-sectional study was conducted and 200 respondents were selected from two different universities using convenience sampling method. This study was conducted from January to March 2019 and a set of self-administered questionnaire which comprises of four parts was used to collect the information related to socio-demographic, knowledge, awareness and willingness to participate in polluter pays principle was used. The questionnaire was posted online on various students' community groups and forum. **Results and discussion:** Most of the respondents have moderate knowledge (N=147, 73.5%), moderate awareness (145, 72.5%) and moderate willingness 138 (69.0%) regarding PPP. The knowledge among science students was significantly higher than non-science course students with median ± IQR of 7.0 (2.0) (z= -3.691, $p<0.001$). There was significant association between courses of respondents with their level of knowledge ($p<0.001$) and awareness ($p<0.05$). There was significant relationship between level of willingness with gender ($p<0.05$). **Conclusion:** University students has moderate knowledge, awareness and willingness level towards PPP. Science students have more knowledge and awareness on PPP than non-science students as they had difference in terms of knowledge background. Government must take proactive steps to disseminate the information regarding PPP to the public.

Keywords: Polluter pays principle, knowledge, awareness, willingness, university student

ABSTRAK

MENILAI PENGETAHUAN, KESEDARAN & KESEDIAAN DALAM KALANGAN PELAJAR UNIVERSITI DI SELANGOR TERHADAP PELAKSANAAN PRINSIP PENCEMAR MEMBAYAR DAN KESAN TERHADAP KESIHATAN

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Pengenalan: Pengurangan sisa adalah bahagian dalam hierarki pengurusan sisa, dan Prinsip Pencemar Membayar adalah salah satu langkah pencegahan untuk mengurangkan pengeluaran sisa. Prinsip Pencemar Membayar (PPP) telah digunakan oleh banyak negara maju seperti Jepun dan Singapura dalam menguruskan sisa pepejal tetapi belum dilaksanakan di Malaysia. **Objektif**: Kajian ini bertujuan untuk mengetahui pengetahuan, kesedaran dan kesanggupan pelaksanaan prinsip pencemar membayar pelajar di universiti di Selangor dan bagaimana amalan ini boleh mengurangkan risiko kesihatan. **Metodologi**: Kajian keratan rentas telah dijalankan dan 200 responden dipilih dari dua universiti yang berlainan iaitu UPM dan UIAM menggunakan kaedah sampling kemudahan. Kajian ini dijalankan dari Januari hingga Mac 2019 dan satu set soal selidik diri yang terdiri daripada empat bahagian digunakan untuk mengumpulkan maklumat yang berkaitan dengan sosio-demografi, pengetahuan, kesedaran dan kesediaan untuk mengambil bahagian dalam prinsip bayaran pencemar telah digunakan. Soal selidik itu disiarkan dalam talian di pelbagai kumpulan komuniti dan forum pelajar. **Keputusan dan perbincangan:** Kebanyakan responden mempunyai pengetahuan sederhana (N = 147, 73.5%), kesedaran sederhana (145, 72.5%) dan kesediaan sederhana 138 (69.0%) mengenai PPP. Pengetahuan di kalangan pelajar sains jauh lebih tinggi daripada pelajar kursus sains bukan median dengan median ± IQR 7.0 (2.0) ($z = -3.691$, $p < 0.001$). Terdapat persamaan yang signifikan antara kursus responden dengan tahap pengetahuan mereka ($p < 0.001$) dan kesedaran ($p < 0.05$). Terdapat hubungan yang signifikan antara tahap kesanggupan dengan jantina ($p < 0.05$). **Kesimpulan:** Pelajar universiti mempunyai tahap pengetahuan, kesedaran dan tahap kesediaan untuk PPP. Pelajar sains mempunyai lebih banyak pengetahuan dan kesedaran tentang PPP daripada pelajar bukan sains kerana mereka mempunyai perbezaan dari segi latar belakang pengetahuan. Pihak kerajaan perlu mengambil langkah proaktif untuk menyebarkan maklumat kepada orang awam tentang PPP.

Kata kunci: Pencemar membayar prinsip, pengetahuan, kesedaran, kesediaan, pelajar universiti

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DOE	Department of Environmental
EU	European Union
MOH	Ministry of Health
NSWMD	National Solid Waste Management Department
PAYT	Pay As You Throw
POP	Persistent Organic Pollutant
PPP	Polluter Pays Principle
SWM	Solid Waste Management
US EPA	United State Environmental Protection Agency
WHO	World Health Organization

CHAPTER 1

INTRODUCTION

1.1 Background

The world population are growing rapidly over the years and according to the US Census Bureau in 2019, there are approximately more than 7.5 billion of people are currently live on earth. This population explosion is putting a significant stain on our environment, as seen by changes in greenhouse gas emissions, deterioration of the natural resources, as well as more wastes are produced and more parts of the earth are being polluted (Mittal et al., 2013). Rushton (2003) stated that waste management which refers to the generation of waste and the collection, processing, transport and disposal of waste, is vital for both the public health, as well as environmental reasons.

These have stimulate a growing number of countries that work towards a reduction of the quantity of solid waste sent to landfills and to enhance diversion and recycling (Reichenbach, 2017). This has driven those countries to come out with the provision of environmental protection policies, and polluter pays principle is one of the policy that have long advocated by economist and policy analysts (Tilton, 2016). The idea of those who pollute should pay for the environmental harm it causes was first started in Western legal history in 1987. In present times, the polluter pays principle become as an international guideline for environmental policy demanding the individual or firm who harms the environment must bear the cost (Luppia, Parisi, & Rajagopalan, 2012).

In polluter pays principle, the person or persons responsible for pollution (the polluter) should pay for the costs of dealing with that pollution (reducing, preventing or eliminating the pollution). In particular, the PPP is used to obtain an equitable distribution of pollution damage costs between polluters and the general public (Tuncer et al., 2005). In EU law on waste management in particular, the PPP is mentioned in the Waste Framework Directive. In accordance with the polluter-pays principle, the costs of waste management shall be borne by the original waste producer or by the current or previous waste holders. There is a various methods for the application of PPP in waste management, targeting different types of waste and waste producers.

There is generally no right or wrong approach in applying PPP in waste management. An integrated waste management strategy will often require a combination of different measures (Schempp, 2011). In any case, any single measure or combination of measures needs to be thoroughly evaluated before implementation, carefully weighing the costs of implementation against the expected benefits, and adapted to the circumstances of a particular country or region.

Schempp (2011) also stated that the most common economic instrument used to apply PPP are waste tariffs or fees charged upon different waste producers such as households, consumers, commerce, industry, aimed at recovering the cost of building and operating the services and infrastructure required for collection, treatment and disposal of the waste they produce. When correctly applied, they also send signals to consumers to reduce the amount of waste produced.

Landfilling has become primary method in handling the continuous high number of solid waste generation in Malaysia, and this has caused solid waste

management as the main environmental issue in this country (Yiing & Latifah, 2017). About 89% waste collected in Malaysia end up in landfills, and Malaysian are expected to generate about 49,670 tonne/ day of waste (Solid Waste Management Lab, 2015). The amount of waste generated continues to increase due to growing population and increasing consumption (Asmawati Desa et al., 2011). Malaysia, with an area of 329,847 sq. km, with approximately 32.4 million estimated population in 2018 and expected to increase in few years to come with an annual population growth rate of 1.1 per cent (Department of Statistics Malaysia, 2018).

As Malaysia surges ahead by focusing on sustainable growth and development, with the population striking up, rapid industrialization and urbanization, the waste generation as a result of depletion in natural resource is also expanding at the equivalent pace. Tremendous land and air pollution for the environment, health problems for communities and bottlenecks to economic growth, as the result of country's waste build up. Modern lifestyle has led to more acute waste problems, convenience products generally require more packaging, careless habits associated with greater affluence lead to greater quantities of waste, as demonstrated by discarded wrappers from the inevitable fast food outlet, and the modern day waste contains a higher proportion of non-degradable materials such as plastics (Asmawati Desa et al., 2011).

Solid waste management is one of the most challenges issues faced by the Local Authorities in Malaysia, and it can be supported with the finding from Burntley's study, where the inefficient organization, financial constraint, complexity and system multi dimensionality are the main challenges faced by the local authority internally in managing the solid waste (Khaliesah et al., 2015). Solid wastes can be categorized

into three major categories, and each category is under the responsibility of a different government where municipal solid waste is under the Ministry of Housing and Local Government (MHLG), DOE manages schedule or hazardous waste and clinical waste is under the Ministry of Health (MOH) (Abd Manaf et al., 2009). The level of knowledge on waste management has direct impact on the public awareness on the environmental impact and their tendency to reduce waste production (Khaliesah et al., 2015).

1.2 Problem Statement

Department of National Solid Waste Management (2015) in their survey on Solid Waste Composition, Characteristics & Existing Practice of Solid Waste Recycling in Malaysia, found that about 33,000 tons of waste are produced by Malaysian every day which households waste contributed the most to the numbers. Asmawati Desa et al., (2011) highlighted that it was estimated waste generated to rise up to 5700t/day in the year 2017 in Selangor, worrying fact that 19% of those waste ends up in the drains. The issue of poor waste management in Malaysia has become one of the nation's major concerns to date. Credits to population escalation, consumption and disposal rates are accelerating rapidly than the country's utilities ability to deal with. Despite of that, the waste management standards in Malaysia are still poor. Worsen the problem, the low of awareness and knowledge among Malaysian concerning the solid waste management (SWM) issues.

Guisti (2009) in his study emphasised that poor waste management can roots to water, soil and air contamination, and to a major impact on public health. Health issues

can arise with every step of the handling, treatment and disposal of waste, both directly (recovery and recycling activities, or exposure to hazardous substances in the waste or to emissions from incinerators and landfill sites, vermin, odours and noise) or indirectly by ingestion of contaminated water, soil and food (Giusti, 2009). The government has adopted a National Strategic Plan for Solid Waste Management with emphasis on the upgrading of unsanitary landfills as well as the construction of new sanitary landfills and transfer stations with integrated material recovery facilities. A new Solid Waste Management Bill was adopted by parliament in June 2007 (Asmawati Desa et al., 2011). However, US EPA (2017) prioritize prevention as the most effective method in waste management as compared to disposal and treatment, lies at the bottom of the waste management hierarchy.

Polluter pays principle (PPP), act as a preventive measure is one of the method adopted by many developed and developing countries in mitigating issues related to waste management and it has stands as an international guideline for the environmental policy stipulating that the person or firm who damage the environment must bear the cost (Luppia et al., 2012).

In implementing this principle, not just the commitment of the policy makers but, the participation of the involved community is also highly required as community participation in environmental programs has been proven to enable more effective decision making in protecting the environment and its natural resources (Siti Mazwin et al., 2016). The implementation of this policy in Malaysia is still being debated among the policy makers and stakeholders.

There were limited study done on the knowledge, awareness and willingness of the public on the implementation of polluter pays principle and how this practice can

reduce health impact in Malaysia. Therefore, this study was designed to assess the knowledge, awareness and willingness to participate in the implementation of polluter pays principle among university students and the impact of this practice on human health. This study provides baseline information to assist policy makers on the suitability of the implementation of PPP.

1.3 Study Justification

Waste management is currently one of the major issue face by the government and this issue can be mitigate by prioritizing reduction at the sources. Reduction of waste is the top in the waste management hierarchy, and polluter pays principle is one of the preventive measure in reducing waste production. However, the polluter pays principle is yet to be implemented in Malaysia and public stakeholders in the planning and implementation of the principle in Malaysia. Participation is one of the important elements in determining the success of the principle.

Generally, universities and schools are the place that serve as main foundations of knowledge and cultures, making these institutes are the most suitable to establish campaigns and programs, with the aims to attain consciousness regarding environmental issues, and PPP in this case. Public education institutes play an important role to promote public environmental awareness. With large in number of people and size, universities campus can be considers as minor cities which can create significant environmental impacts either by direct or indirect activities. Thus, social environmental survey and research in public educational institutes is essential, which

can be used to as a preliminary instrument to assess public awareness (Ferronato et al., 2017).

Students are important generation for the future and the number of students in universities are increasing year by year, so thus the amount of waste generated every day also indicate accelerating growing pattern (Asmawati Desa et al., 2011). Different type of educational knowledge received may influence an individual level of awareness on environmental issue as found in previous study that science group students are more aware to their environment as compared to arts group (Hassan & Ratnakar, 2012). Therefore, it is crucial to assess the students' knowledge, awareness and willingness to be part of the principle. Since there is limited study emphasis on this issue, this research is aimed to provide some information and view on the public knowledge, awareness and willingness to participate in the implementation of the principle among university students as this directly affecting the success and effectiveness of the principle.

1.4 Definition of Terms

1.4.1 Waste

Waste can be defined as materials considered as unwanted goods or seen materials for which there are no further use (Nooraida Yakob et al., 2012).

1.4.2 Solid Waste

Solid waste refers to unused, unusable, unwanted, or discarded material available in solid form (Rajvir, 2015).

1.4.3 Waste Management

Waste management can be defined as the collection, transport, processing, recycling or disposal, and monitoring of waste materials (Demirbas, 2011).

1.4.4 Knowledge

Knowledge is a precondition for environmental awareness to ignite in individuals. It is the students' ability to understand and evaluate the impact of society on the ecosystem (Behzad et al., 2011).

1.4.5 Environmental knowledge

Environmental knowledge refers to a person's ability to identify a number of symbols, concepts and behaviour patterns related to environmental protection (Laroche et al., 2001).

1.5 Conceptual Framework

Waste in Malaysia can be categorized into five type which are construction and demolition waste, electronic waste (E-Waste), municipal solid waste, hazardous waste and bio-medical or clinical waste (Solid Waste Management Lab Report, 2015). Municipal solid waste are included household waste and commercial waste. These waste can be managed by using several methods, and these methods are based on waste hierarchy. The most preferable method is source reduction and reuse which can help to reduce number of waste produce. Recycling is next on the hierarchy. After that, composting of waste, then energy recovery is on the second level of the hierarchy. Lastly, the least preferable method is treatment and disposal of waste (Solid Waste Management Lab Report, 2015).

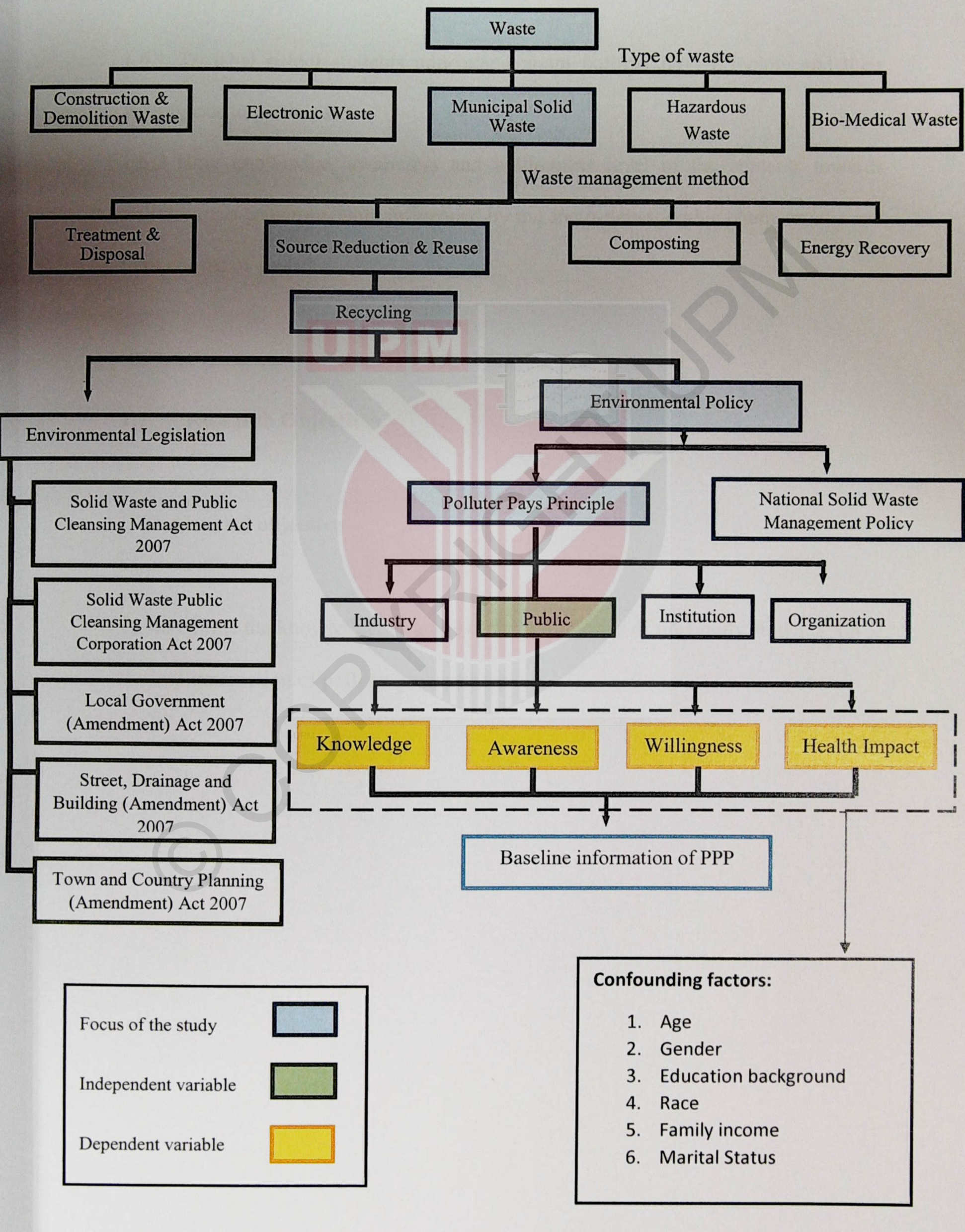
All these methods of waste management are subjected to the environmental legislation and policy in Malaysia. The law and legislation that related to waste in Malaysia are Solid Waste and Public Cleansing Management Act 2007, Solid Waste Public Cleansing Management Corporation Act 2007, Local Government (Amendment) Act 2007, Street, Drainage and Building (Amendment) Act 2007 and Town and Country Planning (Amendment) Act 2007 (Department of National Solid Waste Management, 2018).

Government and authorities also have come out with environmental policy with the purpose to control the waste in Malaysia. These environmental policy are included National Solid Waste Management Policy (NSWM Policy) which was formulated in 2002 and was adopted in 2005, and Polluter Pays Principle (PPP). PPP is one of the

government strategy plan for solid waste generation minimisation under Thrust 1 in the Waste Plan 2008 (Solid Waste Management Lab Report, 2015). However, PPP is yet to be implemented in Malaysia and still under discussion. If PPP is implemented in Malaysia, those who are subjected to this principle are industry, public, institution and organization (but not limited to). However, the success and effectiveness of this principle also depends on the level of public's knowledge, awareness and willingness on PPP, as well as what are the impact of PPP on health. All these information can serve as the baseline information prior the implementation of PPP in this country.

The confounder in this study could possibly be age, gender, education background, race, family income and marital status. For instance, the level of knowledge on PPP could be higher among those who study in science courses.

Conceptual Framework



1.6 Research Questions

1.6.1 To what extent students understand about polluter pays principle and their willingness to participate?

1.6.2 How knowledge, awareness and willingness level of the students towards polluter pays principle being influenced by the socio-demographic characteristic and their course of study?

1.7 Research Objectives

1.7.1 General objective

To determine the knowledge, awareness and willingness of university students' on the implementation of polluter pays principle.

1.7.2 Specific objectives

1. To determine the socio-demographic characteristics of the repondents in the study area.

2. To assess respondents' knowledge, awareness and willingness level on the implementation of polluter pays principle.

3. To compare knowledge, awareness and willingness level on PPP among science and non-science courses students.

4. To determine relationship between demographic characteristics and knowledge, awareness and willingness level of the students.

1.8 Research Hypothesis

1.8.1 There is significant difference in the knowledge, awareness and willingness level on PPP among science and non-science courses students in Selangor.

1.8.2 There is significant association between the socio-demographic characteristics and knowledge, awareness and willingness level of the students.

CHAPTER 2

LITERATURE REVIEW

2.1 Solid Waste Management in Malaysia

In global municipalities, one of the major environmental problems faced is regarding solid waste management (Irina & Siwar, 2015) and it is one of the main environmental problem that currently stipulating in Malaysia. Malaysia, with a population of over 32 million population in 2018 (Department of Statistic Malaysia, 2018) estimated to generates approximately an average of 30,000 tons of waste every day, with only 5 percent are being recycled (Solid Waste Management Lab, 2015). Solid waste management can be defined as the discipline associated with the control of generation (Mohamad & Keng, 2013). The major consequence of Malaysia's rapid urbanization is viewed as a social transformation with a greatly increased generation of municipal solid waste (Irina & Siwar, 2015). As the population increase at rapid pace, the waste generates are also rise at a remarkable amount. In view of that, Malaysia disposes of 28,500 tonnes /day of MSW directly into landfills (Mohamad & Keng, 2013).

Solid wastes management in Malaysia generally can be divided into three groups namely municipal solid waste management, scheduled waste management and clinical waste management, where each category is under different government agencies (Bashir et al., 2018). Ministry of Housing and Local

Government is responsible to manage municipal solid waste, Department of Environment (DOE) takes the responsibility to supervise the scheduled waste generation and disposal matters, whereas clinical waste management is under the control of Ministry of Health (Bashir et al., 2018).

In Malaysia, the solid waste composition is dominated by municipal solid waste (64%) with the rest comprises of industrial waste, commercial waste, and construction waste. Municipal solid waste include all community waste (Babaei et al., 2015) which mainly refers to household waste.

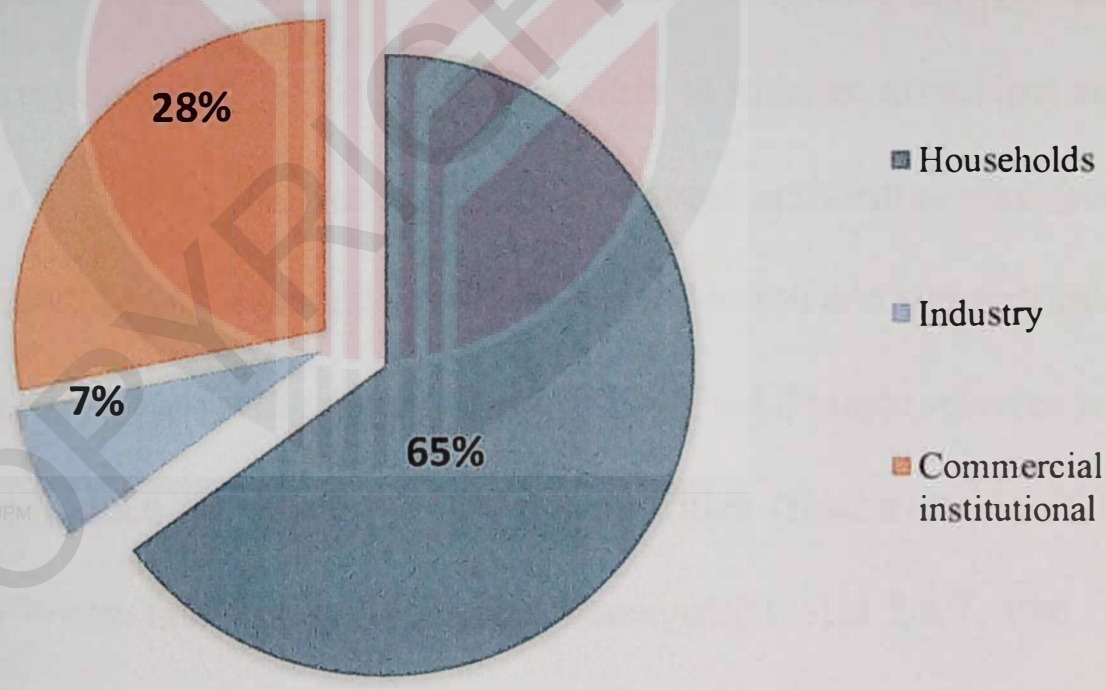


Figure 1: Solid waste generation in Malaysia (Solid Waste Management Lab, 2015)

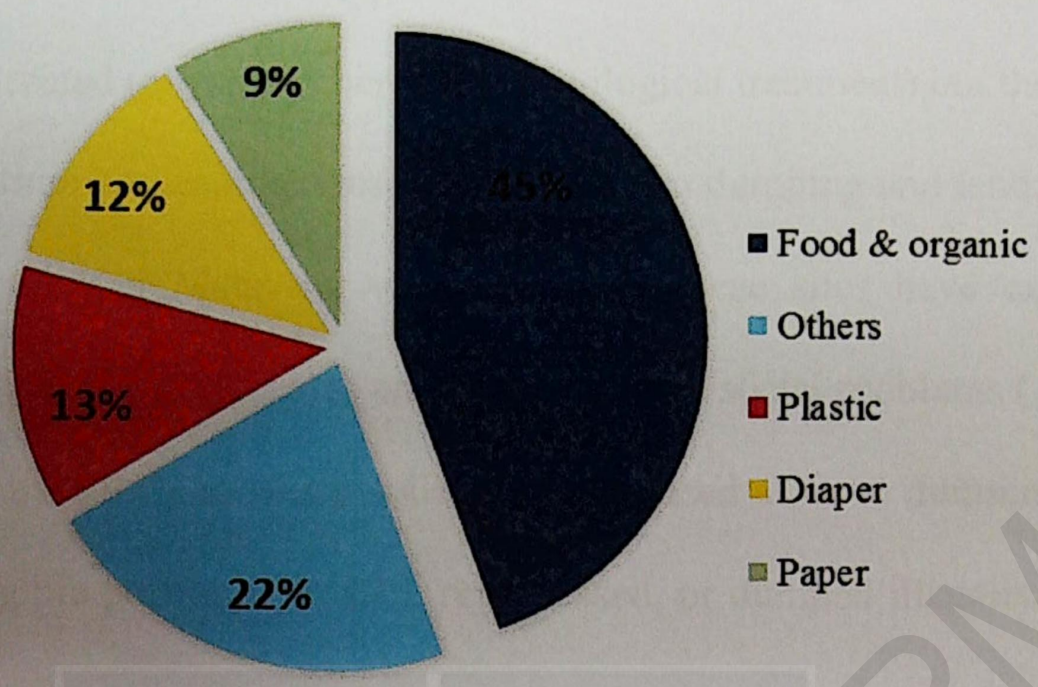


Figure 2: Household waste composition (Solid Waste Management Lab, 2015)

In Malaysia, under Section 72 of Local Government Act (LGA) 1976, it stated that it is shall be the responsibility of the local authorities to manage municipal solid waste (Abd Manaf et al., 2009). However, revenue of local authorities was facing deficit due to high operation cost associated with waste collection and transportation, revenue of local authorities was facing deficit. Back in 1996, solid waste services were privatized in order to reduce the burden of local authorities (Bashir et al., 2018). Besides, under Solid Waste and Public Cleansing Management Act 2007, two new agencies were established by Malaysian Federal Government. National Solid Waste Management Department (NSWMD) was established as a policy making and regulatory body to administer solid waste services based on local administration boundary. Solid Waste and Public Cleansing Management Corporation was established to complement and ensure the successful implementation of the national solid waste management policy (Abd Manaf et al., 2009).

The least preferred disposal method is landfilling, as waste should be separated and treated (physical, chemical, or biological treatment) but these options are costly and time-consuming. Despite of that, open dumping and landfills are the main method used in Malaysia, where most of these sites have exceeded its functional capacity, lead to serious environmental and social problems (Abd Manaf et al., 2009). About 95% of waste collected is disposed at these dumping sites and the other negligible portion is treated, reprocessed, or dumped illegally (Babaei et al., 2015).

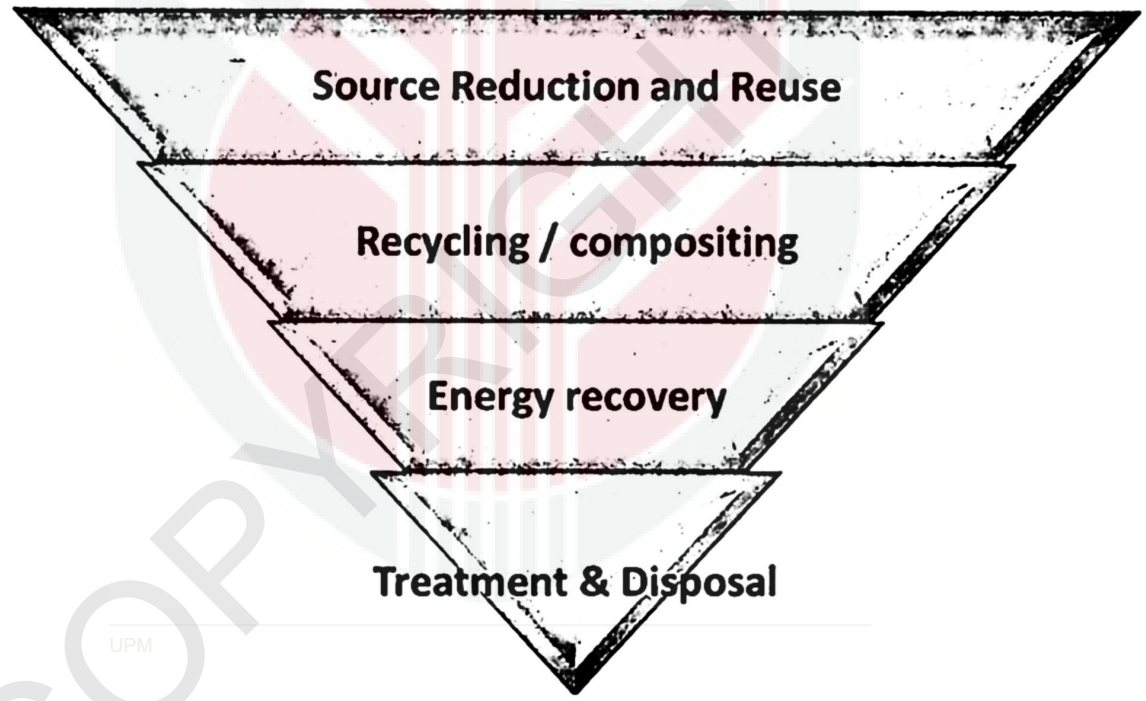


Figure 3: Waste management hierarchy

Waste management system is made up of four major parts which are generation, collection and transport, treatment, lastly disposing (Demirbas, 2011). Waste management hierarchy is a concept of the waste management and its acts as a base for developing several strategies in waste management (US EPA, 2017). In waste management hierarchy, reduction at source and reuse are the main priority which will help to lower the number of waste generated and toxicity that may arise

from waste. The aim of this method is to avoid unessential consumption and maximise efficiency which can be achieved by choosing items or materials with least packing or need less resources, avoid disposable or single- use items, select or buy recyclable, refillable, re-usable or biodegradable items or products. Reuse is when the item or materials can be used again in their original form.

Recycling and composting is in the second tier, where recycling is refers to the processing of materials that can be disposed into a new product (US EPA, 2017). While composting is a process of harnessing the natural decomposition to reduce the decay duration of biodegradable organic waste such as food waste, paper, wood, manure and crop residue. Many microorganism involve in this process such as bacteria and fungi, which will break down the organic compound into simpler form. Next is energy recovery on the third tier. This process involve the waste that unable to be recycled that later converted into useable forms of energy such as light, electricity and heat energy. This will minimize the use of natural resources. Last but not least, the least preferable method of waste management is treatment and disposal. After the waste are treated at the treatment facilities, they are disposed in the landfills which will produce many greenhouse gases such as methane gas and carbon dioxide as the result of decomposition of the waste (US EPA, 2017).

2.2 Solid Waste Management Law and Policy in Malaysia

Striking increment of solid waste generated over the years has poses a great challenge to the government in ensuring an effective waste management. Thus, a progressive solid waste management legislation and policy is essential to mitigate this issue. Government has established various law and policy in ensure proper management of solid waste in Malaysia (Zaipul Anwar & Ahmad Rahman, 2017).

Table 1: Existing law and policy on solid waste management in Malaysia

Solid Waste Management Law	Solid Waste Management Policy
Solid Waste and Public Cleansing Management Act 2007	National Solid Waste Management Policy 2007
Solid Waste Public Cleansing Management Corporation Act 2007	
Local Government (Amendment) Act 2007	
Street, Drainage and Building (Amendment) Act 2007	
Town and Country Planning (Amendment) Act 2007	

Source: **(Department of National Solid Waste Management, 2018)**

Under Solid Waste and Public Cleansing Management Act 2007 (Act 672) was gazetted on 30th August 2007, it regulates the solid waste and public cleansing management to make certain of proper sanitation maintenance in Peninsular Malaysia as well as in the Federal Territories od Labuan and Putrajaya. There is a provision of 3R (reduce, reuse and recycle) in this act which it emphasized the waste minimization and 3R activities. Separation of solid waste at source was made as mandatory by the government as of 1 September 2015 in pursuant to this act which enforced in the Federal Territories of Kuala Lumpur and Putrajaya, Melaka, Negeri Sembilan, Johor, Pahang, Perlis and Kedah (Ministry of Housing and Local Government, 2015).

Solid Waste Public Cleansing Management Corporation Act 2007 allows the implementation of municipal solid waste management and public cleansing activities in Federal Territories of Labuan and Putrajaya, and Peninsular Malaysia and the Federal Government has the executive power to do so. Through this act, the responsibility of municipal solid waste has been change from local state authorities to Malaysia Federal Government and privatised to concession companies (Zaipul Anwar & Ahmad Rahman, 2017). Under Section 72 of Local Government Act (LGA) 1976, it stated that it is shall be the responsibility of the local authorities to manage municipal solid waste, however local authorities was facing deficit due to high operation cost associated with waste collection and transportation, revenue of local authorities was facing deficit. Back in 1996, solid waste services were privatized in order to reduce the burden of local authorities (Bashir et al., 2018). In Street, Drainage and Building (Amendment) Act 2007, it emphasises on the

maintenance, provision and repair of ash pits and dustbin (Department of National Solid Waste Management, 2018).

The National Solid Waste Management (SWM) Policy was established in 2006 emphasizes the environment conservation, selection of affordable technology and to ensure the public health, with the aim to create an integrated, holistic, cost effective, sustainable, acceptable solid waste management to the community. This policy also aimed to apply the waste hierarchy in the solid waste management which highlight waste reduction via 3R, intermediate treatment and final disposal (Department of National Solid Waste Management, 2018).

2.3 Waste Management and Human Health

World Health Organization (WHO) (2015) stated that improper waste management and illegal waste shipments will result in negative impacts on both environment and public health. Different handling and disposal activities can lead to soil, water and air pollution. Whereas inefficiently disposed of or untreated waste may cause serious health problems for populations live near the disposal areas. Leaks from the waste may pollute soils and water streams, and emissions of heavy metals and persistent organic pollutants (POPs) may results in air pollution (Martuzzi et al., 2010). Despite the increasing recycling activities, landfills and incinerators are widely used in waste disposal.

There are several ways people can be exposed to pollutants from waste facilities namely by inhalation, by ingestion of food or of water, by skin contact and by fire or explosion (Alam & Ahmade, 2013). The potential health risk posed by residential near

to landfills have been highlighted in several papers. The major concerns are cancer and births outcomes, and recently respiratory diseases and annoyance were also studied. Excess for cancer has been found for different sites (e.g., pancreas, larynx, liver, kidney) and non-Hodgkin lymphoma, but the overall evidence is not sufficient to drawn conclusion (WHO, 2015).

Table 3: Waste management activity and health impact

Waste management activity	Exposure route	Hazard	Health outcome
Sewage discharges	Ingestion through bathing in recreational waters	Pathogens, primarily enterococci and faecal streptococci	Gastrointestinal symptoms
Sewage Treatment plants	Occupational exposure	Pathogens such as enteric bacteria, faecal streptococci, campylobacter, and viruses	Gastrointestinal tract problems, headache, fatigue and airways symptoms
Composting	Occupational exposure at a centralised composting facility	Bioaerosols with bacteria (e.g. Clostridium botulinum, endotoxin-producing gram negative bacteria) and/or fungal spores (Aspergillus fumigatus)	Airways symptoms
Landfill	Residence near site, occupational exposure	Any hazards – organic compounds, heavy metals, etc.	Any health outcomes
Incineration	Residence near site, Occupational exposure	Any hazards - heavy metals, organic compounds such as dioxins, etc.	Any health outcomes
Composting	Residence near centralised composting facility	Any hazards – pathogenic bioaerosols	Any health outcomes
Sewage treatment	Occupational exposure	Any hazards – pathogens, hydrogen sulfide, mercury, radionuclides	Cancer
Landspreading sewage sludge	Ingestion of food grown on land fertilised with sewage sludge	Any hazards – heavy metals, organic compounds, pathogens	Any health outcomes

(Source: (Alam & Ahmade, 2013)

2.4 Polluter Pays Principle and Impact on Health

The Polluter Pays Principle (PPP) is an environmental policy principle, which provides that those who causes damage to the environments should borne the responsibility and the cost of the damages. PPP mainly aims to promote economic efficiency by encouraging producers to use scarce environmental resources more efficiently as well as targeting on waste reduction and encourage reuse and recycling among the stakeholders (Schempp, 2011). The polluter pays principle was first implemented by the European Union in the Single European Act 1987, and later in 1992 it was recognized by the United Nations Conference on the Environment and Development delegates, which known as Rio- Declaration.

Over the years, the use of this principle has changed, where it is most known as a principle that is capable of internalizing the social cost of an activity, and a principle that therefore justifies the recourse to economic measures, it is clear that there are more functions that can be attributed to this principle. In some countries, the PPP is implemented by state government by direct regulation which create economic incentives, result in the polluters to bear the consequences of the environmental damage due to their activities through regulation that imposes direct environmental liability on the polluting agents (Luppia et al., 2012).

Following the polluter-pays principle, in Belgium, most municipalities moved from a flat household waste tax to unit-based tax systems, where only solid household waste presented in the required bag sold at the local stores are accepted. Schempp (2011) in his paper highlighted that one of the benefit of applying PPP is it results in prevention/mitigation measures. The principle will help in reduce the waste produce, thus less waste will be sent to the landfill for disposal. This will help to reduce health

risk pose by human as less air pollutants will be release during waste disposal (Luppia et al., 2012).

Table 2: Main environmental impact of municipal solid waste management

	Water	Air	Soil	Climate
Activity				
Landfilling	Leachate (heavy metals, synthetic organic compounds	CO2, CH4, odour, noise, VOCs	Heavy metals, synthetic organic compounds	
Incineration	Fall-out of atmospheric pollutants	SO2, NOx, N2O, HCl, HF, CO, CO2, dioxins, furans, PAHs, VOCs, odour, noise	Fly ash, slags	Greenhouse gases
Composting	Leachate	CO2, CH4, VOCs, dust, odour, bioaerosols	Minor impact	Small emissions of greenhouse gases
Land spreading	Bacteria, viruses, heavy metals	Bioaerosols, dust, odour	Bacteria, viruses, heavy metals, PAHs, PCBs	Small emissions of greenhouse gases
Recycling	Wastewater	Dust, noise	Landfilling of residues	Minor emissions
Waste transportation	Spills	CO2, SO2, NOx, dust, odour, noise, spills	Spills	Significant contribution of CO2

(Source: **Giusti, 2009**)

2.5 Success or Failure of PPP Worldwide

Polluter pays principle (PPP) has been adopted in many countries and showed various outcome of the implementation. Following initial trials during 1994 to 1996 in the municipality of Stockstad, the county rolled out a PAYT system in 1997. This system has been working ever since, and today, the County of Aschaffenburg has one of the highest recorded rates of recyclables collection (86%) one of the lowest recorded rates of residual waste generation (55 kg per capita per year (kg/cap/1yr1)). When Sanford adopted PAYT in 2010 waste tonnages fell from a high of near 600 tons per month to under 300 tons per month. The study showed that municipalities with pay-by-weight schemes in Sweden collected 20% less household waste per capita than other municipalities (Dahlén & Lagerkvist, 2009).

As in Vietnam, Decree 67 is the first attempt of application of PPP to control industrial pollution (Thanh, 2009). In January 2004, the legislation became officially effective, which required all registered enterprises in the country to manage their wastewater properly and pay an environmental protection fee. However, Thanh (2009) in his study revealed that the legislation was less successful at stopping pollution due to great number of company manager that had lack of knowledge on effective wastewater management, and that the legislation was not clear and detailed enough which made it difficult for firms to comply with.

Another case study conducted by Jaeger (2010) in Flanders, Belgium found that municipalities implemented weight-based pricing system for residual household waste using were not perform better than other municipalities that not adopted the principle. Taiwan has a nation-wide recycling rate of 55% which much higher than the 35% rate in the U.S after they implemented this scheme in their country (Waste Zero, 2016).

Last but not least, the positive impact of PPP can be seen when the municipalities with pay-by-weight schemes in Sweden collected 20% less household waste per capita than other municipalities (Dahlen & Lagerkvist, 2009).

2.6 Knowledge and awareness on Environmental Issue in Malaysia

Environmental awareness has three concepts that include emotional, attitude and practice of sustainability awareness (Hassan et al., 2010). With the motivating of psychological factors and emotional forces, the intention to conduct environmentally friendly actions is driven. Altin et al. (2014) in their study mentioned that environmental awareness is reflected as awareness to the environmental issues and active participation in environmental organizations. Hence, the awareness and concern of environmental issues and the causes and adverse impacts are necessary to be measured in an environmental awareness context (Karatekin, 2014). Neo et al., (2016) in their research concluded that Malaysians have the highest awareness towards water pollution and reflect the highest intention to conduct conservative action simultaneously.

Studies by various scholars have demonstrated that the quality of the environment depends critically on the level of knowledge, attitude, values and practices of the people. Afroz et al., (2017) research findings indicate that majority of the citizens have knowledge about the environmental and health impact of WEEE and 65% of them stated that they considered the environmental factors when they

purchased EEE for their households. However, only 3% and 2% of them were involved with recycling activities. Khaliesah et al., (2015) finding reveals that there was a weak and positive correlation between community participation in recycling programme with community attitude on solid waste segregation in Putrajaya. The knowledge level on solid waste segregation among the community recorded were also low.

Based on a study conducted on community participation on solid waste segregation through recycling programmes in Putrajaya, the findings showed that about 52.9% of the respondents stated that they participated in waste segregation program (Khaliesah et al., 2015). Another study conducted on knowledge, attitude, and practices of recycling among undergraduate students in UPM, it was found that 85.2% of respondents have high levels of knowledge on recycling. Despite of having, only 42.9% of them show positive levels of attitude and 49.0% of respondents have good recycling practices (Nadiah Nordin & Suhainizam, 2016). In 2017, a study done by Irina Safitri and C. Siwar on household acceptance recycling in Kuala Lumpur found that 90% of 412 respondents showed positive attitude towards recycling program.

CHAPTER 3

METHODOLOGY

3.1 Study design

This research is a quantitative study with cross-sectional study as the study design to determine the university students' knowledge, awareness and willingness on the implementation of polluter pays principle in Selangor and its risk on human health. This study was conducted from January 2019 to March 2019.

3.2 Study location

In this study, Selangor is chosen as the study location. Selangor with an area about 7957 km^2, currently populated by 6.47 million (Department of Statistics Malaysia, 2018) people and contribute approximately 6.9% of Gross Domestic Product (GDP) in Malaysia (Department of Statistic Malaysia, 2018). Selangor is chosen as the study location as it is one of the states in Malaysia that produce high number of solid waste, 7 220 tonne per day (Department of National Solid Waste Management, 2018).

3.3 Study population

The population of the respondents were consist of the university students. Where they had been chosen from two different universities in Selangor, namely Universiti Putra Malaysia and Universiti Islam Antarabangsa Malaysia. UPM was established in 1931 as the School of Agriculture the in 1947 it was declared as College of Agriculture Malaya. In 1971, it was established as Universiti Pertanian Malaysia. Later in 1997 it was changed to Universiti Putra Malaysia. Currently, there are 16 faculties in UPM, 15 in UPM Serdang, Selangor, and one in UPM Kota Kinabalu, Sabah. Total students in UPM are 21,302 students with 11,981 undergraduate students (UPM, 2019). UIAM was established on 20 May 1983, and currently have a total of 16 faculties with a total of 30,649 students (UIAM, 2019).

3.4 Sampling

3.4.1 Sampling method

The sampling method that used was convenience sampling, where those who responded to the questionnaire that posted online and full fill the inclusive and exclusive criteria selected as respondent. The questionnaire was posted in student website, faculty discussion group and on other social media.

3.4.2 Inclusive criteria

1. Malaysian
    - Only Malaysian included in this research because the result can reflect the current situation in Malaysia and Malaysians' level of knowledge on PPP.
2. Male and Female
3. Student of UPM and UIAM
4. Science and non-science courses student
    - The students categorized in these two groups as in previous studies showed that their course of study influences their level of knowledge on environmental.
5. First to forth year students.
    - All years of undergraduate students included as in previous study showed that their level of education may influenced their knowledge level.

3.4.3 Exclusive criteria

1. Foreigner
    - Foreign students might only for few years in Malaysia and go back to their country in the future. This can affect the representativeness of the result.

3.4.4 Sampling frame

The sampling frame is the list of students in UPM and UIAM

3.4.4 Sampling unit

The sampling unit is the science and non-science courses students in all UPM and UIAM universities.

3.4.5 Sample size calculation

The sample size for this study is calculated by using the following formula from Lemeshow, Hosmer, Klar, and Lwanga (1990).

$$n = \frac{\{z_{1-\alpha}^2\sqrt{2\,\bar{P}(1-\bar{P})} + Z_{1-\beta}\sqrt{P_1(1-P_1)+P_2(1-P_2)}\}^2}{(P_1-P_2)^2}$$

Where,

$\overline{P}$ = (P1+P2)/2

P_1 = estimated proportion (larger)

P_2 = estimated proportion (smaller)

$Z1-\alpha/2$ = standard errors associated with confidence intervals

$Z1-\beta$ = standard errors associated with power

The larger estimated proportion (P_1) is taken as 0.64 which represented the knowledge on solid waste management among students in Selangor (Asmawati Desa et al., 2010) and the smaller estimated proportion (P_2) is taken as 0.35 that represented the knowledge and willingness of students to participate in the waste management in Kuala Lumpur. The sample size calculated as below with 95% confidence interval which has 1.96 of standard error and 5% of desired precision.

$$\mathbf{n} = \frac{\{1.96\sqrt{2\,(0.5)(0.5)} + \,0.842\sqrt{0.64(0.36) + 0.35(0.65)}\,\}^2}{(0.64 - 0.35)^2}$$

n = 45 respondents

After considering 10% of respondents were added into the sample size for non-response problem, the sample size is **50 respondents**. There will be comparison between science and non-science course students, so the sample size is multiply by two, making the sample size as **100 respondents.** 100 respondents will be selected from each university, where 50 students from non-science course and 50 students from science courses. Thus, the total sample size is 200 respondents.

3.5 Study Instrumentation

3.5.1 Questionnaire

For this research, a structured and self-administered questionnaire with four sections and written in English. The questionnaire was adopted and modified from a study by Mukherji et al., (2016) on resident knowledge and willingness to engage in waste management in Delhi, India, a study on the knowledge, awareness, attitude and motivational analysis of plastic waste and household perspective in Malaysia (Rafia Afroz et al., 2017). The questionnaire were be applied individually using an online form.

Part A: Socio-demographic information

This section requires the respondents to give general information on their age, gender, education background, races, family income and marital status.

Part B: Knowledge level on waste management

In this part, respondents were required to answer the questions related to knowledge on PPP such have they heard of polluter pay principle or pay-as-you-throw, do they know that PPP is based on the volume and amount of waste being disposed and PPP applies the concept of polluters have to bear the cost to control, prevent and clean the pollution caused by them. The format used was dichotomous scale, which are Yes/No. The respondents given 1 point for each correct answer and 0 score for the wrong answer.

Part C: Awareness on waste management

For this part, there were seven questions which focusing on the respondents' awareness on polluter pays principle such as do they think that polluter pays principle is necessary to manage solid waste problem in Malaysia and do they know that they have to pay for the amount of the trash they throw if PPP is applied. The respondents will get 1 point for each correct answer and 0 score for the wrong answer. The format used was dichotomous scale, which are Yes/No. The respondents given 1 point for each correct answer and 0 score for the wrong answer.

Part D: Willingness to participate in polluter pays principle

This part contain six questions that aimed to assess the respondents' willingness to participate in the PPP where they were asked will they support any PPP programme if implemented in the future, does is practical for them to pay for the trash they disposed and do they willing to pay if taxes are imposed based on the amount of waste they

dispose. The format used was dichotomous scale, which are Yes/No. The respondents given 1 point for each correct answer and 0 score for the wrong answer.

Every respondent's score for each variable were calculated and totalled up and their knowledge, awareness and willingness level determined, the classification are as below;

- Score $\geq 80\%$: High
- Score 50-79% : Moderate
- Score $\leq 49\%$: Low

3.6 Statistical Analysis

All data analysed using Statistical Package for Social Sciences (SPSS) software for Windows, version 22. The descriptive statistical analysis performed to obtain percentage, frequencies, median, standard deviation and range for each variables in this study. Chi square test was used to analyse the relationship between socio-demographic characteristics and the knowledge, awareness and willingness level of the community. Mann-Whitney U Test was used to compare the mean of knowledge, awareness and willingness level on PPP among university students in Selangor. A p value of < 0.05 was considered as statistically significant.

3.7 Ethical Consideration

This study has obtained ethical approval from Ethics Committee for Research Involving Human Subjects (JKEUPM), reference number (UPM/TNCPI/1.4.18.2 (JKEUPM). Written consent obtained from all respondents prior the study and all information about the respondents are confidential.

CHAPTER 4

RESULTS

4.1 Socio-demographic information of respondents

A total of 200 respondents from two local public universities in Selangor participated in this study, where 100 students selected from each university and 50 respondents from science and non-science courses respectively. This study mainly surveyed on knowledge, awareness and willingness on Polluter Pays Principle among the respondents. Majority of the students were female (N=153, 76.5%) and 23.5% are male (N= 47). The number of respondents were dominated by Malay (N= 178, 89.0%), followed by Chinese (N=13, 6.5%), Indian (N= 6, 3%) and others (N=3, 1.5%). The respondents aged between 20-25 years old with mean (SD) age of 21.74(1.12), where most them were 21 years (N=60, 30%).

In term of year of study, most respondents were forth year students (N=64, 32.0%), followed by second year students (N= 63, 31.5%), third year students (N=41, 20.5%) and first year students (N=32, 16.0%). The respondents who have working experience were 23% (N=46) and most of them did not have any working experience (N=154, 77%). More than half (N=115, 57.5%) of the respondents have monthly allowance of RM 1500 and below, and the rest were above RM 1500. Over half (N= 179, 89.5%) of the respondents live in the hostel, and only some are renting (N=19, 9.5%) and live with their family (N=2, 1.0%) as in Table 4.1.

Table 4.1: Socio-demographic information of respondents (N= 200)

Data	N (%)	Mean (SD)	Minimum	Maximum
University:				
UPM	100 (50%)			
UIAM	100 (50%)			
Field of study:				
Science	100 (50%)			
Non-science	100 (50%)			
Gender:				
Male	47 (23.5)			
Female	153 (76.5)			
Race:				
Malay	178 (89.0)			
Chinese	13 (6.5)			
Indian	6 (3.0)			
Others	3 (1.5)			
Age (years):				
20	30 (15.0)			
21	60 (30.0)	21.74 (1.12)	20	25
22	50 (25.0)			
≥23	60 (30.0)			
Year of study:				
First	32 (16.0)			
Second	63 (31.5)			
Third	41 (20.5)			
Forth	64 (32.0)			
Monthly allowance:				
<RM1500	115 (57.5)		500	3000
>RM1500	85 (42.5)			
Residential:				
Hostel	178 (89.0)			
Renting	2 (1.0)			
Family	20 (10.0)			
Working experience:				
Yes	46 (23.0)			
No	154 (77)			

4.2 Level of knowledge on Polluter Pays Principle (PPP)

The level of knowledge, awareness and willingness on implementation of Polluter Pays Principle (PPP) presented in Table 4.2, 4.3 and 4.4 respectively. Most of the respondents have moderate knowledge regarding PPP (N=147, 73.5%). A total number of 121 respondents (60.5%) knows that PPP is based on volume and amount of waste being disposed. About 40% of the respondents does not know that PPP applies the concept of polluters have to bear the cost to control, prevent and clean the pollution caused by them. More female (12.5%) have high level of knowledge as compared to male students (4.0%). Student who age of 23 have the highest percentage of high knowledge compared to other age. Those who were not working showed more percentage of high level of knowledge.

Table 4.2: Level of knowledge on Polluter Pays Principle (PPP) by socio-demographic background (N=200)

Variable	Level of Knowledge		
	Low (%)	Moderate (%)	High (%)
Gender:			
Male	3 (1.5)	36 (18.0)	8 (4.0)
Female	17 (8.5)	111 (55.5)	25 (12.5)
Race:			
Malay	19 (9.5)	129 (64.5)	30 (15.0)
Chinese	1 (0.5)	11 5.5)	1 (0.5)
Indian	0 (0.0)	3(3.0)	0 (0.0)
Others	0 (0.0)	1 (0.5)	2 (1.0)
Age (years):			
20	9 (4.5)	21 (10.5)	0 (0.0)
21	4 (2.0)	55 (27.5)	1 (0.5)
22	5 (2.5)	40 (20.0)	5 (2.5)
23	1 (0.5)	29 (14.5)	25 (12.5)
24	0 (0.0)	2 (1.0)	1 (0.5)
25	1 (0.5)	0 (0.0)	1 (0.5)
Residential:			
Hostel	18 9.0)	132 (66.0)	28 (14.0)
Renting	2 (1.0)	13 (6.5)	5 (2.5)
Family	0 (0.0)	2 (1.0)	0 (0.)
Working experience:			
Yes	7 (3.5)	32 (16.0)	7 (3.5)
No	13 (6.5)	115 (57.5)	26 (13.0)
Course:			
Science	2 (0.9)	88 (37.6)	31 (13.2)
Non-science	19 (8.1)	85 (36.3)	9 (3.8)
Year of study:			
First	9 (3.8)	24 (10.3)	1 (0.4)
Second	5 (2.1)	68 (29.1)	1 (0.4)
Third	4 (1.7)	38 (1.7)	3 (1.3)
Forth	3 (1.3)	43 (18.4)	35 (15.0)
University:			
UPM	7 (3.5)	76 (38.0)	17 (8.5)
UIAM	13 (6.5)	71 (35.5)	16 (8.0)

4.3 Level of awareness on Polluter Pays Principle (PPP)

In terms of awareness, most of the respondents also had moderate awareness regarding PPP (145, 72.5%), where about 80.0% of the respondents agreed that PPP is necessary in order to manage solid waste problem in Malaysia. However, only 42% of them were aware that they have to pay for the amount of trash they throw if PPP is applied in Malaysia. Same result for awareness level where, female students, those who aged 23 and those who are not working have greatest number of high level of knowledge.

Table 4.3: Level of awareness on Polluter Pays Principle (PPP) by socio-demographic background (N=200)

	Level of Awareness		
	Low (%)	Moderate (%)	High (%)
Gender:			
Male	4 (2.0)	33 (16.5)	10 (5.0)
Female	11 (5.5)	112 (56.0)	30 (15.0)
Race:			
Malay	14 (7.0)	128 (64.0)	36 (18.0)
Chinese	1 (0.5)	11 (5.5)	1 (0.5)
Indian	0 (0.0)	5 (2.5)	1 (0.5)
Others	0 (0.0)	1 (0.5)	2 (1.0)
Age (years):			
20	8 (4.0)	20 (10.0)	2 (1.0)
21	2 (1.0)	54 (27.0)	4 (2.0)
22	3 (1.5)	38 (19.0)	9 (4.5)
23	1 (1.0)	30 (15.0)	24 (12.0)
24	0(.0)	2 (1.0)	1 (0.5)
25	1 (0.5)	1 (0.5)	0 (0.0)
Residential:			
Hostel	11(5.5)	131 (65.5)	36 (18.0)
Renting	3 (1.5)	13 (6.5)	4 (2.0)
Family	1 (0.5)	1 (0.5)	0 (0.0)
Working experience:			
Yes	2 (1.0)	35 (17.5)	9 (4.5)
No	13 (6.5)	110 (55.0)	31 (15.5)
Course:			
Science	4 (1.7)	81 (34.6)	36 (15.4)
Non-science	12 (5.1)	88 (37.6)	13 (5.6)
Year of study:			
First	8 (3.4)	23 (9.8)	3 (1.3)
Second	2 (2.7)	68 (29.1)	4 (1.7)
Third	0 (0.0)	38 (16.2	7 (3.0)
Forth	6 (2.6)	40 (17.1)	35 (15.0)
University:			
UPM	7 (3.5)	72 (36.0)	21 (10.5)
UIAM	8 (4.0)	73 (36.5)	19 (9.5)

4.4 Level of willingness on Polluter Pays Principle (PPP)

As for willingness, a total number of 138 (69.0%) respondents have moderate willingness to towards PPP, where about 80% of the respondents said that they will support any PPP program if implemented in the future. However, only 30.5% of them states that they were willing to pay if taxes are imposed based on the amount of waste disposed, and 45.0% stated that it is practical for them to pay for the trash that they disposed.

Table 4.4: Level of willingness on Polluter Pays Principle (PPP) by socio-demographic background (N=200)

Variable	Level of Knowledge		
	Low (%)	Moderate (%)	High (%)
Gender:			
Male	47 (23.5)	14 (7.0)	8 (6.0)
Female	153 (76.5)	24 (12.0)	16 (8.0)
Race:			
Malay	35 (17.5)	119 (59.5)	24 (12.0)
Chinese	2 (1.0)	11 (5.5)	0 (0.0)
Indian	0 (0.0)	6 (3.0)	0 (0.0)
Others	1 (0.5)	2 (1.0)	0 (0.0)
Age (years):			
20	12 (6.0)	17 (8.5)	1 (0.5)
21	11 (5.5)	47 (23.5)	2 (1.0)
22	9 (4.5)	34 (17.0)	7 (3.5)
23	4 (2.0)	37 (18.5)	14 (7.0)
24	1 (0.5)	2 (1.0)	0 (0.0)
25	1 (0.5)	1 (0.5)	0 (0.)
Residential:			
Hostel	33 (16.5)	123 (61.5)	22 (11.0)
Renting	3 (1.5)	15 (7.5)	2 (1.0)
Family	2 (1.0)	0 (0.0)	0 (0.0)
Working experience:			
Yes	6 (3.0)	37 (18.5)	3 (1.5)
No	32 (16.0)	101 (50.5)	21 (10.5)
Course:			
Science	2 (0.9)	88 (37.6)	31 (13.2)
Non-science	19 (8.1)	85 (36.3)	9 (3.8)
Year of study:			
First	9 (3.8)	24 (10.3)	1 (0.4)
Second	5 (2.1)	68 (29.1)	1 (0.4)
Third	4 (1.7)	38 (1.7)	3 (1.3)
Forth	3 (1.3)	43 (18.4)	35 (15.0)
University:			
UPM	7 (3.5)	76 (38.0)	17 (8.5)
UIAM	13 (6.5)	71 (35.5)	16 (8.0)

4.5 Comparison of knowledge, awareness and willingness between science and non-science courses

Table 4.5 shows the comparison of knowledge, awareness and willingness level on Polluter Pays Principle (PPP) between science and non-science courses students using Mann-Whitney U Test. The knowledge among science students was significantly higher than non-science course students with median ± IQR of 7.0 (2.0) (z= -3.691, $p<0.001$). The awareness among science students was also significantly higher than non-science students with median ± IQR of 5.0 (2.0) (z = -2.927, p = 0.3). Nevertheless, the willingness score of all students was not significantly different between science and non-science students.

Table 4.5: Comparison of knowledge, awareness and willingness between science and non-science courses (N=200)

Variable	Mean (std)		z	P
	Science	Non-science		
Knowledge	6.79 (0.988)	5.99 (1.314)	-3.691	**<0.001***
Awareness	5.00 (0.964)	4.62 (0.972)	-2.927	**0.03***
Willingness	3.54 (1.158)	3.36 (0.938)	-1.053	0.292

*Mann-Whitney U Test, statistically significant at $p < 0.05$

4.6 Relationship between socio-demographic characteristics and the knowledge, awareness and willingness level of the students.

Based on Chi-square test, this study found that there was significant association between courses of respondents with their level of knowledge and awareness as shown in Table 4.6 and 4.7. Science students have higher level of knowledge and awareness as compared to non-science students. However, there was no significant association between level of knowledge and awareness with other socio-demographic characteristics (gender, age, race, working experience and monthly allowance). In addition, it was found that there was no significant association between the level of willingness with other socio-demographic characteristics except for gender as shown in Table 4.8. Female students observed to have higher willingness towards PPP as compared to male students.

Table 4.6: Association between level of knowledge with socio-demographic characteristics. (N=200)

Variable	Level of Knowledge			Chi-square	p-value
	Low (%)	Moderate (%)	High (%)		
Gender:					
Male	3 (1.5)	36 (18.0)	8 (4.0)	2	0.640
Female	17 (8.5)	111 (55.5)	25 (12.5)		
Age (years):					
20	9 (4.5)	21 (10.5)	0 (0.0)	10	0.350
21	4 (2.0)	55 (27.5)	1 (0.5)		
22	5 (2.5)	40 (20.0)	5 (2.5)		
23	1 (0.5)	29 (14.5)	25 (12.5)		
24	0 (0.0)	2 (1.0)	1 (0.5)		
25	1 (0.5)	0 (0.0)	1 (0.5)		
Race:					
Malay	19 (9.5)	129 (64.5)	30 (15.0)	6	0.190
Chinese	1 (0.5)	11 (5.5)	1 (0.5)		
Indian	0 (0.0)	6 (3.0)	(0.0)		
Others	0 (0.0)	1 (0.5)	2 (1.0)		
Course:				2	**<0.001***
Science	2 (1.0)	73 (36.5)	25 (12.5)		
Non-science	18 (9.0)	74 (37.0)	8 (4.0)		
Year of study:				6	**<0.001***
First	9 (4.5)	22 (10.0)	1 (0.5)		
Second	5 (2.5)	57 (28.5)	1 (0.5)		
Third	4 (2.0)	34 (17.0)	3 (1.5)		
Forth	2 (1.0)	34(17.0)	28 (14.0)		
Monthly allowance:				4	0.338
<RM1500	14 (7.0)	87 (43.5)	14 (7.0)		
>RM1500	6 (3.0)	60 (30.0)	19 (9.5)		
Residential:					
Hostel	18 (9.0)	132 (66.0)	28 (14.0)	4	0.760
Renting	2 (1.0)	13 (6.5)	5 (2.5)		
Family	0 (0.0)	2 (1.0)	0 (0.0)		
Working experience:				2	0.404
Yes	7 (3.5)	32 (16.0)	7 (3.5)		
No	13 (6.5)	115 (57.5)	26 (13.0)		

*statistically significant at $p < 0.001$

Table 4.7: The relationship between level of awareness with socio-demographic characteristics. (N=200)

Variable	Level of Awareness			Chi-square	p-value
	Low (%)	Moderate (%)	High (%)		
Gender:				2	0.915
Male	4 (2.0)	33 (16.5)	10 (5.0)		
Female	11 (5.5)	112 (56.0)	30(15.0)		
Age (years):				10	0.114
20	8 (4.0)	20 (10.0)	2 (1.0)		
21	2 (1.0)	54 (27.0)	4 (2.0)		
22	3 (1.5)	38 (19.0)	9 (4.5)		
23	1 (0.5)	30 (15.0)	24 (12.0)		
24	0 (0.0)	2 (1.0)	1 (0.5)		
25	1 (0.5)	1 (0.0)	0 (0.0)		
Race:				6	0.423
Malay	14 (7.0)	128 (64.0)	36 (18.0)		
Chinese	1 (0.5)	11 (5.5)	1 (0.5)		
Indian	0 (0.0)	5 (2.5)	2 (1.0)		
Others	(0.0)	0 (0.0)			
Course:				2	**0.001***
Science	4 (2.0)	68 (34.0)	28 (14.0)		
Non-science	11 (5.5)	77 (38.5)	12 (6.0)		
Year of study:				6	**<0.001**
First	8 (4.0)	21 (10.5)	3 (1.5)		
Second	2 (1.0)	57 (28.5)	4 2.0)		
Third	0 (0.0)	34 (17.0)	7 (3.5)		
Forth	5 (2.5)	33 (16.5)	26 (13.0)		
Monthly allowance:				4	0.195
<RM1500	10 (5.0)	88 (44.0)	17 (8.5)		
>RM 1500	5 (2.5)	57 (28.5)	23 (11.5)		
Residential:				4	0.114
Hostel	11 (5.5)	131 (65.5)	36 (18.0)		
Renting	3 (1.5)	13 (6.5)	4 (2.0)		
Family	1 (0.5)	1 (0.5)	0 (0.0)		
Working experience:				2	0.637
Yes	2 (1.0)	35 (17.5)	9 (4.5)		
No	13 (6.5)	110 (55.0)	31 (15.5)		

*statistically significant at $p < 0.05$

Table 4.8: The relationship between level of willingness with socio-demographic characteristic. (N-200)

Variable	Level of Willingness			Chi-square	p-value
	Low (%)	Moderate (%)	High (%)		
Gender:				2	**0.002***
Male	14 (7.0)	25 (12.5)	8 (4.0)		
Female	24 (12.0)	113 (59.8)	16 (8.0)		
Age (years):				10	0.053
20	12 (6.0)	17 (8.5)	1 (0.5)		
21	11 (5.5)	47 (23.5)	2 (1.0)		
22	9 (4.5)	34 (17.0)	7 (3.5)		
23	4 (2.0)	37 (18.5)	14 (7.0)		
24	1 (0.5)	2 (1.0)	0 (0.0)		
25	1 (0.5)	1 (0.5)	0 (0.0)		
Race:				6	0.426
Malay	35 (17.5)	119 (59.5)	24 (12.0)		
Chinese	2 (1.0)	11 (5.5)	0 (0.0)		
Indian	0 (0.0)	6 (3.0)	0 (0.0)		
Others	1 (0.5)	2 (1.0)	0 (0.0)		
Course:				2	0.089
Science	17 (8.5)	66 (33.0)	17 (8.5)		
Non-science	21 (10.5)	72 (36.0)	7 (3.5)		
Year of study:				6	**0.002***
First	12 (6.0)	18 (9.0)	2 (1.0)		
Second	13 (6.5)	48 (24.0)	2 (1.0)		
Third	4 (2.0)	31 (15.5)	6 (3.0)		
Forth	9 (4.5)	41(20.5)	14 (7.0)		
Monthly allowance:				4	0.218
<RM1500	22 (11.0)	84 (42.0)	9 (4.5)		
>RM 1500	16 (8.0)	54 (27.0)	15 (7.5)		
Residential:				4	0.064
Hostel	33 (16.5)	123 (61.5)	22 (11.0)		
Renting	2 (1.0)	0 (0.0)	0 (0.0)		
Family	3(1.5)	15 (7.5)	2 (1.0)		
Working experience:				2	0.154
Yes	6 (3.0)	37 (18.5)	3 (1.5)		
No	32 (16.0)	101 (50.5)	21 (10.5)		

*statistically significant at $p < 0.05$

CHAPTER 5

DISCUSSIONS, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion

5.1.1 Socio-demographic information of respondents

This study was conducted to study the level of knowledge, awareness and willingness on the implementation of polluter pays principle (PPP) among university students in Selangor. This is because there were limited study conducted on knowledge, awareness and willingness among university students regarding PPP and the implementation of PPP in Malaysia is still under discussion. Thus, this study aimed to provide some baseline regarding PPP among university students.

A total of 200 respondents from local public universities in Selangor participated in this study, where majority of the students were female, Malay and forth year students, aged between 20-25 years old. This is normal population observed in the university as more female are involved in higher education and Malays are the majority group in Malaysia.

5.1.2 Level of knowledge, awareness and willingness on Polluter Pays Principle (PPP)

Most of respondents have a moderate knowledge, awareness and willingness on PPP which range between 50-70%. This is consider acceptable as the PPP is consider new policy in Malaysia and yet to be implemented in this country. It was found that number of low score of willingness (score below 50%) is higher as compared to knowledge and awareness. This is because they are students whose are not financial stable would consider how they will spend their money as compare to those who are working, as found in previous study conducted found that more than were willing to pay for improving solid waste management for the sake of environment (Afroz et al., 2017).

It was found that science students have the most number of high level knowledge score (13.2%) as compared to non-science students (3.8%). However, low level of knowledge observed to be more among non-science students (8.1%) as compared to science students (0.9%). This is are closely related to the type of knowledge they perceived in the university. Apart from that, the study also found that there was only slightly difference on the level of knowledge on PPP between UPM and UIAM students with 0.5% of difference. This shows even though UPM is known as one of the top research university in Malaysia, the students' level of knowledge on PPP was not quite difference form UIAM students, same results observed in the level of awareness among these two universities students.

5.1.3 Comparison of knowledge, awareness and willingness between science and non-science courses

Based on the findings on the comparison of knowledge, awareness and willingness level between science and non-science students, it found that there were significant difference in the means of knowledge and awareness level between science and non-science students. This finding supported by a previous study where the researchers stated that different type of educational knowledge received may influence an individual level of awareness on environmental issue as found in previous study that science group students are more aware to their environment as compared to arts group (Hassan & Ratnakar, 2012). A study also found that students from Faculty of Medicine and Health Sciences demonstrated higher level of knowledge on recycling as compared to students from Faculty of Engineering (Nadiah Nordin & Suhainizam Muhamad, 2016). Science students have more knowledge on environmental issue as they are more exposed to this knowledge during the classes as compared to non-science students.

This finding was also similar to a previous study where it was observed that there was a significant difference in environmental awareness among science and arts students, where science students have higher awareness as compared to art students (Jagjit, 2017). Another study also has similar finding, where science students have higher environmental awareness than arts and commerce students (Negar et al., 2017). This may be attribute by the fact that science subjects are related to physical environmental. However, it was found that there was no significant difference

between the level of willingness among science and non-science students regardless of their level of knowledge and awareness.

5.1.4 Relationship between socio-demographic characteristics and the knowledge, awareness and willingness level of the students.

This study found that there was a significant association between courses of respondents with their level of knowledge and awareness, where the number of students who have high knowledge (score 80% and above) were higher (25) among science students as compared to non-science students (8). In addition, it also observed that the percentage of non-science students who have low knowledge is higher than science students which were 9.0%. This is because science students are more equipped with knowledge regarding environmental and science through-out their studies as their courses required them to do so (Hassan & Ratnakar, 2012). This shows that the type of educational background received does has a significant influence on individual's level of knowledge. This is also supported by a study on knowledge, attitude, and practices of recycling among undergraduate students in UPM, where the study found that the Faculty of Medicine and Health Sciences have the highest level of knowledge among respondents, followed by the Faculty of Engineering and the Faculty of Ecology (Nadiah Nordin & Suhainizam Muhamad, 2016).

Furthermore, it also observed that most of the respondents who have high knowledge level were forth year students with a total percentage of 14%, whereas first year and second year students both have the lowest number of 1.0% total high score

students. For low level of knowledge, first year students showed the greatest number of students (4.5%) and the least were forth year (1.0%). This shows that those who has longer duration of study, has more knowledge as they learnt more through their studies. As for level of awareness, it found that science students has more awareness as compared to non-science students with a percentage of 14% as compared to 6%, which closely related to their level of knowledge. In terms of year of study, forth year students has a significant higher level of awareness (13%) as compared to other years, and first year students has to most number of low awareness level (1.5%). It shows that year of study has significant association with the level of awareness among respondents. This supported by a finding where environmental awareness observed was higher among postgraduate students compared to undergraduate students. This due to the chance to learn and expose more environmental related issue are more as their years or study and age are higher (Sharifah Zarina & Aminrad, 2011).

Lastly, there was a significant association between gender and level of willingness, where more females (8%) were willing to participate in PPP as compared to male (4%). This similar to the finding in previous study were female has higher participation level on environmental issue than males (Hassan & Ratnakar, 2012) and also supported by a study that showed female have more willingness to participate in environmental related activities (Hayes, 2001). However, there were no significant association between gender and level of knowledge and awareness, which is similar with the finding conducted in the level of environmental knowledge, awareness, attitudes and practices among UKM students (Arbaat Hassan et al., 2012). According to a study, more women than men said they would recycle and waste segregation. The study shows that women are more likely than men to experience "green guilt," 41% versus just 27% of men. As a result, women are more focused on following through

with their green resolutions. About 41 percent of women compared to 27 percent of men cite eco-friendly living as a daily goal, a national survey finds. The same study showed that more women than men want to use reusable shopping bags and women reduce their household's energy use (Babaei et al., 2015).

5.1.5 Study Limitation

There were some potential limitation in this study, one of them is the sample size. The study population only involved students from two local universities due to time and financial constraints. This might not reflect the whole university students in this state. Secondly, the biases could arise from the self-administered online form questionnaire used in this study. The respondents might not answer the question based on their true knowledge but based on their perception instead.

5.2 Conclusion

The study found most of the respondents (73.5%) have moderate knowledge, (72.5%) have moderate awareness and (69%) have moderate willingness regarding polluter pays principle. From this study, it was found that science students have higher knowledge and awareness on polluter pays principle. This study also found that courses and year of study have important impact on level of knowledge and awareness. Level of willingness showed significant association with gender of respondents, where female students have higher willingness to participate in polluter pays principle.

5.2 Recommendation

For further study, larger sample size is required to increase the reliability, acceptability and representativeness of the study finding. Intervention study can be conducted on the knowledge, awareness and willingness towards polluter pays principle among students. The Government should come out with a strategy to increase their level of knowledge and awareness on PPP before this principle could be implemented in this country as this directly affecting their attitude and participation on PPP. More information regarding PPP should be disseminated to students and the public to enhance their knowledge and awareness on this matter. The university should be used as a good platform to increase our public awareness and knowledge on environmental issues especially regarding solid waste and PPP.

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APPENDICES

ETHICS COMMITTEE FOR RESEARCH INVOLVING HUMAN SUBJECTS
(JKEUPM)
UNIVERSITI PUTRA MALAYSIA

Research title	:	**Assessing the Knowledge, Awareness & Willingness of The Community in Selangor on the Implementation of Polluter Pays Principle And Its Health Impact**
Study Site	:	**Selangor**
JKEUPM Ref No.	:	**JKEUPM-2018-358**
Researcher	:	**Nor Izati Mat Daud**
Supervisor	:	**Dr. Sharifah Norkhadijah Syed Ismail**

Documents received and reviewed with reference to the above study:

1. Ethics Application Form, Version 1 dated 29/10/2018
2. Respondent Information Sheet & Consent (English), Version 2 dated 6/12/2018
3. Proposal (English), Version 2 dated 28/12/2018
4. Questionnaires/ Interviews (English), Version 1 dated 29/10/2018
5. Curriculum Vitae of:
    a. Dr. Sharifah Norkhadijah Syed Ismail

The University Research Ethics Committee, Universiti Putra Malaysia (JKEUPM) operates in accordance the ICH-GCP Guidelines.

Decision by JKEUPM:

[X] Approved

[X] **Permission MUST BE OBTAINED from the respective hospitals/ institutions before conducting the research**

[ ] Disapproved

Please note that the approval is **VALID UNTIL 31 DECEMBER 2019**

Researchers should comply with the following:

I. Complete a Study Final Report upon study completion (Form 3.2).

II. Ethical approval is required in the case of amendments/ changes to the study documents/ study sites/ study team.

III. Applicable for Clinical Trial Studies and Clinical interventional Studies only: Progress Report has to be submitted to JKEUPM at every 6 months from the date of approval (Form 3.1). Report occurrences of all Serious Adverse Events (SAEs), Suspected Unexpected Serious Adverse

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SELANGOR, MALAYSIA

FORM 2.4: RESPONDENT'S INFORMATION SHEET AND INFORMED CONSENT FORM

Please read the following information carefully and do not hesitate to discuss any questions you may have with the researcher.

1. STUDY TITLE :

ASSESSING THE KNOWLEDGE, AWARENESS & WILLINGNESS OF THE COMMUNITY IN SELANGOR ON THE IMPLEMENTATION OF POLLUTER PAYS PRINCIPLE AND ITS HEALTH IMPACT

2. INTRODUCTION:

Waste management is currently one of the major issue face by the government and this issue can be mitigate by prioritizing reduction at the sources. Reduction of waste is the top in the waste management hierarchy, and polluter pays principle is one of the preventive measure in reducing waste production. However, the polluter pays principle (PPP) is yet to implement in Malaysia and public participation is one of the important element in determining the success of the principle. It is crucial to assess the public knowledge, awareness and willingness to be part of the principle. Therefore, this study is designed to assess the knowledge, awareness and willingness of the community on the implementation of polluter pays principle and the impact of this practice on human health. This study provides baseline information to assist the policy maker on the suitability of the implementation PPP.

3. WHAT WILL YOU HAVE TO DO?

Fill in the questionnaire form provided by investigator to collect the information related to the study.

4. WHO SHOULD NOT PARTICIPATE IN THE STUDY?

Students from other university and not Malaysia citizen

5. WHAT WILL BE THE BENEFITS OF THE STUDY:

(a) TO YOU AS THE SUBJECT?

The research will help respondents to incease their knowledge on polluter pays principle and impact of waste management.

(b) TO THE INVESTIGATOR?

Help the investigator to gain information on knowledge, awareness & willingness of the community in Selangor on the implementation of polluter pays principle and its health impact.

6. WHAT ARE THE POSSIBLE RISKS

None. ***The respondents are not entitle to any compesation since this research only involve questionnaire and pose no risk.***

7. WILL THE INFORMATION THAT YOU PROVIDE AND YOUR IDENTITY REMAIN CONFIDENTIAL?

Yes, all of the information given by the respondent will only be used for education purposes and be kept confidential.

8. WHO SHOULD YOU CONTACT IF YOU HAVE ADDITIONAL QUESTIONS DURING THE COURSE OF THE RESEARCH?

Please contact the investigator if you have any questions:

Nor Izati Mat Daud,

Final Year Student,

Bachelor Science (Environmental and Occupational Health),

Faculty of Medicine and Health Sciences,

University y Putra Malaysia.

Email: izatimd2@gmail.com

Phone no.: 017-4142473

*Please initial here if you have read and understood the contents of this page*_____

9. CONSENT

I ..... Identity Card No. .....

address.....

.....hereby voluntarily agree to take part in the research stated above *(clinical /drug trial/video recording/ focus group/interview-based/ questionnaire-based).

I have been informed about the nature of the research in terms of methodology, possible adverse effects and complications (as written in the Respondent's Information Sheet). I understand that I have the right to withdraw from this research at any time without giving any reason whatsoever. I also understand that this study is confidential and all information provided with regard to my identity will remain private and confidential.

I* wish / do not wish to know the results related to my participation in the research

I agree/do not agree that the images/photos/video recordings/voice recordings related to me be used in any form of publication or presentation (if applicable)

* delete where necessary

Signature .....
(Respondent)

Date :.....

Signature .....
(Witness)

Name :.....

I/C No. :.....

I confirm that I have explained to the respondent the nature and purpose of the above-mentioned research.

Date .....

Signature .....
(Researcher)

Date : [ ] ID No : [ ]

QUESTIONNAIRES

RESEARCH TITLE :

ASSESSING KNOWLEDGE, AWARENESS & WILLINGNESS AMONG UNIVERSITY STUDENTS IN SELANGOR ON THE IMPLEMENTATION OF POLLUTER PAYS PRINCIPLE AND ITS HEALTH IMPACT

RESEARCHER NAME:

NOR IZATI BINTI MAT DAUD

This questionnaires consist of 4 sections:

1.	Section A:	Socio-demographic
2.	Section B:	Knowledge on Polluter Pays Principle
3.	Section C:	Awareness on Polluter Pays Principle
4.	Section D:	Willingness on Polluter Pays Principle

Saya..... No Kad Pengenalan. .....
beralamat.....
..... dengan ini bersetuju untuk mengambil bahagian secara sukarela dalam penyelidikan ini. Saya memahami bahawa saya berhak menarik diri dari penyelidikan ini pada bila-bila masa tanpa memberi sebarang alasan. Saya juga memahami bahawa sebarang maklumat yang berkaitan identiti saya akan dirahsiakan.

Tandatangan .....
(*Responden*)

Tarikh :.....

Tandatangan .....
(*Saksi*)

Nama :.....

No. K/P: .....

PART A: RESPONDENT SOCIO-DEMOGRAPHIC BACKGROUND

Please tick (/) in the answer choice box.

1. **Gender** : Male ☐ Female ☐

2. **Race** : Malay ☐ Chinese ☐ India ☐
   Others: _____

3. **Age** : _____

4. **Family Income** : < RM 2000 ☐ RM 2001- RM 3000 ☐
   RM 3000-RM 5000 ☐ > RM 5000 ☐

5. **University:** _____

6. **Current course taken** : _____

7. **Current year of study** : _____

8. **Marital Status** : Single ☐ Married ☐ Divorced ☐

9. **Working experience** : Yes ☐ No ☐

10. **Residence** :Family ☐ Hostel ☐ Renting ☐

PART B: KNOWLEDGE ON POLLUTER PAYS PRINCIPLE (PPP)

Please tick (/) in the answer choice space provided

No.	Question	Yes	No
1.	Have you heard of polluter pay principle or pay-as-you-throw?		
2.	PPP is one of the method used to reduce waste produced.		
3.	In PPP, waste generators should pay based on the type of waste they throw away.		
4.	Current solid waste management system is good enough to manage the waste in Malaysia.		
5.	PPP can alleviate the landfill saturation problem in Malaysia		
6.	PPP is based on the volume and amount of waste being disposed		
7.	PPP applies the concept of polluters have to bear the cost to control, prevent and clean the pollution caused by them.		
8.	PPP is not yet being implemented in Malaysia		
9.	PPP is aimed to increase recycling rate among Malaysian		
10.	Most of waste disposed by Malaysian are actually recyclable		

PART C: AWARENESS ON POLLUTER PAYS PRINCIPLE

Please tick (/) in the answer choice space provided

No.	Question	Yes	No
1.	PPP make me more aware of the cost of waste disposal.		
2.	PPP should be promoted as a recycling best practice.		
3.	I am aware that I have to pay for the amount of trash i throw if PPP is applied		
4.	I think PPP will helps to increased environmental awareness among students.		
5.	I think PPP is an easy policy to enforce.		
6.	More information about PPP should be blast by the government		
7.	PPP is necessary in order to manage solid waste problem in Malaysia		

PART D: WILLINGNESS TO PARTICIPATE IN POLLUTER PAYS PRINCIPLE

Please **tick (/)** in the answer choice space provided

No.	Question	Yes	No
1.	I will support any PPP programme if implemented in the future.		
2.	I am willing to pay if taxes are imposed based on the amount of waste I dispose.		
3.	I think it is difficult for me to participate in PPP.		
4.	I will share information about PPP to family and friends.		
5.	I support public policies that lead to improved waste reduction and reuse		
6.	It is practical for me to pay for the trash that i disposed		
7.	I will support any PPP programme if implemented in the future.		

END OF QUESTIONS

THANK YOU FOR YOUR TIME