



***PERCEPTION, COMPLIANCE AND ECONOMIC VALUATION OF SOLID
WASTE SEPARATION AT SOURCE AMONG HOUSEHOLDS IN
PUTRAJAYA AND MELAKA, MALAYSIA***

IBRAHIM AISHATU OGIRI

FEP 2019 5



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By

IBRAHIM AISHATU OGIRI

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia,
in Fulfillment of the Requirements for the Degree of Doctor of Philosophy**

January 2019

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DEDICATION

To my family for their relentless support and prayers



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in Fulfillment of the Requirement for the degree of Doctor of Philosophy

PERCEPTION, COMPLIANCE AND ECONOMIC VALUATION OF SOLID WASTE SEPARATION AT SOURCE AMONG HOUSEHOLDS IN PUTRAJAYA AND MELAKA, MALAYSIA

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January 2019

Chairman : Associate Professor Shaufique Fahmi bin Ahmad Sidique, PhD
Faculty : Economics and Management

As drastic policy response to curb the menace associated with increasing generation of municipal waste in Malaysia necessitated the introduction of the mandatory recycling programme termed separation at source. However, challenges still exist as participation is still not encouraging. An understanding of what will ensure the success of the programme from the perspective of the target population is very important. This study undertook a multifactorial approach aimed to assess perception towards the waste separation at source recycling programme, identify and evaluate preferences for attributes of waste separation at source facilities and examine determinants of separation at source compliance behaviours among households among households.

A few methods including factor analysis, choice experiment (CE) and structural equation modelling (SEM) were used to address the objectives of this study. A total of 431 and 435 respondents were randomly selected from different housing types in Putrajaya and Melaka respectively. The results of the factor analysis identified two dimensions of perception (fairness and effectiveness) which were used to assess the perception of the households towards the recycling programme. The respondents in both location of study exhibited positive perception both in terms of fairness and effectiveness of the programme. Meanwhile, CE was used to estimate the preference of the households for attributes of waste separation facilities. Beside the importance attach to the provision of multiple recycling bins, interestingly the results suggested households derive utility from increased number of waste separation. SEM was used to validate and test the model that was developed to examine important factors that can enhance compliance towards the waste separation at source recycling programme. Previous studies extensively used the TPB and NAM in waste management studied, this study introduces a new dimension by integrating the TPB

and NAM with the economic deterrence model. Interestingly the results showed that even with the presence of deterrence other psycho-social factors are still important to motivate compliance to recycling programmes. The model explained approximately 64% of the variance in compliance behaviour towards waste separation at source among the respondents. The most salient factors found to influence compliance behaviour include: Attitude, Perceived severity of sanction, Environmental benefit of waste separation, Moral norms and Perceived behavioural control.

The outcome of this study informs policy makers about the much-needed waste separation facilities needed to support households' waste separation. Thus, policy-makers will be able to match household demand and affordability of supply for the facilities. To encourage participation in waste separation activities, a policy mix is needed, to include the provision of appropriate waste separation facilities and moral suasion that would appeal to the households' environmental concern. This is important to help inculcate a waste minimisation philosophy, which would help maximise the social net benefit from recycling, minimise the negative environmental impact of mixed waste disposal, and alleviate the government challenge meeting its 22% target recycling rate by 2020.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**PERSEPSI DAN PEMATUHAN TERHADAP PENGASINGAN PADA
PROGRAM SUMBER DAN PENILAIAN EKONOMI ATRIBUT KITAR
SEMULA DALAM KALANGAN PENGHUNI DI PUTRAJAYA DAN DI
MELAKA MALAYSIA**

Oleh

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Sebagai tindak balas dasar yang drastik untuk membendung ancaman yang dikaitkan dengan penjanaaan sisa perbandaran di Malaysia memerlukan pengenalan program kitar semula wajib yang dipanggil pemisahan di sumber. Walau bagaimanapun, cabaran masih wujud kerana penyertaan masih tidak menggalakkan. Pemahaman tentang apa yang akan menjamin kejayaan program dari perspektif populasi sasaran adalah sangat penting. Kajian ini menjalankan pendekatan multifactorial yang bertujuan menilai persepsi terhadap pemisahan sisa di program kitar semula sumber, mengenalpasti dan menilai sifat-sifat pemisahan sisa di kemudahan sumber dan mengkaji penentu pemisahan pada tingkah laku pematuhan sumber di kalangan isi rumah.

Beberapa kaedah termasuk analisis faktor, eksperimen pilihan (CE) dan pemodelan persamaan struktur (SEM) digunakan untuk menangani objektif kajian ini. Sebanyak 431 dan 435 responden dipilih secara rawak dari pelbagai jenis perumahan di Putrajaya dan Melaka. Hasil analisis faktor mengenalpasti dua dimensi persepsi (keadilan dan keberkesanan) yang digunakan untuk menilai persepsi keluarga terhadap program kitar semula. Responden di kedua-dua lokasi kajian menunjukkan persepsi positif baik dari segi keadilan dan keberkesanan program. Sementara itu, CE digunakan untuk menganggarkan keutamaan isi rumah untuk sifat-sifat kemudahan pemisahan sisa. Di samping kepentingan melekat pada penyediaan sampah kitar semula, menariknya, keputusan yang dicadangkan oleh isi rumah membangkitkan utiliti daripada peningkatan jumlah pemisahan sisa. SEM digunakan untuk mengesahkan dan menguji model yang dibangunkan untuk mengkaji faktor-faktor penting yang boleh meningkatkan pematuhan terhadap pemisahan sisa di program kitar semula sumber. Kajian terdahulu secara meluas menggunakan TPB

dan NAM dalam pengurusan sisa yang dikaji, kajian ini memperkenalkan dimensi baru dengan mengintegrasikan TPB dan NAM dengan model pencegahan ekonomi. Menariknya hasilnya menunjukkan bahawa walaupun dengan adanya pencegahan faktor psiko-sosial yang lain masih penting untuk memotivasi pematuhan kepada program kitar semula. Model ini menjelaskan kira-kira 64% daripada varians dalam tingkah laku pematuhan terhadap pemisahan sisa di sumber di kalangan responden. Faktor-faktor yang paling menonjol yang dapat mempengaruhi tingkah laku pematuhan termasuk: Sikap, Keterikan sanksi yang diakui, Manfaat alam sekitar pemisahan sisa, norma Moral dan kawalan tingkah laku yang Diperhatikan.

Hasil kajian ini memberitahu para pembuat dasar mengenai kemudahan pemisahan sisa yang diperlukan untuk menyokong pemisahan sisa isi rumah. Oleh itu, pembuat polisi akan dapat menandingi permintaan isi rumah dan kemampuan bekalan untuk kemudahan itu. Untuk menggalakkan penyertaan dalam aktiviti pemisahan sisa, satu campuran dasar diperlukan, termasuk penyediaan kemudahan pemisahan sisa yang sesuai dan penceriaan moral. Ini penting untuk membantu memupuk falsafah meminimumkan sisa, yang akan membantu memaksimumkan manfaat bersih sosial daripada kitar semula, meminimumkan kesan negatif alam sekitar pembuangan sampah campuran, dan mengurangkan cabaran kerajaan 22% kitar semula menjelang 2020.

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To my late Dad and Brothers, may Aljannat fiddausi be your final abode (*Amin*).

This thesis was submitted to the Senate of the Universiti Putra Malaysia and has been accepted as a fulfillment of the requirement for the degree of Doctor of Philosophy. The members of the Supervisory Committee were as follows:

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LIST OF ABBREVIATIONS

AMOS	Analysis of Moment Structures
CE	Choice experiment
CFA	Confirmatory Factor Analysis
CFI	Comparative fit index
CLM	Conditional logit model
CMIN	Minimum Value of the Discrepancy
DF/ <i>df</i>	Degree of Freedom
DT	Deterrence Theory
EEA	European Environment Agency
EPA	Environmental Protection Agency
EPN	Environment Paper Network
GFI	Goodness-of-Fit Index
GHG	Green House Gas
IFI	Incremental Fit index
JICA	Japanese international co-operation agency
INECE	International Network for Environmental Compliance and Enforcement
ISWM	Integrated Solid Waste Management
KLIA	Kuala Lumpur International Airport
MHLG	Ministry of Housing and Local Government
MLM	Mixed logit Model
MSW	Municipal solid waste
NAM	Norm activation model
<i>P</i>	Level of Significance
PPJ	Perbadanan Putrajaya (Putrajaya Holdings)
R ²	Coefficient of Determination
RP	Revealed preference

RPL	Random Parameter logit Model
SAS	Separation at source
SEM	Structural equation model
SP	Stated Preference
SW	Solid Waste
SWCorp	Solid Waste Management and Public Cleansing Corporation
TPB	Theory of planned behaviour
TRA	Theory of Reasoned Action
SWM	Solid Waste Management
UNEP	United Nations Environment Programme, Basel Convention
UNDP	United Nations Development Programme
UPM	Universiti Putra Malaysia
WTP	Willingness to Pay

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Rapid industrialisation has availed humanity the opportunity to produce in mass, to match aggregate demand arising from rapid population growth, urbanisation, and increased affluence, leading to a continuous increase in household consumption. These phenomena resulted in the generation of tremendous volume of solid waste, a rapidly growing predicament in urban centres around the world.

Solid waste (SW) is the by-product of human activities, tending to increase with rapid urbanisation, improved standard of living, and changing consumption patterns (Moh & Abd Manaf, 2014).

Over the past decades, solid waste generation and disposal have emerged as one of the pressing health, environmental and revenue-depleting issues facing both developed and developing countries. Managing solid waste has become increasingly difficult and challenging for municipalities with increasing population, urbanisation, and prosperity. It is described as a problem created by mankind through thoughtless act of consumerism (Sebastian, 2010).

Malaysia, like other rapidly developing countries, is faced with the challenges of managing the increasing volume of waste. As highlighted in the United Nations Development Programme report (UNDP, 2008), solid waste management poses a major challenge for Malaysia, which needs to be addressed to enable achievement of Vision 2020. Vision 2020 encompasses strategy directions for Malaysia to reach the status a fully developed nation by 2020.

Malaysia has been experiencing rapid growth in population, urbanisation, and industrialisation. These rapid developments have resulted in the production of greater amounts of municipal solid wastes. The production of municipal waste increases at an annual rate of 5.19% (JPSPN, 2012). The daily amount of solid wastes produced in recent times has reached approximately 33,000 tons, which exceeds the projected generation of 30,000 tons by 2020 (SWcorp, 2015). As such, the projected municipal waste generation is expected to reach 49670 tons/day by the year 2020. Figure 1.1 shows the trend in waste generation in Malaysia from 2015 to 2020.

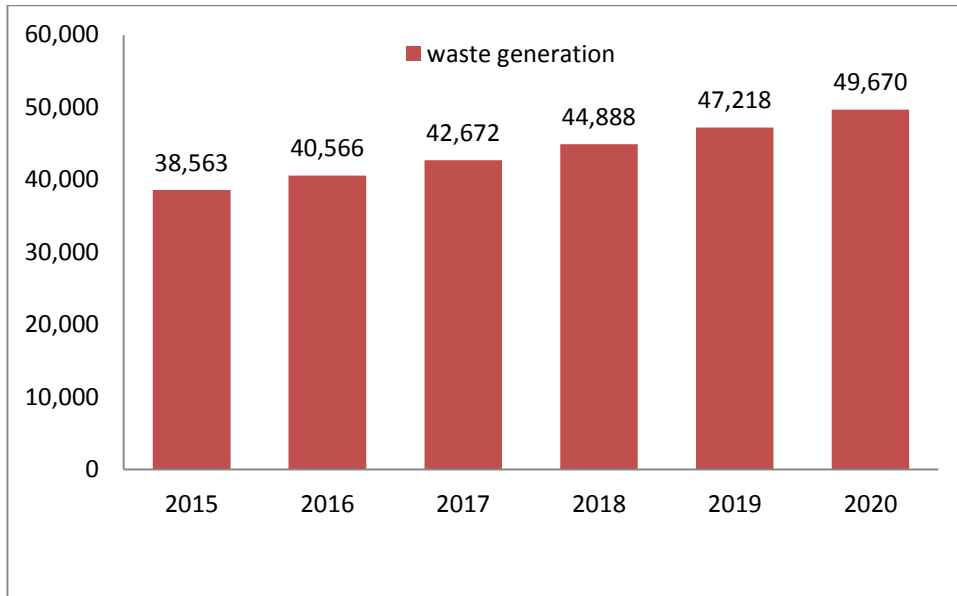


Figure 1.1 : Increasing trend of Municipal solid waste from 2015 to 2020
(MHLG, 2015)

According to Johari et al. (2014), the main source of municipal solid waste is from residence (48%), followed by commercial waste (24%), industrial and construction waste (4%), institutional waste (6%), landscape conservation (7%) and street cleaning (11%). Figure 1.2, below, shows the contribution to municipal solid waste (MSW) by different sectors. About 70-80% of households' waste consists of recyclables, but is disposed of in the landfills despite high potentials for recycling (Johari et al., 2014; Moh & Abd Manaf, 2014)

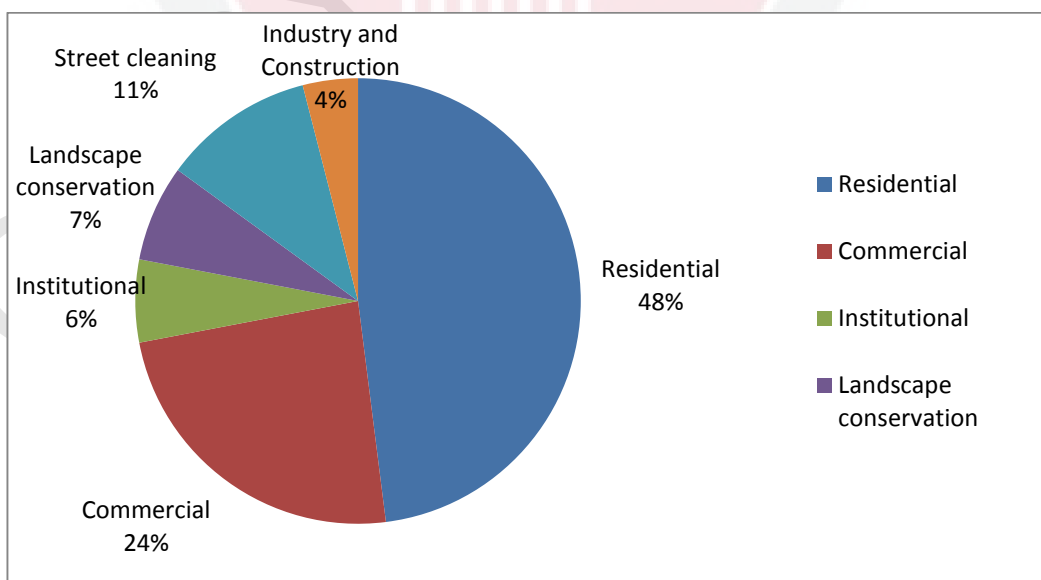


Figure 1.2 : Composition of municipal solid waste by sector
(Source : Johari et al., 2014)

Landfill disposal is one of the most preferred means of waste disposal in Malaysia, because it is cost-effective. However, increasing rises in waste generation pose challenges to solid waste disposal via landfilling. Quite a number of the existing landfills are near their threshold or have already exceeded their utmost capacities (Moh & Manaf, 2014). Of the 297 landfills in Malaysia, only 166 are operational which cater for more than 95% of the waste generated in the country (MHLG, 2015; Pariatamby, 2017). Out of the 166 operational landfills only 10 are considered as sanitary (MHLG, 2015). Table 1.1 presents statistics on landfills facilities in Malaysia. Construction of new landfill sites has become even more burdensome due to the increasing opportunity cost of land arising from the population increase and urbanisation (Aja & Al-Kayiem, 2014; Manaf et al., 2009). Society is becoming more aware of negative externalities arising from solid waste disposal facilities; thus, siting new landfills is more challenging as residents adopt a not-in-my-backyard attitude (NIMBY).

Table 1.1 : Landfill facilities as at 2015

State	Landfills in operation		Landfills not in operation	Total
	Sanitary	Non-Sanitary		
Johor	1	13	23	37
Kedah	1	7	7	15
Kelatan	-	13	6	19
Melaka	1	2	5	8
N. Sembilan	-	7	11	18
Pahang	-	16	16	32
Perak	-	17	12	29
Perlis	-	1	1	2
Pulus Pinang	1	2	1	3
Sabah	-	19	2	21
Sarawak	3	46	14	63
Selangor	3	5	14	22
Terengganu	-	8	12	20
WP KL	-	0	7	7
WP Labuan	-	1	0	1
Total	10	156	131	237

(Source : MHLG, 2015)

Landfilling of solid waste is identified as a major source of environmental contamination, leading to emissions of leachate and greenhouse gas (GHG). These emissions lead to water and air pollution that spreads diseases (Agamuthu & Fauziah, 2011; Fauziah & Agamuthu, 2012). For instance, improper landfilling contaminated a drinking water source in Klang Valley, leading to a public uproar in 2007 (Fauziah & Agamuthu, 2012). Landfills are the major source of GHG, and household waste is the second largest contributor to GHG after the energy sector, the households contributed 20% to the greenhouse effect (Malaysia's second national communication (NC2) report, 2000).

The collection and disposal of municipal solid waste (MSW) is a burden and costly obligation for local governments. Increasingly, large proportions of many cities' budgets are being devoted to solid waste management (SWM; UN-HABITAT, 2010). Hoornweg and Bhada-Tata (2012) estimated the global SWM costs \$205.4 billion annually, and is projected to cost \$375.5 billion by 2025. The provision of proper SWM in Malaysia takes a major portion of the total local area (LA) budget. It was projected to engulf of more than 60% of the annual LA budgets (Agamuthu & Fauziah, 2011; Masirin et al., 2008). The Malaysian government spends approximately RM 2 billion annually to provide SWM services (New Straits Times, Sept. 2015).

These situations create an urgent need for a more efficient and sustainable waste management practices in the country.

1.1.1 Sustainable Waste Management

A more comprehensive method is required to deal with the rise of solid waste which incorporates solid waste prevention prior to generation and management after generation, termed as integrated solid waste management (ISWM) (Hoornweg & Bhada-Tata, 2012). This is mostly encouraged through reduce, re-use, and recycle (3R). However, emphasis on recycling as a means of waste diversion from the landfills and a sustainable waste management strategy has represented a change in the method of waste collection and disposal via landfills. Waste diversion is crucial as future demand for solid waste collection services are expected to increase with an increase in population (Coffey & Coad, 2010).

Under Act 672 "Recycling" is defined as the separation of solid waste and collection for the purpose of producing products (Pariatamby, 2017). Furthermore, (Moh & Abd Manaf, 2017) define "Household recycling as involving the separation and placing the right recyclables materials in the right bin. Additionally, household recycling entails sorting household waste which the outcome reduces the problem of increasing solid waste generation and resource depletion (Halvorsen, 2012). The adoption of recycling as sustainable strategy for waste management saw the emergency of a number of mandatory and voluntary programmes for waste source separation of recyclables materials. A waste source separation programme requires the target participant to separate recyclable materials into one of more fractions for collection (Tchobanoglous & Kreith, 2002). This is because recyclables separated at source produces cleaner and higher quality materials than those recovered from mixed waste (Moh & Manaf, 2017). Recycling through waste separation is believed widely as an acceptable means of sustainable solid waste management method. Zen and Siwar (2015) noted that household recycling is one of the most important alternatives of diverting the increasing amount of municipal solid waste that cannot be fully disposed in the available landfills. Thus, household recycling helps to alleviate the problems municipal solid waste management by diverting materials with economic value away from the waste stream, thereby reducing cost of collection and disposal, and prolonging the life span of the landfill sites. Household

recycling also offers great economic and environmental benefits, including providing better quality and less contaminated recycling materials, conservation of natural resources, reducing negative environmental and health impacts, and providing job and revenue generation opportunities (Aphale et al., 2015; Johari et al., 2014; Owusu et al., 2013). However, household recycling and waste separation remains minimal despite the dominance of recyclable materials in the municipal waste stream.

Participation by the household is required to ensure proper waste separation at source. Thus, household will choose to participate in waste separation at source if it is designed in such a way that it provides them a certain level of utility. The sorting of the household waste at source will therefore be based on the unobserved utility obtained from participating in waste separation at source (Tadesse, 2009). This utility is not direct in that it is random. In other words, it is only the utility maximizing variables that could be observed and not the utility *per se* (Tadesse, 2009). Hence, the utility model which is utilized to explain waste separation is based on the assumption that household's participation results from its preference for waste separation attributes and other behavioural and judicial (Penalty) factors.

1.1.2 Waste Management Policies in Malaysia

Responding to the urgency for proffering solution to the increasing generation of solid waste and the limited capacity in dealing with it, the Malaysian Government, under the ministry of housing and local government, formulated several SWM plans over the years. Figure 1.3 shows an overview of national solid waste management policies and plan strategies in Malaysia.

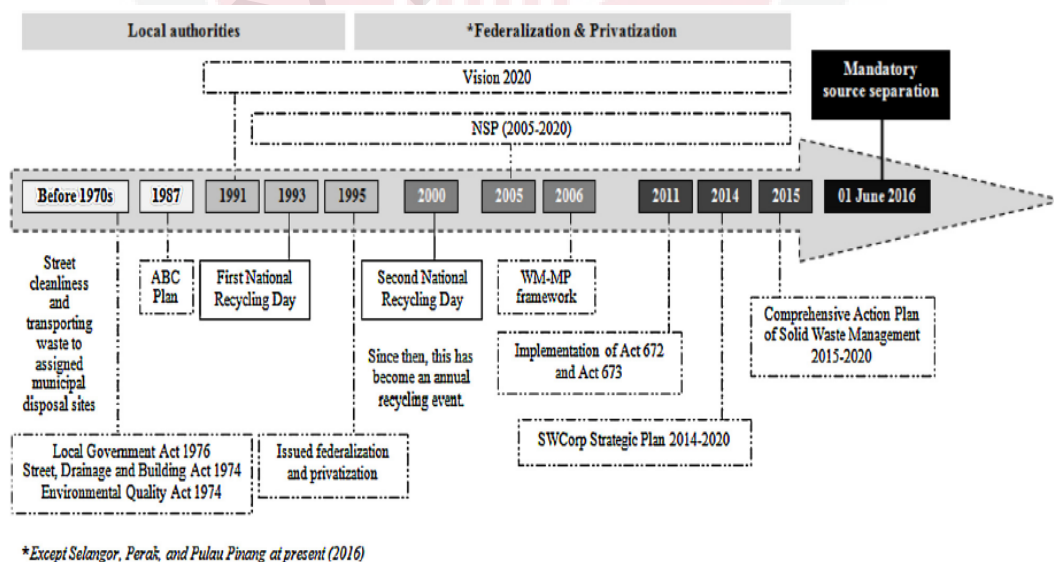


Figure 1.3 : Overview of national solid waste management policies and plan strategies in Malaysia
(Source : Moh, 2017)

The action plan for beautiful Malaysia (ABC plan, 1987) saw the introduction of the first National Recycling Campaign in 1993 (JICA, 2006). However, the scheme suffered setbacks, as it was characterised by a lack of appropriate policies, a lack of a master plan for recycling or separation at source, and a poor public response (JICA, 2006; Moh & Manaf, 2014). The failure of the first national recycling program was followed by a re-launch in December 2000, with the primary objective of inculcating the habit of reduce, reuse, and recycle (termed “the 3Rs”) in the populace (Moh & Manaf, 2014). This was hoped to ultimately lead to a reduction in landfill disposal and expenditure on SWM and reduce the importation of waste.

To disseminate information and create awareness, massive campaigns appeared on the television, in newspapers, through electronic media, on billboards, and through exhibitions and carnivals with the tagline, ‘Think before you throw’ (JICA, 2006; Moh & Manaf, 2014). In 2001, the 11th of November was established as national recycling day, during which lots of publicity about recycling appeared (JICA, 2006).

The ABC plan also saw the subsequent federalisation and privatisation of SWM in 1996. Three solid waste concessionaries, Idaman Bersih Sdn Bhd, Alam Flora Sdn Bhd, and Southern Waste Management, were awarded the responsibility of managing municipal solid waste in the Northern, Central, and Southern regions, respectively (Manaf et al., 2009). The federalisation and privatisation of solid waste management were deemed necessary because of lack of; finance, expertise, proper strategies to handle illegal dumping, and open burning of waste by the local authorities (Fauziah & Agamuthu, 2012).

To deal with the growing problems posed by SW in the country, the National Policy on Municipal Solid Waste Management, also referred to as the National Strategic Plan (NSP), was mapped out in 2002, and later adopted in 2005, to succeed the ABC plan (JICA, 2006). The NSP’s key strategy aims to achieve sustainable WM through waste reduction, re-use, and recycling, hoping to increase the diversion of waste from the landfill sites. The plan was also intended to integrate economic development and stakeholders’ needs to improve SWM system (Moh & Abd Manaf, 2017). Figure 1.4 below, shows the waste hierarchy adopted by the NSP. In addition, a draft concession agreement between the Malaysian government under the NSP and the concessionary companies providing waste management targeted 22% recycling, 8% composting, 16% incineration, and 50% landfilling by 2020 (Johari et al., 2014).

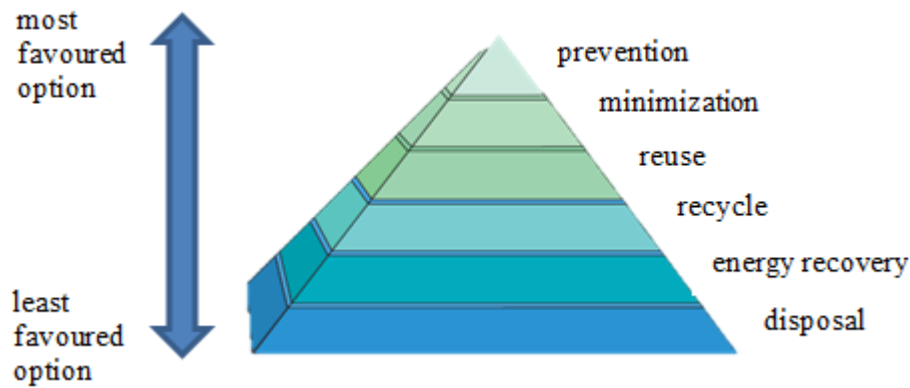


Figure 1.4 : Waste minimisation strategy

(Source : Japan International Cooperation Agency JICA, 2006)

Despite the government initiatives to boost recycling practices among the populace, mixed waste disposal remains a lingering problem. Though awareness of recycling increased significantly from 79% in 2002 to almost 100% in 2003, participation is still low (Moh & Manaf, 2014). Recycling rates in the country remain low, at 10.5%, compared to other Asian countries, including Singapore at 61%, Thailand at 22%, Korea at 66%, Taiwan at 60%, and Japan at 77% (Moh & Abd Manaf, 2017; SWcorp, 2015). In addition to creating awareness, the MHLG provided recycling facilities to the public, like drop-off and recycling centres (RC) and buy back centres (BBC), and placed more than 10,797 bins (240 and 360 litres) and 3,950 bins (660 litres) at public places and collection centres, respectively (Zen & Siwar 2015; JICA, 2006). Despite issuing guidelines for use and maintenance of the bins, gross misuse of these facilities occurred. Thus, the household's response to various spur of pro-environment behavioural change remains complex, as evident in the failure of the various recycling programmes.

The situation is further aggravated by the fact that the fee for SWM, which is estimate at approximately RM15 premises (NSWMD, 2012) is financed through the property tax, which is paid as a share of annual house assessment (Afroz & Masud, 2011; Pek & Jamal, 2011). Hence, for most Malaysians, the cost of throwing away an additional item has been zero. Thus, voluntary recycling efforts by the household without any form of incentive can only achieve limited results. These situations, according to Agamuthu and Fauziah (2011); Moh and Abd Manaf (2014), are due to the lack of appropriate policies for MWM found in most developed countries.

Therefore, with the largely hidden cost of solid waste disposal and lack of an appropriate policy to promote waste minimisation among households in the county, it is obvious why the "throwaway ethic" has thrived. To instil recycling habits among households, there is a need for a systematic change in policy measures that will change the behaviour of waste generators (Taylor, 2000).

The Malaysian government, in accordance with the solid waste and public cleansing management (SWPCM) act 2007 (Act 672), implemented waste separation at source programme as an effort to promote sustainable WM. This is to serve as an incentive to overcome the populace's poor recycling habit and transform the "throw-away" culture to that of a "conserving" one. The separation at source programme, henceforth referred to as SAS programme, mandates that beginning 1st September 2015, households within the area of jurisdiction are to separate their household waste before dropping off for collection. Households are required to separate their recyclable waste according to composition, like paper, plastic, and miscellaneous recyclables, and place beside the garbage bin on collection days (SWCorp, 2015). Failure to do so will attract a fine of RM50 for the first offense, RM100 and RM200 for subsequent offenses, and failure to pay the fine attracts a court charge with a maximum of RM1000 (Moh & Manaf, 2014).

The enforcement of the act, according to the then Deputy Prime Minister Tan Sri Muhyiddin Yassin, is part of the government's effort to reduce disposal of solid waste to landfills, which is becoming worrisome (Bernama, 2015). The enforcement of the programme is perceived as one of the best methods to discipline society while instilling civic consciousness and a first-class mentality in the populace (The Daily Express, 2015).

The enforcement of the act will begin with the states of Johor, Melaka, Negeri Sembilan, Pahang, Kedah, and Perlis, and the Federal Territories of Kuala Lumpur and Putrajaya. The main targets of the programme are the households, as they contribute the major part of MSW (as depicted in Figure 1.2, above). The programme enforcement attempts to reap the environmental and economic benefits of recycling by inculcating the habit of recycling through SAS among Malaysian households, since various previous efforts by government and its agencies did not achieve the desired results.

1.2 Problem Statement

Due to the rising costs of solid waste disposal, landfill scarcity and crisis, public resistance, and materials recovery and revenue potentials, recycling activities have become a more attractive element of waste management strategies across the globe. However, despite concerted effort by the Malaysia government to encourage recycling amongst households, statistics show a low recycling rate of 10.5%. This necessitated the implementation of the waste separation at source programme (SAS). Correspondence with officials of the SWCorp during a focus group discussion in April 2017 revealed that despite the implementation of the SAS programme, households still fail to sort their waste. Visits to the study sites revealed that not all households comply with the programme directives. Therefore, challenges still exist for successful waste separation practices. This is buttressed by Moh and Abd Manaf (2017) argument that despite the implementation of the SAS programme, challenges still exist in achieving the nation's target of 22% recycling by 2020. Understanding people participation in recycling programmes can be very complex and would require a multifactorial approach (Graham-Rowe et al., 2014). As such it is

important to assess the recycling needs of the households as well as determine what motivates their participation (Seacat & Boileau, 2018).

The success of any recycling programme (such as the on-going SAS programme) largely depends on household participation (Kipperberg, 2007; Kuo & Perrings, 2010). Hence, one of the core strategies of the SWCorp, as stated in its 2014-2020 strategic plan, is to “transform the public mind-set into a sense of responsibility” for a cleaner environment. This implies that the continued commitment and participation from the public is essential for the success of the programme and to achieve Malaysia’s target of 22% recycling rate by 2020.

Previous household recycling programmes involving voluntary participation did not result in much success, as evident in the failure of various recycling campaigns. Surveys on barriers to household recycling participation indicated that more than 70% of Malaysians stated that they failed to separate their waste because the recycling facilities were not provided or are insufficient (Fauziah et al., 2009). However, a survey on recycling participation in Malaysia, conducted by JICA (2006), concluded that recycling facilities were adequately provided but was grossly misused. A question raised is whether the facilities were provided in accordance with the preference of the consumers. Moreover, these facilities were mainly provided at the public level, despite the need for recycling facilities at the household level.

Though waste separation can be an inconvenient task, Wright (2012) emphasised that household participation in waste separation programmes can be enhanced when the programmes design incorporate facilities most preferred by households. This is essential as it will enhance convenience, thereby assuring high participation. However, solid waste management studies in Malaysia did not precisely evaluate preferences for household waste separation facilities; rather, these studies only include waste separation by the household as an attribute of an envisaged waste management improvement services (Afroz & Masud, 2011; Othman, 2007). Limited studies exist on households’ preferences for waste separation facilities, namely (Czajkowski et al., 2017; Gillespie & Bennett, 2013; Karousakis & Birol, 2008; Yuan & Yabe, 2014), which were conducted in London, China, and Poland, respectively.

Information based on people’s preferences is important for SWM policy decisions. As such, to encourage household participation in the SAS programme, an evaluation of household preferences for attributes of waste SAS facilities will provide useful information on the most preferred attributes. Additionally, formation of preferences is a dynamic process, hence it is essential to examine and re-examine the preferences of household for household recycling after a programme has been implemented (Wright, 2012). Therefore, this study employed choice experiment stated preference technique of economic valuation to assess household preference for attributes of waste separation at source facilities.

While assessing the preference for attributes of SAS facilities is essential for motivating participation in waste separation at the household level, Pouta and Rekola (2001) noted that models based exclusively on the traditional stated preference (SP) often fall short of providing an adequate understanding of partaking in and supporting a program. This could be because the environmental good in question is a cause worth supporting irrespective of the household demand for waste separation facilities. Moreover, simply implementing an intervention programme like the waste SAS does not automatically translate into desirable behaviour (Stanton et al., 2005). More needs to be done to ensure compliance with the SAS programme. Thus, while the SAS programme and the presence of penalty for non-compliance is expected to increase recycling among households, there is a need for the policymakers to understand the association between such a policy instrument and the target population compliance behaviour. This will further strengthen the programme strategy while addressing public demand. A critical challenge in household recycling practices is the public behaviour towards imbibing separation of waste at source. To investigate factors that motivate behaviour towards complying with the programme directives, this study integrated behavioural models, including Theory of Planned Behaviour (TPB) (Ajzen, 1991), the Norm Activation (NAM) (Schwartz, 1977), the Economic Deterrence Theory (Becker, 1968), and awareness on environmental benefits of separation at source.

Therefore, in addition to assessing the preference of the households for attributes of SAS facilities, understanding what drives compliance could contribute to figure out strategies to promote compliance towards the programme among households.

Review of literature revealed studies that examine factors determining compliance with organisation policy and tax compliance (Bobek et al., 2013; Cheng et al., 2013; Ifinedo, 2014; Smart, 2013a), forest rule compliance (Ramcilovic-Suominen & Epstein, 2015), and traffic rule compliance (Poulter et al., 2008). To the best of the researcher's knowledge, no study studied the determinants of compliance towards mandatory source separation programme. Most of the reported research was an evaluation of voluntary recycling programmes. Only one exploratory study by Smeesters et al. (2003) assessed mandatory household recycling. Therefore, in addition to determining attributes of waste separation facilities, this study also examines compliance with the SAS programme by developing and testing an integrated model for compliance behaviour. This could provide a new model for examining compliance behaviour with household recycling or waste separation at source.

Understanding the perception of households is a prerequisite for success of intervention programmes (Saad, 2010a). With an understanding of the perception of a target population towards a programme as well as on perception on the attributes of waste separation facilities, better lessons can be learned for reassessment. Intervention programmes need to understand that the perception of a target group as a "one size fits all" approach to a programme does not ultimately achieve the highest household recycling rates (Lane & Wagner, 2013). However, given the importance

of assessing perception towards an intervention programmes, there is generally a lack of understanding on the perception towards the SAS programme among Malaysians, which could result in the failure of the programme (Moh & Abd Manaf, 2017). More so, if a positive perception toward an intervention programme is established, they will show preference for the various attributes of waste separation facilities. The perception of the households on the preference for the attributes of waste separation is expressed in monetary value for each attribute (Limburg et al., 2002). In view of this, while objective one captures the acceptability of the waste separation at source programme by the target population through their perception of the programme, objective two further establish perception towards the SAS programme by estimating the preference for attributes waste separation at source. This is expressed in terms of utility (expresses in monetary value) derived from the provision of the waste separation at source attributes. Therefore, given that the ongoing separation at source programme is relatively new, an understanding of the perception of the households towards the programme and on the various attributes could be relevant for programme reassessment.

Since the SAS programme is relatively at the infant stage, a comprehensive view of the programme from the perspective of the target population becomes essential. Hence, this provides a timely opportunity for researchers to explore and analyse preferences of the households in terms of SAS attributes, motivating factors that could maximise compliance, and assess the household perception of the programme. These could help shed light on performance improvement measures of the SAS programme, thereby maximising social net benefit from recycling, minimising negative environmental impact, and contributing to meeting the 22% recycling by 2020.

1.3 Research Objectives

The aims of this study are to evaluate the preference for separation at source attributes, examine the determinants of compliance, and assess perception towards the separation at source programme among households. The following are the specific objectives of the study:

- i. To determine the households' perception towards the separation at source programme.
- ii. To determine preferences for attributes of waste separation facilities.
- iii. To develop a compliance behaviour model that can be utilised to explain participation in the separation at source programme.

1.4 Significance of Study

Solid waste generation has become an issue of global concern. Policy-makers around the world responded by designing policies to reduce the quantum of waste volumes, by encouraging recycling through waste separation. Waste separation is considered

the best alternative for waste diversion from the landfill. This study was envisaged to contribute to literature, policy, and serve as a guide for stakeholders in SWM.

Since the households are identified as the major contributors to MW in Malaysia, sustainable management of household waste is important to curtail its adverse impact on health, environment, and finances. The enforcement of the SAS programme is anticipated to serve as a policy incentive to encourage and instil recycling behaviour among Malaysians. The households' response to the SAS programme could be an important outcome of interest to policymakers for programme assessment.

Indicators of the acceptability of the programme, and the varying perception based on respondents' location, are provided by how the households perceive the waste separation policy. This could aid in any needed re-evaluation of the programme to ensure increased household participation, resulting in a lesser burden on the households and the regulators.

This study used choice experiment technique to identify attributes of household recycling facilities most desired by households. This could prevent a mismatch between what is provided by the MSW service providers and what is desired by the households. Identifying such preferences could increase participation, as the households are provided with facilities to suit their convenience. It is also necessary to prevent reversion back to former behaviours once interventions have ended (Hensher et al., 2005). More so, this study contributes by providing estimates of the value of multiple service alternatives. This could help relevant authorities to prioritise heterogeneous household recycling attributes.

Since the incorporation of economic valuation techniques in the Malaysian national policy on the environment in 2002, there has been enthusiasm in applying it to value environmental goods and services. However, the review of literature revealed a lack of studies on economic valuation on household recycling attributes using the CE approach in Malaysia. Studies identified as applying economic valuation using CE on municipal solid waste management were limited to general improvement in waste management and view household waste separation as part of the improvement in SWM. This study, therefore, adds to the body of literature on the application of CE in waste management studies specifically regarding to waste separation at source. The application of this technique on waste separation at source would be the first attempt in Malaysia, and Putrajaya and Melaka, specifically.

Deterrence in the form of penalty for non-compliance alone is not sufficient enough to motivate compliance with the waste SAS programme. Therefore, this study adds to the body of literature on pro-environmental behaviour, by developing an integrated model for examining compliance. This can be translated into strategies to enhance waste SAS practices. This is important, as it could provide relevant non-market motivation requiring intervention via campaigns. Hence, assessing the

determinants of households' compliance with the SAS programme, especially ex-post, could provide necessary information on what drives compliance. This is imperative to ensure future success in policy implementation, thereby improving waste separation activities. This could contribute to ensuring the success of the programme in achieving the 2020 target of 22% recycling. This study also serves as relevant materials for further research in solid waste management.

1.5 Scope of study

This study focuses mainly on households as the unit of analysis, because the SAS programme's main target is the households, since they contribute the major part of the MSW. The participation of this sector of municipality is identified as a very vital factor in the success of recycling programme. However, a poor recycling habit is evident despite their considerably high awareness of recycling and its possible impact on the environment. To inculcate the habit of recycling among the Malaysia household saw the implementation of the mandatory waste separation at source programme. Identifying waste separation attributes most preferred by the household and what behavioural factors motivate are important yardstick for successful outcome of intervention programmes. This study therefore, estimate attributes of waste separation that are considered preferable to the household. On the other hand, aside provision of physical waste separation facilities, important behavioural factors that can influence participation to the programme directives were also determined. The present study surveyed selected residential precincts in Putrajaya and districts in the state of Melaka, where the SAS programme is implemented. Besides, based on the strong correlation between population growth and waste generation (Kaza et al., 2018) these two locations were surveyed for the present study. According to the 2010 population census, Putrajaya recorded highest population growth of about 17.8%. On the other hand, Alor Gajah recorded the highest population growth among the districts in Melaka. Melaka, considered a historic city by UNESCO in 2008 and the third smallest city in Malaysia, rank third (2.65%) after Selangor. These two cities also had previous experience of recycling where less success was recorded. This study would unveil how households' perceive the SAS programme, preferences for household recycling attributes, and determinants of household compliance with the programme.

1.6 Definition of key terms

Solid Waste (SW)	According to the Malaysian laws “Act 672” Solid Waste is defined as: 1) Any scrap material or other unwanted surplus substance or rejected products rising from the application of any process. 2) Any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled. 3) Any other material that according to this Act or any other written law is required by the authority to be disposed of, but does not include scheduled wastes as prescribed under the Environmental Quality Act 1974 (Act 127), sewage as defined in the Water Services Industry Act 2006 (Act 655) or radioactive waste as defined in the Atomic Energy Licensing Act 1984 (Act 304). (Pariatamby, 2017)
Municipal Solid Waste (MSW)	Part of solid waste, including: 1) Any scrap material or other unwanted surplus or rejected products arising from the application of any process. 2) Any substance required to be disposed of as being broken, worn out, contaminated or otherwise spoiled or any other material that according to Solid Waste and Public Cleansing Management Act 2007. 3) Any other substance according to other written laws, that is required by the authority to be disposed of, including: public waste, imported waste, household waste, institutional waste, commercial waste (Borongon & Okumura, 2010)
Waste Generation (WM)	Generation refers to the amount of materials and products in MSW as they enter the waste stream before any materials recovery, composting, or combustion take place (Tchobanoglous & Kreith, 2002)
Integrated Waste Management (IWM)	Selection and application of suitable techniques, technologies, and management programs to achieve specific waste management objectives and goals (Tchobanoglous & Kreith, 2002).
Household Solid Waste (HSW)	Waste produced by normal household activities (Zhang et al., 2015)
Recycling	Act 672, defines recycling as the separation and collection solid waste for the purpose of producing products(Pariatamby, 2017) Recycling returns raw materials to market by separating reusable products from the rest of the municipal waste stream (Tchobanoglous & Kreith, 2002)
Waste separation at source	Entails separating waste into required categories (Halvorsen, 2012) Process by which waste is separated into different elements at the household or through curbside collection (Xu et al., 2017). it involves separating solid waste according to waste compositions and collected on fixed schedules (MHLG, 2015 http://www.kpkt.gov.my/separationatsource/en/)
Landfill	Landfills are physical facilities used to dispose waste on land space and ideally, should be considered as the final disposal option for unrecovered waste (Tchobanoglous & Kreith, 2002)
Act 672	An Act to provide for and regulate the management of controlled solid waste and public cleansing for the purpose of maintaining proper sanitation (Pariatamby, 2017)

1.7 Chapter Disposition

This study consists six chapters. Chapter One presents an overview of the background of the study to buttress the problem statements. The chapter also highlights the aim and objectives of the study, the significance of the study, and the scope of the study.

Chapter Two and Three focuses on a review of literature, including models in economics and psychology. Chapter Two review theoretical literature on the use of stated preference technique in economic valuation of non-market goods and also review empirical studies on the use of the CE technique in WM studies. Chapter Three on the other hand, reviewed attitudinal-behavioural theories applicable to compliance behaviour. The chapter also reviewed empirical studies that employ these theories on compliance behaviour. Lastly, the conceptual framework and hypothesis were presented.

Chapter Four presents a comprehensive breakdown of the chronological sequence of the methodology employed for successful completion of the research. It includes the sampling technique and procedure for data collection, sample size determination, steps to ascertain the attributes employed in this study, and the issues of experimental and questionnaires development. The chapter further presents the statistical analysis used to achieve the objectives of this study. The results for the reliability test from the pilot test and the results of the data screening are also presented in this chapter.

Chapter Five presents outputs of the estimated results of the models to address the research objectives. The chapter also provides discussion and interpretation of the findings.

Chapter Six covers the summary of results, conclusions, and policy implications based on the research findings. The chapter also highlights the study limitations and recommendations for further studies.

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