



# HOKKAIDO UNIVERSITY

Title	A New Approach for Promoting Resource Recycling and Residual Waste Reduction in Malaysia
Author(s)	Ariffin, Faisal Bin
Degree Grantor	北海道大学
Degree Name	博士(工学)
Dissertation Number	甲第14885号
Issue Date	2022-03-24
DOI	<a href="https://doi.org/10.14943/doctoral.k14885">https://doi.org/10.14943/doctoral.k14885</a>
Doc URL	<a href="https://hdl.handle.net/2115/85352">https://hdl.handle.net/2115/85352</a>
Type	doctoral thesis
File Information	Faisal_Bin_Ariffin.pdf



**A New Approach for Promoting Resource Recycling and Residual  
Waste Reduction in Malaysia**

(マレーシアにおける資源リサイクルと埋立ごみ削減促進のための新しいア  
プローチ)

by

**FAISAL BIN ARIFFIN**

A thesis submitted in partial fulfillment of the requirements for the degree of Doctor of  
Philosophy in Environmental Engineering

Division of Environmental Engineering

Graduate School of Engineering

Hokkaido University

March 2022

## **Acknowledgement**

Firstly, I would like to thank my supervisor, Prof. Dr. Kazuei Ishii for his guidance, advice, and supervision.

I also would like to thank all members of Laboratory of Sustainable Material Cycles Systems especially to Dr. Satoru Ochiai, Dr. Shiho Ishikawa and Dr. Masahiro Sato (Left this lab on March 2021).

My highest gratitude to Government of Malaysia and all its agencies especially Public Service Department of Malaysia, Ministry of Housing and Local Government of Malaysia, National Solid Waste Management Department of Malaysia and Solid Waste and Public Cleansing Corporation of Malaysia for providing opportunity for me to further my study in doctorate level and for their support during my research.

My highest appreciation to all Public Higher Education Institutions, solid waste management companies especially Environment Idaman Sdn. Bhd., Cenviro Sdn. Bhd., Alam Flora Sdn. Bhd. and SWM Environment Sdn. Bhd., NGOs, and individuals that kindly help me during my study including by providing information, answering, and forwarding my questionnaires survey.

Finally, I would like to acknowledge my family and all my friends for their continuous support during my study including in the hard time during this pandemic era.

## **ABSTRACT**

Malaysia is a developing country that highly dependence on landfills, as many developing countries in Southeast Asia. As the Malaysian population is still growing annually, it is predicted that resource limitation and landfill land scarcity will become more critical in the future. To resolve these issues, the Government of Malaysia has taken precautionary measures including mandatory recyclables separation at source. However, it is still the case that a very low amount of recyclables are separated at source. Hence, source separation is an indispensable option to increase the recovery of recyclables and to reduce residual waste going from directly disposed to the landfill sites. Economic incentive is a promising tool to enhance recycling. In Malaysia, an unique activity “e-money incentive” started, where incentive for recyclables are given by e-money. The objectives of this study are to evaluate the effectiveness of the e-money incentives systems that implemented in Malaysia in terms of the amounts of collected recyclables and residual waste to landfill, to design a new incentive mechanism, and to predict the effectiveness of the new proposed incentive mechanism. In this study, we define residual waste as others wastes that are not separated for reuse or recycle including compost.

In the first study, we evaluated two e-money-incentive systems that were introduced by a private company. The two systems were “Recycle for Life” (RFL) and “Barcode.” We measured and compared the systems with other world practices to improve recyclables collection. The effectiveness of the “Barcode” system was significant in reducing 3.4% residual waste generation compared with the RFL system (0.08%) because

the Barcode system allowed residents who separate their recyclables at source, to be rewarded by e-money without the need for them to bring their recyclables to the designated points. Based on a comparative study with world practices elsewhere, Malaysia also needs to introduce a “negative incentive system (charge system)” as well as “positive incentive system”, such as the RFL and the Barcode systems, to enhance resource recycling and reduce residual waste.

In the second study, we designed a new incentive mechanism that we named as ‘Zero Budget System’ to further enhance reduction of residual waste generation. This new system is hybrid approach to waste management that incorporates negative and positive incentives. In this study, we applied a two-step analysis via questionnaire (a) to identify attributes affecting residents' acceptance of the charge system in Malaysia (b) to design the system. There are two waste management systems in Malaysia that are mentioned later in this study as a system of federalized and non-federalized states.

The first step analysis was conducted to clarify respondents' willingness to pay and willingness to participate in the Zero Budget System, as well as to identify attributes that influence residents' acceptance of the charging system via a questionnaire survey. The due to worldwide pandemic, this survey was conducted through an online platform. In total, the questionnaire managed to achieve 451 respondents. As the results we identified 5 attributes which consist of incentive amount, recyclables collection method, residual waste collection frequency, subsidy on waste bin and charge amount.

The second step analysis was also conducted by online platform using attributes and level obtained from the first. The form was distributed to the respondents that agreed to participate in the second questionnaire during the first. The response rate for the questionnaire was 40.7%. Through a conjoint analysis, we also found that the scenario with a residual waste charge (RWC) of MYR 0.20/kg for door-to-door recyclables collection (DtoDRC), monetary incentive for separated recyclables (MISR) of MYR 0.90/kg, residual waste collection (RWCol) twice per week, and 100% subsidy for waste bins (WB) showed the highest utility function for federalized states; for non-federalized states, the scenario that showed the highest utility function was RWC of MYR 0.20/kg, DtoDRC, MISR of MYR 0.90/kg, RWCol three times per week, and a 50% subsidy for waste WB.

In the third study we conducted another online survey to clarify respondents' willingness to separate their recyclables at source based on the incentive and charge amount. In total, the questionnaire managed to achieve 174 respondents. As the result through ordered logistic regression analysis, we found that dummy for highest incentive amount for separated recyclables at MYR0.9/kg showed the highest coefficient and low p-value for all type of recyclables in both federalized and non-federalized states. This means that respondents' willingness to separate are strongly dependent on incentive amount that worth the effort. In the meantime, we also observed positive coefficient if charge amount, reduce from MYR 0.2/kg to MYR 0.1/kg. That indicated that respondents are unlikely to separate their recyclables if the charge amount increase. This because most respondents didn't see that source separation as a practical way to save their disposal cost.

Finally, we predicted that the system is effective to reduce residual waste generation from 8.4% to 13%. The reduction percentage of 'Zero Budget System' are higher than currently implemented positive incentive only systems (RFL and Barcode System) that only effective to reduce residual waste from 0.08% to 3.4%. This mean, a hybrid system which cooperate positive and negative incentive will further improve resource recycling and residual waste reduction.

In conclusion, this study proved that 'Zero Budget System' is an effective approach to promote resource recycling and residual waste reduction in Malaysia. The system also had potential to be implemented in other developing countries especially to those that already adapted positive incentive system to further enhance resource recovery and residual waste reduction

## Contents

<b>Acknowledge</b> .....	ii
<b>Abstract</b> .....	iii
<b>Table of content</b> .....	vii
<b>List of Figures</b> .....	ix
<b>List of Tables</b> .....	xi

### **1 Chapter 1 (Introduction)**

1.1 Research background.....	1
1.2 Objective of the research.....	3
1.3 Thesis overview.....	3

### **2 Chapter 2**

#### **Review of worldwide practices on incentive mechanism**

2.1 Introduction.....	6
2.2 Practised based on negative incentive.....	7
2.3 Practised based on positive incentive.....	11
2.4 Summary.....	12

### **3 Chapter 3**

#### **The effectiveness of the e-money incentive mechanism in promoting separation of recyclables at source in Malaysia**

3.1 Introduction.....	15
3.2 Methodology.....	20
3.3 Result and discussion.....	25
3.4 Summary.....	39
3.5 Appendix.....	40

### **4 Chapter 4**

#### **'Zero Budget System' A new mechanism in enhancing separation of recyclables at source in Malaysia**

4.1 Introduction.....	47
4.2 Procedure of analysis.....	51
4.3 First step analysis.....	52
4.4 Second step analysis.....	74
4.5 Summary.....	93

### **5 Chapter 5**

#### **Prediction on the effectiveness of 'Zero Budget System'**

5.1 Introduction.....	100
5.2 Methodology.....	100

5.3	Result and discussion.....	109
5.4	Summary.....	128
<b>6</b>	<b>Chapter 6</b>	
	<b>Conclusion.....</b>	<b>130</b>

## LIST OF FIGURES

Figure 1.1:	Research Structure.....	4
Figure 2.1:	Two different types of incentive system.....	7
Figure 3.1:	Flows of residual waste and recyclables in Malaysia.....	16
Figure 3.2:	Recyclable and electronic money flow in two e-money incentive systems.....	18
Figure 3.3:	Total recyclables collection of the RFL system.....	26
Figure 3.4	Composition of collected recyclables.....	26
Figure 3.5:	Monthly distributed incentive in the RFL system.....	28
Figure 3.6:	Collection of recyclables before and after implementation of the Barcode system.....	30
Figure 3.7:	The relation between residual/combustible waste reduction, RCtoGNI and RItoGNI.....	36
Figure 4.1:	Two-step questionnaire flow.....	51
Figure 4.2:	Citizen willingness to pay for waste management.....	58
Figure 4.3	Citizen willingness to pay after considering bias effect.....	59
Figure 4.4:	Citizens Support on Implementation of ‘Zero Budget System’ in Malaysia.....	60

Figure 4.5	Citizens Support on Implementation of ‘Zero Budget System’ in Malaysia after considering bias effect.....	61
Figure 4.6	5 Main Factors that Government Needs to Focus to Secure citizens Support on Charging System .....	62
Figure 4.7A	Dendrogram of clustered attributes (federalized).....	65
Figure 4.7B	Dendrogram of clustered attributes (non-federalized).....	66
Figure 4.8A	Level for Percentage of Subsidy on Waste Bin.....	68
Figure 4.8B	Level of collection method for recyclables.....	69
Figure 4.8C	Level of frequency on collection of residual waste.....	70
Figure 4.8D	Level of incentive amount for separated recyclables.....	71
Figure 4.8E	Level of charge amount for residual waste.....	72
Figure 4.9	Utility function for proposed scenarios.....	91
Figure 4.10	Benefit–charge balance for separated recyclables at source.....	93
Figure 5.1:	Prediction of residual waste reduction by ‘Zero Budget System’ .....	127

## LIST OF TABLES

Table 3.1:	Rate of Two Incentive Systems (Market value in Sept. 2019) .....	19
Table 3.2:	Participation of Recycle for Life System.....	25
Table 3.3:	Private Participation in e-Money Redemption.....	29
Table 3.4:	Estimation of Incentive Received by Residents During Pilot Project...31	
Table 3.5:	Comparison of Worldwide Incentives for Source Separation.....	38
Table 4.1:	Comparison Between Federalised and non-Federalised States .....	50
Table 4.2:	Question used in first survey.....	53
Table 4.3:	Respondent attributes for first questionnaire.....	57
Table 4.4:	Extracted attributes and level.....	73
Table 4.5:	Selected 18 proposed and current scenarios of federalized and non-federalized states.....	75
Table 4.6:	Forms used in 2 <sup>nd</sup> Questionnaire.....	77
Table 4.7:	Example of Question used in 2 <sup>nd</sup> Questionnaire.....	78
Table 4.8:	Dummy used in conjoint analysis.....	79
Table 4.9	Explanation of symbols, assumptions, and values in this research.....	83

Table 4.10:	Results of Conjoint Analysis.....	85
Table 5.1:	Attributes and level for federalized and non-federalized states.....	101
Table 5.2:	Selected scenarios for federalized and non-federalized states.....	102
Table 5.3:	Dummy used in conjoint analysis.....	103
Table 5.4:	Respondents' attributes.....	110
Table 5.5:	Result for conjoint analysis (federalized).....	112
Table 5.6:	Result for conjoint analysis (non-federalized).....	113
Table 5.7:	Respondents' willingness to separate (federalized) .....	115
Table 5.8:	Respondents' willingness to separate (non-federalized).....	116
Table 5.9:	Influenced of respondents' attributes towards willingness to separate (federalized).....	119
Table 5.10:	Influenced of respondents' attributes towards willingness to separate (non-federalized) .....	123

# CHAPTER 1

## Introduction

### 1.1 Research background

Malaysia is a developing country with a gross domestic product (GDP) of USD 12,120.08 per capita [1] and a population of 32,723,756 citizens [2]. The Malaysian average waste generation is 1.17 kg/capita/day [3], and it is estimated that Malaysia produces waste at nearly 13.4 million t/yr. With an annual population growth from 0.6% to 2.4% (2010–2019) [4], waste generation is predicted to increase yearly and become more important.

To improve the quality of waste management and standardize the services, the Malaysian government took over the waste management system from the local authorities and privatized the services on September 1, 2011. After introducing separate collection at source by phases, and in line with Pillar 1 (Minimizing waste generation and optimizing resources), Strategy 1 (To encourage 3R practices at household, commercial, industry and institutional level) and Action Plan No. 5 of the Malaysian National Solid Waste Management Policy [5], the Malaysian government made it mandatory for residents to separate their wastes at source from September 1, 2015.

In 2018, Malaysia achieved a 24.6% recycling ratio that exceeded the national target, which was set at 22% by 2020, but this figure included recyclables extracted from landfills. The amounts of recyclables separated at the source were considered to be still low. Recyclables that are separated at source are easier to use than recyclables from landfills that are mixed with other waste, particularly organic compounds. Thus, source

separation is an indispensable option for reducing wastes going to landfill sites and increasing the recovery of recyclables as a resource.

Even though there is various area that can be focused to improve source separation such as law enforcement, awareness program, education and many more. In this study we are focusing into a new approach, an economic incentive that can be optimized further.

According to Mavropoulos et al. [6], “recycling success in developing countries is usually linked with survival and daily income”. Happenhofer et al. [7] mentioned “the importance of the economic theory that states that individuals seek to maximize their benefit”. Thøgersen [8] mentioned that “consistent with economic reasoning, households with a pay-by-weight scheme delivered more recyclable materials to recycling and composted more of their fruit and vegetable waste in the garden”. Dijkgraaf and Gradus [9] also mentioned that “it seems likely that the introduction of unit-based pricing (charge by weight, bag or can/bin) results in a significant change in residents’ behavior”. Based on this, it is clear that economic instruments are effective in motivating residents to separate recyclables at the source. Thus, Malaysia as a developing country needs to consider the implementation of an economic incentive to enhance separation at the source.

Based on this, Environment Idaman Sdn. Bhd., a waste management company that appointed by Government of Malaysia had introduced e-money incentive system in northern region of Peninsular Malaysia to enhance source separation and recovery of recyclables that will be evaluated latter.

## **1.2 Objective of the research**

The objectives of this research are:

1. To evaluate the effectiveness of the e-money incentives in terms of the amounts of collected recyclables and residual waste to landfill.
2. To design a new incentive mechanism; and
3. To predict the effectiveness of the new incentive system.

## **1.3 Thesis overview**

Overall, this thesis consisted with 6 chapter. In Chapter 1, we discussed about the need of Malaysia to consider in implementing economic incentive to improve source separation. We also established 3 main objectives for the research. In Chapter 2, we reviewed worldwide practices on incentive mechanism. In this chapter, we categorized incentive mechanism into 2 types, negative and positive incentive. In Chapter 3, we evaluated 2 e-money incentive systems, RFL System and Barcode System which implemented in Northern Region of Peninsular Malaysia. However, the effectiveness of the systems considered low compared to pay as you throw system which implemented in developed countries. To improve the situation in Chapter 4, we designed 'Zero Budget System' a new system that incorporated charging system and monetary incentive system. In Chapter 5, we predicted the effectiveness of 'Zero Budget System' by Ordered Logistic Regression. Lastly, in Chapter 6 we discussed about the conclusion of this research.

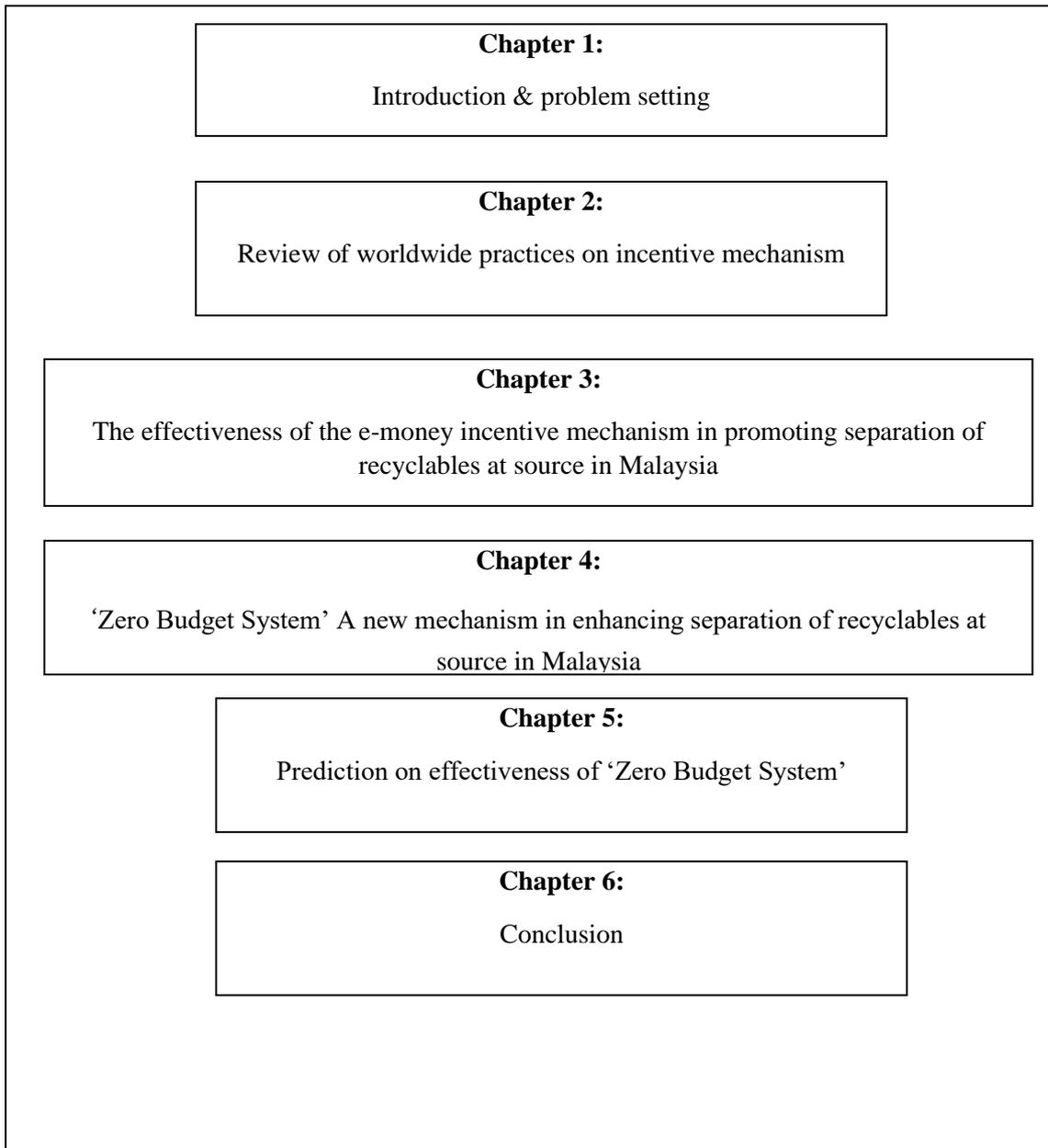


Figure 1.1: Research Structure

## References

- [1] World Bank (2018) GDP per capita (Constant 2010 US\$)-Malaysia
- [2] Jabatan Perangkaan Malaysia (DOSM) (2020) <https://www.mycensus.gov.my/>
- [3] GSR (2012) Survey on SW Composition, Characteristic & Existing Practice of SW Recycling in Malaysia
- [4] DOSM (2019) Siaran Akhbar, Anggaran Penduduk Malaysia 2018–2019
- [5] Government of Malaysia (2016) National Solid Waste Management Policy
- [6] A. Mavropoulos, EPEM SA (2009) Recycling Behaviour: The Present Focus Brain and a Framework to Understand Personal Differences in Recycling. (pg. 1)
- [7] A. Happenhofer, P. Beigl, S. Salhofer (2017) Analysis of Economic Incentive Scheme to Promote Efficient Separation at Source. Proceeding Sardinia 2017, 16th International Waste Management and Landfill Symposium (pg. 3)
- [8] J. Thøgersen (2003) Monetary Incentive and Recycling: Behavioural and Psychological Reactions to a Performance-Dependent Garbage Fee, Journal of Consumer Policy 26: 197–228 (pg. 218)
- [9] E. Dijkgraaf and R.H.J.M Gradus (2004) Cost Savings in Unit-Based Pricing of Household Waste: The Case of The Netherlands, Resource and Energy Economics 26: 353–371 (pg. 368)

## **CHAPTER 2**

### **Review of worldwide practices on incentive mechanism**

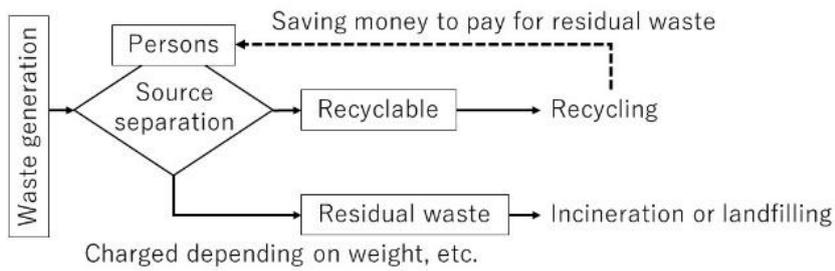
#### **2.1 Introduction**

In this chapter we will review worldwide practices on incentive systems that involved the systems that have been applied in developing countries and also neighbouring region.

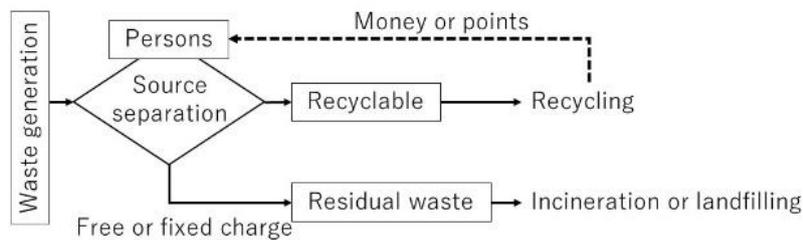
The objective of this review is to benchmark worldwide practices to further improve Malaysian incentive system and will be used as an indicator to evaluate the current system.

In this study, a “negative incentive” means a system whereby waste generators are charged for the collection of residual waste based on volume, weight or frequency, and a minimum base fee (Figure 2.1a), whereas the collection of recyclables is charged at a minimal charge or not at all. Namely, source separation of recyclables can save money for residual waste discharge. Pay-as-you-throw (PAYT) has been introduced in many developed countries and is based on a negative incentive.

“Positive incentive” means a system where the waste generators are rewarded by either money or points for separating and in some cases for bringing their recyclables to designated points during designated times (Figure 2.1b). The system might also include a fixed charge for residual waste collection.



a) Negative Incentive



b) Positive Incentive

Figure 2.1 Two different types of incentive system

## 2.2 Practices based on negative incentive

### 2.2.1 Japan

Japan implemented PAYT as a mechanism to reduce the generation of residual wastes other than recyclables, such as combustible and incombustible wastes, and to improve recyclable collection. Based on this system, waste generators must use designated waste bags for their residual wastes and are charged for the bags according to their volume. Recyclables such as paper, plastic, glass bottles, polyethylene terephthalate (PET) bottles, cans and garden waste are collected at no charge or at a cheaper charge than the residual wastes. This system encourages waste generators to separate their recyclables at the source to reduce the volume of waste placed in bags or reduce amount of waste generation by avoiding unnecessary purchasing or optimizing resources.

Although situation on waste separation, treatment and recycling ways might differ by each municipality, based on survey in 54 municipalities that started to implement PAYT from 2005-2007, Japan had successfully reduced their combustible waste generation from 0.548 kg/capita/day to 0.438 ton/capita/year in third year of implementation of PAYT, namely 20% reduction [1].

### **2.2.2 Seoul, South Korea**

Similar to the PAYT system in Japan, PAYT has been implemented in Seoul since 1995 [2]. Through the system, recyclables such as paper, iron, aluminum cans, glass and plastic are voluntarily sorted by waste generators and are collected at the curbside by the municipality at no cost, whereas residual waste is charged based on the volume of the bags [2]. Based on documents from Seoul Metropolitan Government from 2002, Seoul had successfully reduced residual waste from 1.3 kg/capita/day in 1994 to 0.9 in 2000 (i.e., 31% reduction) [2].

### **2.2.3 Barcelona, Spain**

Torrelles de Llobregat introduced a new system consisting of PAYT and door-to-door collection in January 2003 [3]. In this system, biowaste, paper/cardboard, diapers and glass are collected according to the recyclable collection schedule at no cost, whereas non-biowaste (residual waste), is left for collection with standardized charged bags [3]. Even though it is admitted that the measuring period of time might be not enough and as many cases, rebound in waste generation can be seen as time goes by and measured data might be larger than its actual effect if the system can be continued for longer times, by

comparing waste collection flow 9 months prior and after the implementation of the system, PAYT successfully reduced 84.5% non-biowaste generation and diverted 81.4% waste from landfill [3].

#### **2.2.4 Vienna, Austria**

This following study was done by Gerhard Spet (2002). In 1994, Vienna introduced a system where a 110/120 L bin became the basic bin size with a minimum of one collection per week [4]. For larger bins, the fee is based on multiplication ratios [4]. Recyclables such as paper, glass, metal, biowaste and plastic are collected in separate bins without any charge [4]. Based on ERRA Review (Issue 5, July 1998), the system contributed to a reduction in residual waste from 1.30 kg/capita/day to 1.18 (9% reduction) and to an increase of 18% in recyclable collection [4].

#### **2.2.5 Les Sorinières, France**

Les Sorinières introduced a charging system where the fee is fixed for each household individually according to the volume of containers and the frequency of collection [4][5]. Various services are covered under the charge includes the collection of household waste once per week with limits on volume and collection of recyclables such as paper, cardboard, plastics and clean metal packaging [6] once per week without volume limitation[4][5]. By comparing the annual waste generation before and after the implementation of this system, PAYT reduced waste generation from 0.79 kg/capita/day to 0.48 (39% reduction) [4][5].

### **2.2.6 Aschaffenburg, Germany**

Aschaffenburg, Germany implemented a PAYT system in 1997[7]. The system charged waste generators by the weight of the waste [7]. Residual, biodegradable and bulky waste are charged by their weight, and other types of recyclables such as paper, glass, metals and plastics are collected from the waste generator's house or from collection centers at no charge [7]. Throughout the implementation of this system, residual waste generation reduced from 0.45 kg/capita/day in 1995 to 0.15 in 2013 or a 65% residual waste reduction, and recyclable collection increased by up to 86% [7].

### **2.2.7 Bjuv, Sweden**

In 2000, Bjuv, Sweden implemented a similar system to Germany, where residual and compostable waste is charged by the weight [4][8]. Waste collection vehicles are equipped with a weighing system and waste bins are tagged with an intelligent chip for identification [4][8]. Collection of recyclables, such as newspapers, cardboard, plastics, glass and metals are based on flat fees according to the collection schedule [4][8]. By comparing waste amount per household before and after the implementation of the system, PAYT has successfully reduced residual waste generation by 44.7% and the collection of recyclables and compostables increased by up to 94.6% [4][8].

### **2.2.8 Flanders, Belgium**

In 1995, Flemish municipalities started to implement PAYT where differentiated taxes (fees) are used [9]. The collection of residual waste is the most expensive, followed by the collection of household biodegradable waste, with lowest taxes applied to plastic

bottles and flasks, metal packaging and drink cartons, whereas paper and cardboard, container glass and textile are collected for free [9]. Through this system, residual waste generation reduced from 0.89 kg/capita/day in 1995 [4] to 0.41 in 2012 [9] or 53.9% residual waste reduction and recyclable collection increased by up to 71% [9].

## **2.3 Practices based on positive incentive**

### **2.3.1 Thailand**

The “School Garbage Bank” (SGB) system was introduced in Thailand in 1999 [10]. In principle, the SGB system functions as a buyback center, where participants are rewarded financially for recyclable materials based on weight and type such as white–black papers, mixed plastic bottles, glass, cardboard and newspapers [10]. The reward earned by a participant at a time is recorded in his passbook, similar to commercial banks [10]. According to Suttibak and Nitivattananon [10], through this program, 32.00 kg/participant/year or 0.088 kg/participant/day recyclables have been recycled. The SGB system recycles 6.85 t/day [10] and the total waste generation in Thailand is estimated at 70,000 t/day [11]; it can be assumed that the SGB system diverted 0.01% residual waste from landfill.

### **2.3.2 Surabaya, Indonesia**

Similar to the SGB system, the “Waste Bank” system was established in Surabaya, Indonesia in 2010 [12]. Through this system, waste generators separate recyclables such as paper, plastic, metal and glass [13] and bring them to waste banks. The money is deposited in their account [12]. The deposited money can be withdrawn in certain time

[12]. The recyclable is sold to buyers for further reuse or recycle [12]. The Waste Bank system has diverted 7.14 t/week or 1.02 t/day waste from landfill [12]. Because Surabaya generates 1,512 t/day residual waste [14], it can be assumed that the Waste Bank system diverted 0.07% residual waste from landfill.

## **2.4 Summary**

From the review of worldwide practices, we can conclude as below:

1. Negative incentive through pay as you throw system that practiced by developing countries showed high potential in improving source separation and recovery of recyclables in Malaysia.
2. Positive incentive system that applied by neighboring region also quit promising if accompanied with more proper system such as collection, storage and transportation.

## References

- [1] Ministry of Environment Japan (MOEJ) (2013) Guidance on charged system for municipal solid waste
- [2] J.H. Kim (2004) Sustainable Urban Waste Management System in Metropolitan Seoul, South Korea, The Sustainable City III, 2004 WIT Press, ISBN 1-85312-720-5
- [3] I. Puig-Ventosa (2008) Charging Systems and PAYT Experience for Waste Management in Spain, *Waste Management* 28: 2767–2771
- [4] Eunomia Research & Consulting (2003) Waste Collection: To Charge or Not to Charge
- [5] Dette B., Julich R., Buchert M., Bukhave M., Dopfer J., Roig J.E.I., Gerken I., Kupperts P., Schneider M., Sorensen S.Y., Stevanato P., Villa L (1999). Waste Prevention and Minimisation, Final Report. Commissioned by the European Commission, DG XI
- [6] F. Gauthier (1999) Les Sorinières Continue The Experience:  
<https://www.lemoniteur.fr/article/les-sorinieres-poursuivent-l-experience.35559>
- [7] J. Morlok, H. Schoenberger, D. Styles, J.-L. Galvez-Martos, B. Zeschmar-Lahl (2017) The Impact of Pay-As-You-Throw Schemes on Municipal Solid Waste Management: The Exemplar Case of the County of Aschaffenburg, Germany, *Resources* 6: 8; doi:10.3390
- [8] Hogg D., Stark W., Callens A., Bogaert G., Christensen E.H., Heikkonen V., Ledore A., Stahl H., Economides D., Tsalas A., Favoino E., Ricci M., Carlsson M.

(2002). Financing and Incentive Schemes for Municipal Waste Management: Case Studies, Final Report to DG Environment, European Commission

- [9] OVAM (2014) Good Practice Flanders: PAYT
- [10] S. Suttibak, V. Nitivattananon (2008) Assessment of Waste Recycling Performance: A Study of School Garbage Banks in Thailand, GMSARN International Journal 2: 83–90
- [11] A. Singsewo, K. Klaoklang (2017) Promoting of a Waste Recycling Bank in Schools: A Case in a Municipality School in Thailand, New Trends and Issues Proceedings on Humanities and Social Sciences 4: 329–334
- [12] D.R. Wijayanti, S. Suryani (2015), Waste Bank as Community-based Environmental Governance: A Lesson Learned from Surabaya, Procedia-Social and Behavioral Sciences 184: 171–179
- [13] IGES (2017) Planning and Implementation of Integrated Solid Waste Management Strategies at Local Level: The Case of Surabaya Cities
- [14] IGES (2017) Development of Work Plan for Reducing SLCPs for MSWM in Surabaya, Indonesia

## **CHAPTER 3**

### **The effectiveness of the e-money incentive mechanism in promoting separation of recyclables at source in Malaysia**

#### **3.1 Introduction**

In accordance with Cluster 3, Circular Economy, Strategy 3.2, Income Generation from Waste (Waste to Money) and Action Plan No. 3.2.4 (To promote recycling through reward redemption and incentive programs) of the Malaysian National Sanitation Policy [1], Environment Idaman Sdn. Bhd. (EI), the waste collection concessionaire appointed by the Malaysian Federal Government for the states of Kedah and Perlis, took the initiative on their own by introducing a new concept of reward system by two e-money incentive systems, “Recycle for Life” (RFL) and “Barcode.” However, there has been no academic research yet that evaluated and clarified the effectiveness of the new systems.

In this study, the effectiveness of the e-money incentives was evaluated in terms of the amounts of collected recyclables and residual waste to landfill and amounts of incentive received by citizens. To enhance the collection of recyclables and to reduce residual waste in Malaysia, improvements for the two new Malaysian e-money incentive systems are discussed and compared with other world practices.

### 3.1.1 Malaysian E-Money Incentive Systems

#### 3.1.1.1 Overview of the waste management system in Malaysia

As mentioned before, after the federalization of waste management, the Federal government in Malaysia introduced a separate collection of recyclables by phases and made source separation mandatory from September 1, 2015. Residents are obliged to separate their recyclables into four categories, namely, paper, plastic, garden waste and others, which consists of glass/ceramic, metal, small electric appliances, and fabric and leather [2]. The flows of residual waste and recyclables in Malaysia are shown in Figure 3.1.

To increase the collection of recyclables and reduce the residual waste directly disposed to landfill, EI developed and introduced the two e-money incentive systems described in the following sections.

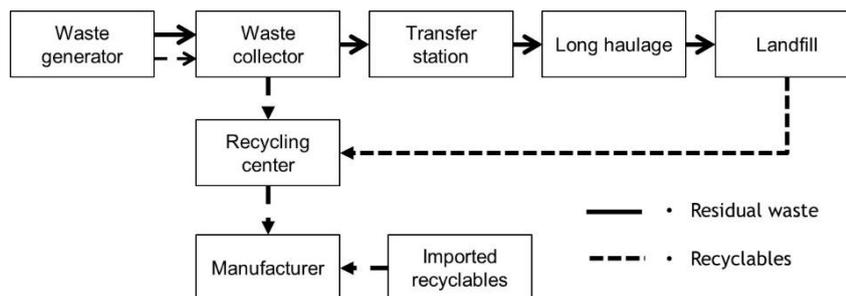


Figure 3.1 Flows of residual waste and recyclables in Malaysia

### **3.1.1.2 The RFL - smart card system**

EI officially launched the RFL system in the state of Kedah on March 20, 2018 and extended it to the state of Perlis on March 14, 2019 (see Appendix I).

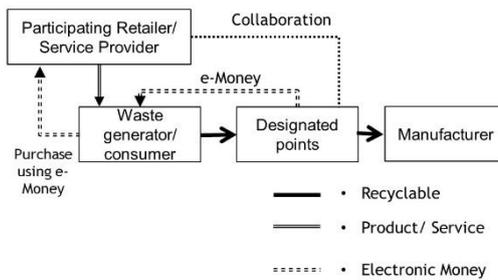
The RFL system is a monetary incentive system for waste generators who bring their segregated recyclables to the designated points (Figure 3.2a). Here, the recyclables are weighed, and the waste generators are rewarded based on the recyclables' weight and type (see Table 3.1). The e-money will be credited to their smartcard. The smartcard can be used at participating retailers or service providers of e-money redemption. The recyclables are sent to manufacturers as resources.

### **3.1.1.3 The Barcode system**

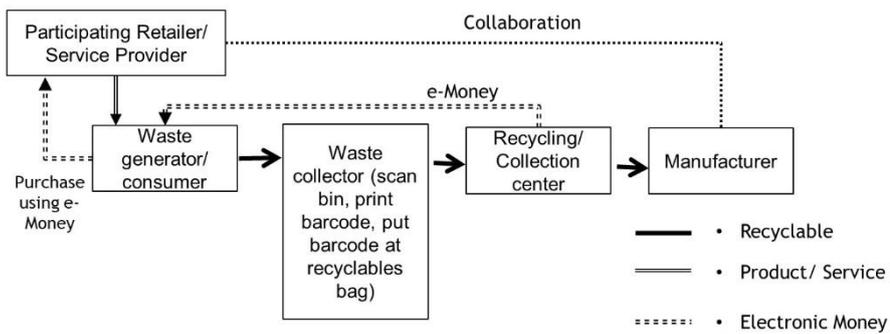
The other incentive to residents to promote further source separation was introduced as a pilot program involving 250 residential premises in the areas of Taman Desa Kubang Rotan Phase I, Taman Desa Kubang Rotan Phase II and Taman Seri Makmur in the municipality of Majlis Bandaraya Alor Setar, in the state of Kedah on July 13, 2018. The program was later extended also to Taman Kubang Rotan in the municipality of Majlis Bandaraya Alor Setar and to Taman Tunku Sarina in the Municipality of Kubang Pasu, state of Kedah. The pilot program uses a barcode system to identify recyclable ownership.

The barcode system allowed residents, who separate their recyclables at source, to be rewarded by e-money at the same incentive rate as the RFL system without having to bring their recyclables to designated points. The participants just need to place their recyclables at the curbside according to their collection schedule. On the recyclables

collection day, a recyclable collector scans the participant's bin with a scanning device and prints a barcode sticker. Then, the recyclables collector places the barcode sticker on the recyclables' bag for identification of the recycling ownership. The recyclables are then weighed at the recycling or collection centers and the incentive amount is credited through a smart card to each household. Credited e-money can be used at retailers/service providers collaborating with this program. The recyclables and the incentive flow are described in Figure 3.2b.



a) RFL system



b) Barcode system

Figure 3.2: Recyclable and electronic money flow in two e-money incentive systems

Table 3.1: Rate of Two Incentive Systems (Market value in Sept. 2019)

<b>TYPE OF RECYCLABLE</b>	<b>Incentive rate MYR/kg</b>
Carboard	0.25
Old Newspapers	0.35
Black & White Paper	0.50
Mix Paper	0.15
Mix Plastic	0.55
PET	0.65
HDPE	0.95
PP	0.80
Aluminum Can	3.00
Tin	0.40
Steel	0.55
Cooking Oil	1.00

### 3.1.2 Definition of Residual Waste

The definition of residual waste analyzed and reviewed in this paper may vary because the waste categorizations depend on countries. In general, including in Malaysia, residual waste means other wastes that are not separated for reuse or recycle including compost. Particularly in Japan, residual waste consists of combustible and incombustible waste. In Torrelles de Llobregat, Barcelona, Spain, for example, residual waste is known as non-biowaste [3].

## **3.2 Methodology**

### **3.2.1 Data Collection**

Data on the RFL and Barcode systems was provided from EI on the actual implementation of the RFL system through several questionnaires between September 2019 and January 2020. The obtained data include the systems' coverage area, residents' participation, amount of collected recyclables, list of collaborating retailers and service providers and amount of incentives received by participants.

### **3.2.2 Data analysis for the RFL system**

The definitions of all symbols and values used in the calculation are shown in Appendix II.

#### **3.2.2.1 Participation ratio**

The participation ratio ( $PR$  [-]), was used to measure the coverage of the system for waste generators. Assuming that each distributed RFL smart card represents one premise,  $PR$  it was estimated as follows.

$$PR = \frac{N_{sc}}{N_{pre}} \times 100 \quad (1)$$

### 3.2.2.2 Monthly average distributed incentive

The monthly average distributed incentive,  $MADI$  [MYR/month] was used to estimate the effectiveness before and after implementation of the RFL system as follows.

$$MADI = \frac{Tl_{om}}{OM} \quad (2)$$

The distributions on March 2018 and March 2019 were not considered because in both states the RFL system did not start from the beginning of March.

### Average recyclables incentive

The average recyclables incentive,  $ARI$  [MYR/kg] was used to evaluate the sufficiency of incentive recyclables per kg as follows.

$$ARI = \frac{TI_{RFL}}{TCR_{RFL}} \quad (3)$$

### Residual waste reduction in the RFL system

The residual waste reduction for the RFL system,  $RWR_{RFL}$  [kg/capita/day] was used to estimate the effectiveness of the RFL system toward residual waste reduction as follows.

$$RWR_{RFL} = \frac{I_{sep2019}}{ARI \times (N_{kedah} + N_{perlis}) \times 30days} \quad (4)$$

For September 2019, only the incentive data were used because they were the latest data in hand and the data for actually collected recyclables were not obtained.

Furthermore, a maximum of 30,374 smart cards has already been distributed during this time.

### 3.2.3 Data analysis for the Barcode system

#### Total incentive

The total incentive,  $TI_{bs}$  [MYR] for the Barcode system was calculated to estimate the total incentive received through the system as follows.

$$TI_{bs} = \sum_i^n (TCR_{bs} \times Com^i \times R^i) \quad (5)$$

#### Incentive per household per month

The incentive per household per month,  $I_h$  [MYR/household/month], was estimated to analyze the average monthly incentive to 250 residential premises that participated in the Barcode system. The incentive per household is calculated as follows.

$$I_h = \frac{TI_{bs}}{N_{om} \times N_h} \quad (6)$$

#### Residual waste reduction (Barcode system)

The residual waste reduction for the Barcode system,  $RWR_{bs}$  [kg/capita/day] was used to measure the effectiveness of the Barcode system toward residual waste reduction. It is estimated as follows.

$$RWR_{bs} = \frac{TCR_{bs}}{N_h \times HS \times N_{od}} \quad (7)$$

### 3.2.4 Data analysis for comparison among incentive systems worldwide

#### 3.2.4.1 Converting each unit for comparison

To compare the effectiveness of a negative incentive on residual or combustible waste reduction, standardization of the charging unit is indispensable.

The charge per weight,  $C_{wfv}$  [MYR/kg], was converted from the charge per volume as follows.

$$C_{wfv} = \frac{C_v}{\rho_{waste}} \quad (8)$$

The charge per weight,  $C_{wth}$  [MYR/kg], was converted from the charge per household as follows.

$$C_{wth} = \frac{Ch}{TW \times HS \times D_m} \quad (9)$$

#### 3.2.4.2 Ratio of charge per year to gross national income

The ratio of charge per year to gross national income was used to standardize the economic impact of the charging system to waste generators with the economic strength of the different countries.

The charge per year,  $C$  [MYR/year], was estimated for practices based on negative incentive as follows,

$$\begin{aligned}
C &= C_w \times TW \times D_y \text{ or} \\
&= C_{wfv} \times TW \times D_y \\
&.= C_{wfh} \times TW \times D_y
\end{aligned} \tag{10}$$

The ratio of the charge per year to gross national income,  $R_c$  [-] was estimated as follows.

$$R_{CtoGNI} = \frac{C}{GNI} \tag{11}$$

\* Basic charge for PAYT weight-based system is not taken into consideration.

### 3.2.4.3 Ratio of incentive per year to gross national income

The ratio of incentive per year to the gross national income (GNI) was used to standardize the economic impact of an incentive to waste generators with the economic strength of the different countries.

The ratio between the estimated incentive per year and the  $GNI$  was estimated for practices based on the positive incentive as follows [in MYR/year].

$$\begin{aligned}
I &= RWR_{RFL} \times ARI \times D_y \text{ or} \\
&.= RWR_{BS} \times ARI \times D_y
\end{aligned} \tag{12}$$

The ratio between the incentive per year and  $GNI$  [-] was estimated as follows.

$$R_{ItoGNI} = \frac{I}{GNI} \tag{13}$$

### 3.3 Results and discussion

#### 3.3.1 RFL System

##### 3.3.1.1 Participants

Based on RFL's smart card distribution, which was obtained from EI, 30,374 participants took part from residential, institutional and commercial entities (Table 3.2). Participants from schools are the largest group (61.8%), followed by government agencies (14.1%), residential (13.6%) and commercial premises (0.03%).

Using the assumption values and eq. (1), based on data from September 2019, the latest PR in the RFL system was only 8% from 381,453 premises served by EI. This means that 92% of potential participants are still to be approached.

Table 3.2: Participation of Recycle for Life System

Category		Number of distributed cards	Percentage, %
RESIDENTIAL		4,143	13.64
INSTITUTION	SCHOOL	18,766	61.78
	AGENCY	4,280	14.09
	OTHERS	3,176	10.46
COMMERCIAL	HOTEL	9	0.03
<b>TOTAL</b>		<b>30,374</b>	<b>100.00</b>

##### 3.3.1.2 Total collected recyclables

The total collected recyclables in the second nine months of the RFL system implementation (January to September 2019) increased from 372 t to 466 (March to December 2018) when the system was expanded to include the state of Perlis (Figure 3.3). After RFL system implementation, in just 18 months, a total of 838 t of recyclables was collected, resulting in a successful reduction in the amount of residual waste going directly to landfill sites.

The collected recyclables consisted of paper and cardboard (58%) followed by plastic (27%), metal (12%) and waste cooking oil (3%) (Figure 3.4a). Other recyclables such as glass and fabric are not collected in this program.

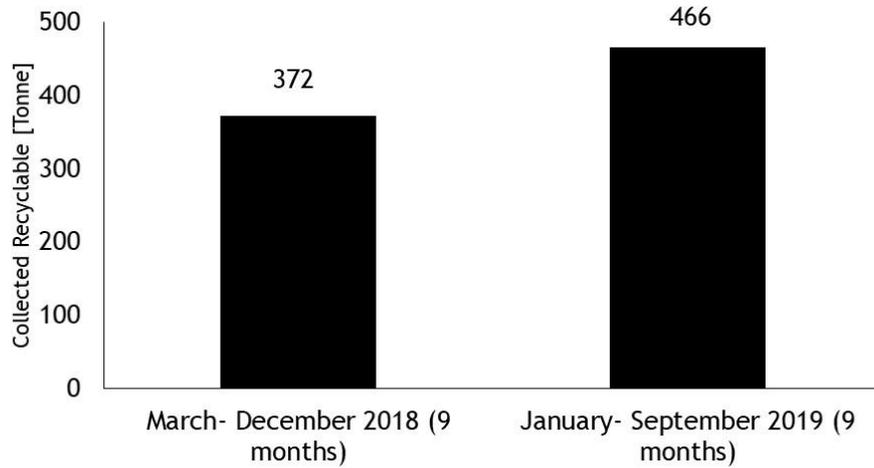


Figure 3.3: Total recyclables collection of the RFL system

The first nine months (March–December 2018): only the state of Kedah

The second nine months (January–September 2019): the states of Kedah and Perlis

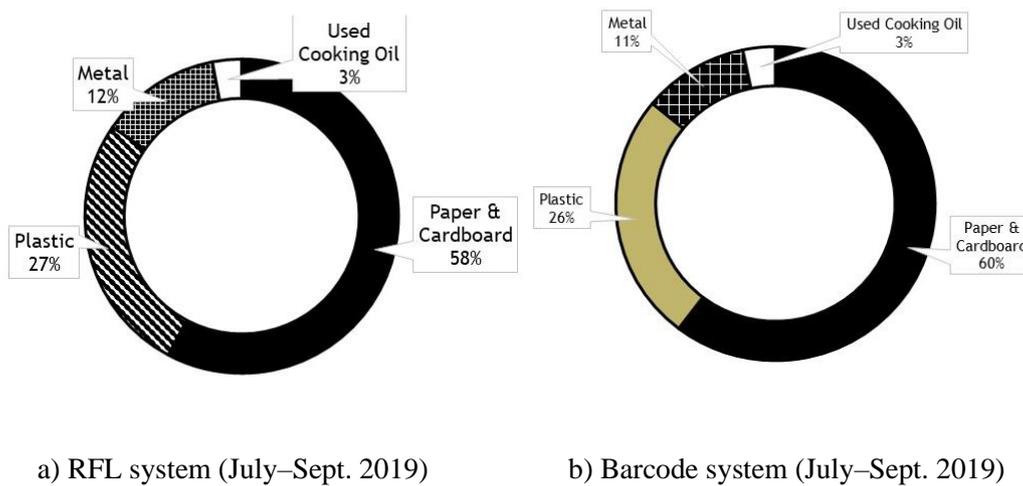


Figure 3.4 Composition of collected recyclables

### **3.3.1.2 Monetary Incentive**

#### **a. Incentives distributed to participants**

Before RFL, EI had implemented cash incentives to waste generators who brought their segregated recyclables to the designated points. To improve the recyclable recovery with more attractive features, the RFL system started to reward waste generators with e-money that also allowed them to accumulate the incentive.

The monthly distributed incentive increased with the introduction of the RFL system in the state of Kedah and it kept increasing until May 2018 (Figure 3.5). However, from June 2018 onward, the incentive distribution decreased and the trend was maintained to November 2018. There were no clear reasons why this happened, but we believe that the change in the ruling government after the general elections in May 2018, which was the first time since Malaysian Independence, might have affected this situation significantly.

From December 2018 to January 2019, the distributed incentive increased again; this may have been the result of long school holidays, from late November to the end of December 2018, which might increase recyclables from food packaging and year-end spring-cleaning activities that generate discarded recyclables such as papers. When the RFL system extended to the state of Perlis, overall, the monthly distributed incentive increased further.

Using the assumption values and eq. (2), the MADI [MYR/month], increased 76% when the RFL system was introduced in the state of Kedah and 38% further when it was expanded to the state of Perlis (Figure 3.5). This may be the result of the attraction of the

e-money system that allowed the smart cardholders to accumulate the monetary incentive that was credited to the smart card to larger amounts of money before spending the incentive.

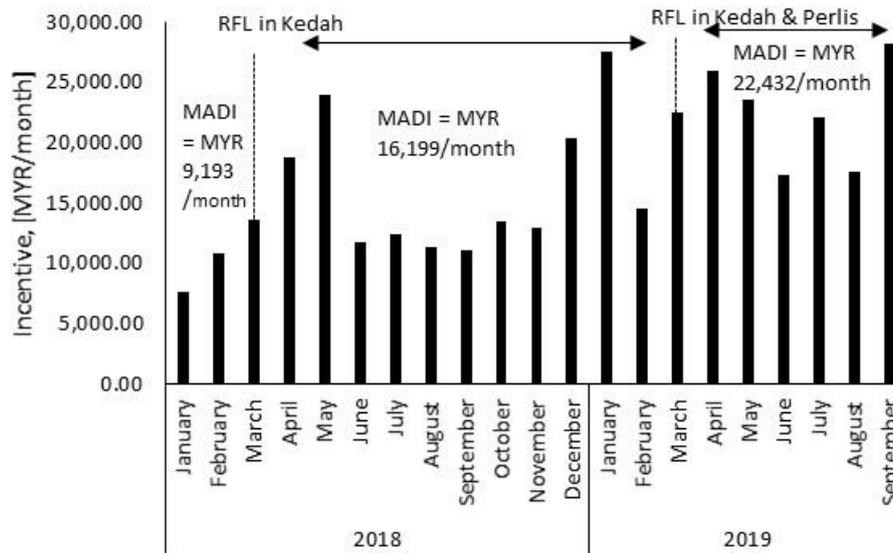


Figure 3.5: Monthly distributed incentive in the RFL system

**b. Private participation in e-money redemption**

As shown in Table 3.3, 38 private entities voluntarily currently participate in e-money redemption of the RFL system. The list includes businesses from hypermarkets to school’s canteens and shops. Support from such entities ensures the effectiveness of this system to all participants regardless of age.

**c. ARI**

Using the assumption values and eq. (3), the ARI was estimated at MYR 0.438/kg, which was not attractive for some participants. For example, the price of 600 mL mineral water in Malaysia is between MYR 0.80 and MYR 1.60, i.e., much higher than 1 kg of separated recyclables.

**d. Residual waste reduction**

Using the assumption values and eq. (4), the residual waste reduction for RFL,  $RWR_{RFL}$ , was estimated to be still at 0.0009 kg/capita/day, meaning 0.075% reduction from the current waste generation of 1.17 kg/capita/day [4]. If a similar system would be implemented nationwide with the same PR, it is estimated that only 28.6 t of recyclables would be prevented from going directly to landfill.

Table 3.3: Private Participation in e-Money Redemption

<b>BUSINESS TYPE</b>	<b>NO.</b>
School's canteen	8
School's shop	10
Restaurant/cafe	4
Beauty parlor	1
Hypermarket/Supermarket/ Groceries Store	6
Gymnasium	1
Car wash	1
Pharmacy	1
Leisure	1
Others	5
<b>Total</b>	<b>38</b>

### 3.3.2 Barcode system

#### 3.3.2.1 Total collected recyclables

The pilot study from July 13 to October 2018 (3.5 months) showed the collected recyclables to increase by more than 3000% (4500 kg), compared with that collected from April to July 12, 2018 (3.5 months) (131 kg) before the Barcode system was introduced (Figure 3.6). This phenomenon may be caused by having fewer logistic issues because residents do not have to find recycling centers to bring their recyclables or to store their recyclables inside their houses. The participants just need to discharge their recyclables separately according to the collection schedule, and they receive the incentive at the same rate as the RFL system.

The composition of the recyclables was almost the same as in the RFL system (Figure 3.4b), with 60% consisting of paper and cardboard, followed by plastic (26%), metal (11%) and used cooking oil (3%).

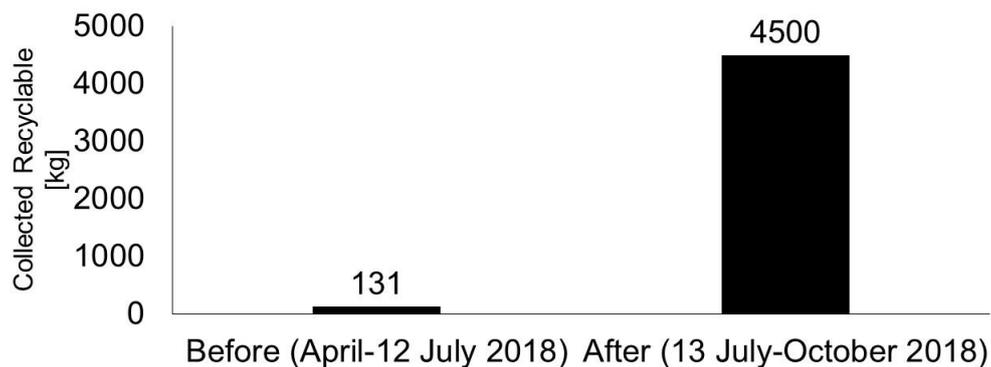


Figure 3.6: Collection of recyclables before and after implementation of the Barcode system

Table 3.4 Estimation of Incentive Received by Residents During Pilot Project

Category	Subcategory	Composition rate, Com <sup>i</sup> , (%)	Subcategory weight (kg)	Incentive rate, IR <sup>i</sup> (RM/kg)	Estimated incentive, (RM)
<b>Paper &amp; Cardboard</b>	Cardboard	14.6	657.8	0.25	164.46
	Black & White Paper	10.3	464.8	0.50	232.39
	Mix Paper	34.0	1529.0	0.15	229.35
	Old Newspaper	1.4	64.4	0.35	22.52
<b>Plastic</b>	HDPE	3.6	160.9	0.95	152.84
	Mixed Plastics	15.4	691.2	0.55	380.16
	PET	5.7	256.2	0.65	166.55
	PP	1.0	46.5	0.80	37.18
<b>Metal</b>	Aluminum Can	0.5	20.3	3.00	60.78
	Steel	5.6	251.5	0.55	138.30
	Tin	4.7	209.7	0.4	83.90
<b>Used Cooking Oil</b>		3.3	14.6	1.00	147.8
<b>TCR<sub>bs</sub></b>			4,500	TI <sub>bs</sub>	<b>1816.21</b>

### 3.3.2.2 Incentive per household per month

The amount of each recyclable was estimated based on the composition of recyclables and the incentive was also estimated using the incentive rate (Table 1), as shown in Table 3.4. Using the assumption values and eq. (5), on average through the pilot program, the incentive for each household,  $I_h$ , was estimated to be MYR 2.08/household/month.

### 3.3.2.3 Estimation of residual waste reduction

Using the assumption values and eq. (6), residual waste reduction,  $RWR_{bs}$ , was estimated at 0.04 kg/capita/day, meaning a 3.4% reduction from the current waste generation of 1.17 kg/capita/day [4]. If the Barcode system is implemented nationwide, it is estimated that Malaysia can reduce more than 1,300 t/day of waste going to landfill sites.

### **3.3.3 Comparing the e-money incentive system in Malaysia with worldwide practice**

It is difficult to evaluate the effectiveness of the economic incentive just by measuring the amount of collected recyclables and the reduction in residual waste because there are other affecting factors such as the charging price of PAYT, segregation categories, collection methods, maturity of recycling technologies and the existing market. However, by roughly comparing the worldwide incentive effectiveness with the new systems in Malaysia it would be meaningful to seek improvement from other schemes.

Without denying other possible factors determining residual waste reduction technically and socially including research limitation due to the differences in the year of data source and methodology to measure the effectiveness of each system, Table 3.5 shows the worldwide incentive effectiveness in promoting source separation, based on the review of worldwide practices in Chapter 2.

#### **3.3.3.1 Comparison with positive incentive activities in Thailand and Indonesia**

The RFL system with e-money incentive, where the participants need to bring their recyclables to designated points, managed to reduce residual waste by 0.08%; that was slightly higher than the SGB system in Thailand, which recycled 0.01% of total waste generation [5][6], and was comparable with the Waste Bank System in Surabaya, Indonesia, which recovered approximately 0.07% recyclables from the total waste generation [7][8].

However, the Barcode system, where an e-money incentive is given to participants who separate their recyclable at the source without the need for them to bring their waste to the recycling or collection centers, reduced the residual waste by up to 3.4%, which

was significantly higher than the RFL, SGB and Waste Bank systems [5][6][7][8]. The Barcode system is more effective than the other positive incentive systems because it solved recycling logistic issues considered problematic in the view of residents such as storage and transportation.

### **3.3.3.2 Comparison with negative incentive systems (PAYT)**

If we compare the Barcode system with the PAYT system that has been adopted in most developed countries, where residents need to pay for their residual waste based on weight or volume, the PAYT system has successfully reduced residual waste or waste generation or combustible waste (Japan) from 9% to 84% [3][9][10][11][12][13][14][15], much more than the Barcode system. Thus, source separation of recyclables can save money for residual waste discharge. This “negative incentive” can enhance participation of certain groups of residents or participants, who are attracted by a positive incentive that may be too low for certain groups of society in Malaysia (MYR 0.438/kg on average), to participate in source separation of recyclables because they need to pay more for their residual waste discharge unless they separate their recyclables.

PAYT may also be a more holistic system compared with the “positive incentive” such as the Barcode, RFL, SGB and Waste Bank systems because this “positive incentive” is only limited to certain recyclables that have a higher market value [5][6][7][8][16].

### **3.3.3.3 Tendency in difference among countries introducing PAYT**

Based on practices in eight countries that implemented PAYT (Chapter 2), in this research, we can divide them into three different systems, namely a) charge by volume based on bin size and collection frequency in Austria and France, b) charge by volume based on waste bags in Japan, Korea and Spain, and c) charge by weight in Germany, Sweden and Belgium [3][5][6][7][8][9][10][11][12][13][14][15][16].

For a) charge by volume based on bin size and collection frequency, the effectiveness of reduction in waste generation varied from 9% to 39%. Method b) charge by volume based on waste bags was more effective in reducing residual or combustible waste generation from 20% to 84% and c) charge by weight was quite stable in the reduction of residual waste at 44% to 66% [3][5][6][7][8][9][10][11][12][13][14][15][16].

According to previous research, weigh-based system appeared as the most effective measures in term of the reduction on waste generation and improvement on the recovery of recyclables, followed by prepaid bag system (charge by volume based on the bag) [13][18][19][20]. Meanwhile, volume-based system that using different sizes of bin, showed the worst [13][18][19][20].

### **3.3.3.4 Ratio of charge or incentive per year to annual GNI**

A significant relation can be observed between residual waste reduction and  $R_{CtoGNI}$ , the ratio of charge per year (C) and the annual GNI for both countries that implemented PAYT by method b), charging by volume based on waste bags, and countries that implemented PAYT by method c), charged by weight (Figure 3.7).

Torrelles de Llobregat, Spain has the highest  $R_{CtoGNI}$  with the highest residual waste reduction among countries that implemented PAYT using the chargeable waste bag system, followed by Seoul, South Korea and Japan. Aschaffenburg, Germany has the highest  $R_{CtoGNI}$  with the highest residual waste reduction among countries that implemented PAYT charged based on weight system, followed by Flanders, Belgium and Bjuv, Sweden [3][9][10][11][12][13][14][15]. This means that in general, a higher ratio between the charge per year and GNI will result in an effective PAYT system.

Thailand implemented a fixed charge system considered as PAYT [17]. Although Thailand had a higher  $R_{CtoGNI}$  than Indonesia and Malaysia, it had the lowest residual waste reduction, even though the SGB system among the three developing countries introduced positive incentives. This means that even when waste generators are charged a low fixed fee, the positive incentive seems not to be attractive for them. This phenomenon may be due to the fixed charge system that most probably kills the effort of waste generators to separate their recyclables because they will still be charged without saving, even if they successfully reduce their residual waste. In the fixed charge system, the proper setting of the charge is important.

In addition, even though the SGB system was adopted by 500 schools in 30 provinces all over Thailand, the systems have certain limitations such as the operation period, dependency on teachers that supervised the business and the logistic constraints in terms of transportation and storage [5]. This shows how important the system route itself to recover more recyclables and reduce more residual waste to landfill.

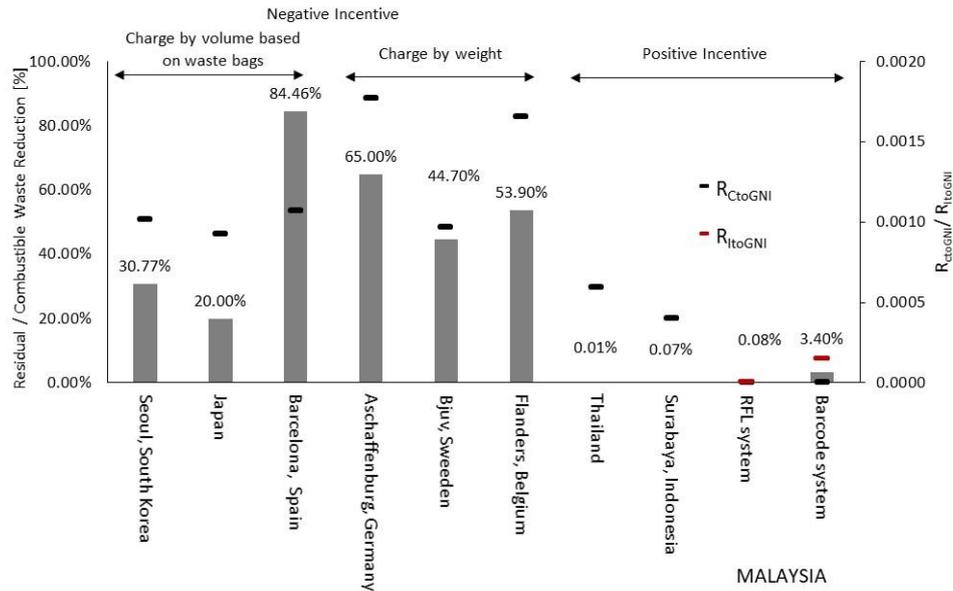


Figure 3.7: The relation between residual/combustible waste reduction,  $R_{CtoGNI}$  and  $R_{ItoGNI}$  [3][4][5][6][7][8][9][10][11][12][13][14][15][16][17][21][22][23][24][25][26][27][28][29][30]

### 3.3.3.5 Improvement of the e-money incentive system in Malaysia

Malaysia, which does not directly charge for its waste management services, has the highest residual waste reduction through both the RFL and Barcode systems among the countries with positive incentives, but the reduction is not sufficient compared with the developed countries.

The ratios of the estimated yearly incentive,  $I$  to GNI,  $R_{ItoGNI}$  are much lower for both the RFL and Barcode systems compared with  $R_{CtoGNI}$  in the developed countries. To reduce the residual waste effectively,  $R_{ItoGNI}$  should be increased to the same level as  $R_{CtoGNI}$ , if the effectiveness of positive and negative incentive systems can be considered as the same.

By contrast, the combination of positive and negative incentives depends on the proper setting of the negative incentive (excluding fixed charge) so that it may further

enhance the effectiveness of the systems in reducing residual waste generation and increasing recyclables collection.

For both the positive and negative incentives to work functionally, the recycling route from collection to usage should be improved. In particular, collection systems for the residents should be established.

Table 3.5 Comparison of Worldwide Incentives for Source Separation

Country (Region)	System	Details	Effect on Reduction	Reduction (Weight Base)	Reduction Rate
Positive Incentive					
States of Kedah and Perlis, Malaysia	RFL System	e-Money incentive (Recyclable collected at a designated point)	Residual waste going to landfill sites	1.17 kg/capita/day (2012) [4] to 1.1691 kg/capita/day (estimation)	0.08%
States of Kedah and Perlis, Malaysia	Barcode System	e-Money incentive (Recyclable collected at source)	Residual waste going to landfill sites	1.17 kg/capita/day (2012) [4] to 1.13 kg/capita/day (estimation)	3.40%
Thailand	SGB [5]	Monetary incentive using a bank system [5]	Residual waste [5]	Recycled 6.85 tonnes [5] from 70,000 tonnes of waste generated [6].	0.01% [5][6]
Surabaya, Indonesia	Waste Bank [7]	Monetary incentive using a bank system [7]	Residual waste [7]	Recycled 1.02 tonnes [7] from 1,512 tonnes of waste generated [8].	0.07% [7][8]
Negative Incentive					
Japan	PAYT	Charge by volume (waste bag)	Combustible waste	0.548 kg/capita/day (2005–2007) to 0.438 kg/capita/day (3 <sup>rd</sup> year implementation) [9].	20.07% [9]
Seoul, South Korea	PAYT	Charge by volume (waste bag) [10]	Residual waste [10]	1.3 kg/capita/day (1994) to 0.9 kg/capita/day (2000) [10]	30.77% [10]
Torrelles de Llobregat, Spain	PAYT	Charge by volume (waste bag) [3]	Non-biowaste (Refuse + packaging waste) [3]	0.868 kg/capita/day (Jan–Sept. 2002) to 0.135 kg/capita/day (Jan–Sept. 2003) [3]	84.45% [3]
Vienna, Austria	PAYT	Charge by volume (bin size and frequency of collection) [11]	Waste generation [11]	1.30 kg/capita/day to 1.18 kg/capita/day [11]	9.23% [11]
Les Sorinières, France	PAYT	Charge by volume (bin size and frequency of collection) [11][12]	Waste generation [11][12]	0.79 kg/capita/day to 0.48 kg/capita/day [11][12]	39.24% [11][12]
Aschaffenburg, Germany	PAYT	Charge by weight (measured) [13]	Residual waste [13]	0.45 kg/capita/day (1995) to 0.15 kg/capita/day (2013) [13]	66.7% [13]
Bjuv, Sweden	PAYT	Charge by weight (measured) [11][14]	Residual waste [11][14]	0.674 kg/household/day (1999) to 0.373 kg/household/day (2000) [11][14]	44.66% [11][14]
Flanders, Belgium	PAYT	Charge by weight (measured) [15]	Residual waste [15]	0.89 kg/capita/day (1995) [11] to 0.41 kg/capita/day (2012) [15]	53.93% [11][15]

### 3.4 Summary

This study evaluated two e-money incentive systems: the RFL and the Barcode systems in Malaysia. The RFL system was effective in promoting separation of recyclables at source, and in just 18 months the system collected 838 t of recyclables, resulting in a reduction of 0.075% in current waste generation.

However, the Barcode system was significantly more effective than RFL because the incentive is given to the residents who do not need to bring their recyclables to designated points. The system successfully increased the collection of recyclables by more than 3000% and caused an estimated 3.4% reduction in current waste generation.

In Malaysia, the ratio of the incentive to GNI was only 0.00015, which seemed to be still low compared with other countries that implemented a negative incentive (0.0009–0.0018). To make the positive incentive system more effective, a higher ratio of the incentive to GNI is required, or in other words, to enhance the collection of recyclables a more attractive incentive rate is indispensable.

To improve the separation of recyclables further at source and to reduce residual waste generation, Malaysia needs to consider the introduction of a negative incentive system, such as PAYT. At the same time, the recycling route from collection to consumption should be improved and expanded to a larger variety of recyclables, including food waste, which constitutes 44.5% of Malaysian waste composition.

Because the effectiveness of PAYT depends on the relation between the charging amount and the resident's income, a further study that explores the Malaysian willingness to pay or determine the acceptable marginal charge is needed before its adoption.

## Appendices



Appendix 1: States where RFL was implemented

Appendix 2: Explanation of symbols and values in this study

Symbols	Definitions and references
<b>Evaluation for the RFL system</b>	
PR [-]	Participation ratio
$N_{sc}$ [cards]	Number of distributed RFL smart cards: 30,374
$N_{pre}$ [premises]	Number of premises served by EI for waste collection: 381,453
MADI [MYR/month]	Monthly average distributed incentive
$TI_{om}$ [MYR]	Total incentive for objective months
OM [month]	Objective months
ARI [MYR/kg]	Average recyclable incentive
$TI_{RFL}$ [MYR]	Total incentive: MYR 367,376.22
$TCR_{RFL}$ [kg]	Total collected recyclables: 838,000 kg
$RWR_{RFL}$ [kg/capita/day]	Residual waste reduction for the RFL system
Isep2019 [MYR]	Incentive in September 2019: MYR 28,139.53
$N_{kedah}$ [persons]	Citizens of Kedah: 2,185,000 [21]
$N_{perlis}$ [persons]	Citizens of Perlis: 254,600 [21]
<b>Evaluation of the Barcode system</b>	
$TI_{bs}$ [MYR]	Total incentive for the Barcode system
$TCR_{bs}$ [kg]	Total collected recyclable: 4,500 kg
$Com^i$ [-]	Composition rate of recyclable i
$IR^i$ [MYR]	Incentive rate for recyclable i
$I_h$ [MYR/household/month]	Incentive per household
$N_{om}$ [month]	Number of objective months: 3.5 months
$N_h$ [households]	Number of households: 250 households
$RWR_{bs}$ [kg/capita/day]	Residual waste reduction for the Barcode system
HS [persons/household]	Household size: 4.31 persons/household [22]
$N_{od}$ [days]	Number of objective days: 105 days
<b>Comparison between worldwide incentive systems</b>	
$C_w$ [MYR/kg]	Charge per weight € 0.18/kg (without basic fee and collection fee) [13] € 0.175/kg (average Euro 0.15–0.20) [23] £ 0.18/kg [11][14]
$C_{wfv}$ [MYR/kg]	Charge per weight changed from charge per volume
$C_v$ [MYR/L]	Charge per volume JPY 2/L [24] USD 0.0155/L [10] € 0.015/L [3]
$\rho_{waste}$ [kg/L]	Waste density: 0.1632 kg/L [25]
$C_{wfh}$ [MYR/kg]	Charge per weight changed from charge per household
HS [persons/household]	Household size 2.94 persons/household (Bangkok) [26] 3.63 persons/household [7]
$C_h$ [MYR/household/month]	Charge per household per month Rp 6250 (Average of maximum and minimum household charge) [27] Bhat 30 (Average of Bhat 20–40) [17]

TW [kg/capita/day]	Total waste generation (kg/capita/day) 0.53 [7] 0.60 [26] 0.92 [28] 0.90 [10] 0.85 [3] 1.16 [29] 0.67 [11][14] 1.08 [13]
D <sub>m</sub> [days/month]	Days per month: 30 days/month
C [MYR/capita/year]	Charge per person per year
D <sub>y</sub> [days/year]	Days per year: 365 days/year
R <sub>CtoGNI</sub> [-]	Ratio of the charge per year to gross national income
GNI [MYR/capita/year]	GNI per person per year Malaysia: USD 10,590 [30] Indonesia: USD 3,840 [30] Thailand: USD 6,610 [30] Japan: USD 41,310 [30] South Korea: USD 30,600 [30] Spain: USD 29,340 [30] Germany: USD 47,090 [30] Sweden: USD 55,490 [30] Belgium: USD 45,910 [30]
I [MYR/capita/year]	Incentive per person per year
R <sub>ItoGNI</sub> [-]	Ratio of the incentive per person per year to GNI per person per year

## References

- [1] Government of Malaysia (2019) National Sanitation Policy
- [2] National Solid Waste Management Department of Malaysia (NSWMD) (2015)  
<https://jpspn.kpkt.gov.my/index.php/pages/view/127>.
- [3] I. Puig-Ventosa (2008) Charging Systems and PAYT Experience for Waste Management in Spain, *Waste Management* 28: 2767–2771
- [4] GSR (2012) Survey on SW Composition, Characteristic & Existing Practice of SW Recycling in Malaysia
- [5] S. Suttibak, V. Nitivattananon (2008) Assessment of Waste Recycling Performance: A Study of School Garbage Banks in Thailand, *GMSARN International Journal* 2: 83–90
- [6] A. Singseewo, K. Klaoklang (2017) Promoting of a Waste Recycling Bank in Schools: A Case in a Municipality School in Thailand, *New Trends and Issues Proceedings on Humanities and Social Sciences* 4: 329–334
- [7] D.R. Wijayanti, S. Suryani (2015), Waste Bank as Community-based Environmental Governance: A Lesson Learned from Surabaya, *Procedia-Social and Behavioral Sciences* 184: 171–179
- [8] IGES (2017) Development of Work Plan for Reducing SLCPs for MSWM in Surabaya, Indonesia
- [9] Ministry of Environment Japan (MOEJ) (2013) Guidance on charged system for municipal solid waste

- [10] J.H. Kim (2004) Sustainable Urban Waste Management System in Metropolitan Seoul, South Korea, The Sustainable City III, 2004 WIT Press, ISBN 1-85312-720-5
- [11] Eunomia Research & Consulting (2003) Waste Collection: To Charge or Not to Charge
- [12] Dette B., Julich R., Buchert M., Bukhave M., Dopfer J., Roig J.E.I., Gerken I., Koppers P., Schneider M., Sorensen S.Y., Stevanato P., Villa L (1999). Waste Prevention and Minimisation, Final Report. Commissioned by the European Commission, DG XI
- [13] J. Morlok, H. Schoenberger, D. Styles, J.-L. Galvez-Martos, B. Zeschmar-Lahl (2017) The Impact of Pay-As-You-Throw Schemes on Municipal Solid Waste Management: The Exemplar Case of the County of Aschaffenburg, Germany, Resources 6: 8; doi:10.3390
- [14] Hogg D., Stark W., Callens A., Bogaert G., Christensen E.H., Heikkonen V., Ledore A., Stahl H., Economides D., Tsalas A., Favoino E., Ricci M., Carlsson M. (2002). Financing and Incentive Schemes for Municipal Waste Management: Case Studies, Final Report to DG Environment, European Commission
- [15] OVAM (2014) Good Practice Flanders: PAYT
- [16] IGES (2017) Planning and Implementation of Integrated Solid Waste Management Strategies at Local Level: The Case of Surabaya Cities
- [17] Climate and Clean Air Coalition Municipal Solid Waste Initiative (CCAC) (2015)

- [18] E. Dijkgraaf and R.H.J.M Gradus (2004) Cost Savings in Unit-Based Pricing of Household Waste: The Case of The Netherlands, *Resource and Energy Economics* 26: 353–371
- [19] Impact on Unit-Based Collection Charges (2006). Working Group on Waste Prevention and Recycling. ENV/EPOC/WGWPR(2005)10/FINAL
- [20] Watkins E., Hogg D., Mitsios A. Mudgal S., Neubauer A., Reisinger H., Troeltzsch J., Acleyen M.V. (2012). Use of Economic Instruments and Waste Management Performances.
- [21] DOSM (2019) Exhibit 1: Demographic statistic by state, third quarter 2019
- [22] DOSM (2010) Table 3: Average Household Size by State, 1980–2010
- [23] C. Allen (2012) Flanders, Belgium: Europe’s Best Recycling and Prevention Program
- [24] City of Sapporo (2018) Category and price of designated bags
- [25] U.S. Environmental Protection Agency (EPA) (2016) Volume-to-Weight Conversion Factors
- [26] T. Kamuang (2017) Country Chapter, State of the 3Rs in Asia and the Pacific, Thailand, UNCRD
- [27] Peraturan Daerah Kota Surabaya Nomor 4 Tahun 2000: Tentang Retribusi Pelayanan Persampahan/ Kebersihan
- [28] MOEJ (2017) <https://www.env.go.jp/press/files/press/1dtgw29.pdf>

- [29] European Commission (EU) (2016) Background Report on Best Environmental Management Practices in the Waste Management Sector, Table 3.2
- [30] World Bank (2018) Gross National Income per capita

## CHAPTER 4

### **‘Zero Budget System’ A new mechanism in enhancing separation of recyclables at source in Malaysia**

#### **4.1 Introduction**

As indicated in 3<sup>rd</sup> chapter, e-money incentive system in Malaysia are effective in reducing residual waste generation by between 0.08% and 3.4% [1]. Similar monetary incentive systems implemented in neighboring developing countries (i.e., Indonesia and Thailand) are effective for recovering recyclables from waste generation at a rate of between 0.01% and 0.07% [2, 3, 4, 5, 6, 1].

While worldwide review result in chapter 2 and 3 also showed that a pay-as-you-throw (PAYT) system, which we categorized as “negative incentive” (a charging system based on the amount of residual waste generation), has been implemented in many developed countries and successfully reduced residual or combustible waste (e.g., in Japan) by a rate of between 9% and 84% [7, 8, 9, 10, 11, 12, 13, 14, 1]. Although it may not technically appropriate to conclude the effectiveness of PAYT simply by comparing the reduction in residual or combustible waste, as such reduction also occurred because of other factors such as the collection system, facilities, and the market for recyclables, it is undeniable that PAYT contributed to the results as a major factor.

This means that negative incentive is an adequate tool to enhance the reduction of residual waste generation and the collection of recyclables, especially in developing countries that have implemented a positive incentive system. Based on this, we propose

a Zero Budget System, which is a hybrid that combines positive and negative incentives, to further enhance reduction of residual waste generation, and to improve recycling toward the realization of a zero-carbon society and a circular economy.

Under the proposed Zero Budget System, residents are charged for their discarded residual waste and receive a monetary incentive for separating recyclables. Ideally, if residents separate their recyclables at a certain level, the total cost is balanced with a reward, and if they separate more, the reward may exceed the charge. However, actual implementation might differ based on the setting of the charging and incentive amounts, which depends on acceptance among residents.

Previous study showed that the residents' willingness to pay is affected by the improvement in the waste management system, such as in Nepal, where nearly 61% of respondents are willing to pay and the main reason for their support is to ensure that their surroundings are clean [15]. In Korea, a study on residents' willingness to pay for improving the waste disposal system revealed that respondents' high preference is on a clean food-waste collection facility [16].

This means that a proper design for the proposed system is indispensable; it should include a service of recyclables collection and residual waste, a monetary incentive for separated recyclables, a subsidy for waste bins, etc.

Given that the system should be designed by considering public acceptance, in particular willingness regarding a trade-off between charge amount and other attributes, we adopted a conjoint analysis, which is often used for system design, including trade-off issues [17, 18, 19]. This chapter aims to explain the design of the implementation plan

for the Zero Budget System in residential areas, and to identify the marginal charge and incentive amount.

### **Waste management system in Malaysia**

In general, the Malaysian waste management system can be divided into two categories: federalized and non-federalized state systems.

As in most countries, waste management in Malaysia is under the purview of local authorities [20]. Due to capability limitations of local authorities in the country, the federal government decided to step in to improve waste management services by federalizing and privatizing the system [21].

However, due to political, legislation and administration limitations, the exercise only involved six states and two federal territories, namely Johor, Melaka, Negeri Sembilan, Pahang, Kedah, Perlis, Kuala Lumpur, and Putrajaya. In other states, local authorities maintained executive power regarding waste management.

This phenomenon resulted in two waste management systems in Malaysia that are mentioned later in this study as a system of federalized and non-federalized states. A general comparison of these two systems is presented in Table 4.1.

Table 4.1 Comparison Between Federalised and non-Federalised States

	Federalised States	Non-Federalised States
Executive power on waste management	Federal Government (Fed)	Local Authorities (LA)
States/ Federal Territories	Johor, Melaka, Negeri Sembilan, Pahang, Kedah, Perlis, Kuala Lumpur, and Putrajaya	Selangor, Perak, Pulau Pinang, Kelantan, Terengganu, Sabah, Sarawak, and Labuan
Service provider	Concessionaires appointed by Fed. (22 years concession)	<ul style="list-style-type: none"> <li>• In house; or</li> <li>• Outsource by short term contracts.</li> </ul>
Service	<ul style="list-style-type: none"> <li>• Special collection for recyclables (door-to-door)</li> <li>• Residual waste bin provided and fully subsidized by Fed.</li> <li>• Residual waste collected 2 times per week*</li> </ul>	<ul style="list-style-type: none"> <li>• No special collection for recyclables</li> <li>• No residual waste bin provided by LA**</li> <li>• Residual waste collected 3 times per week***</li> </ul>

\* standard service level for landed properties

\*\* might differ in certain areas

\*\*\*standard service level for landed properties but might differ in certain areas

## 4.2 Procedure of analysis

We applied a two-step analysis in this study (Fig. 4.1). The first analysis was conducted to clarify respondents' willingness to pay and willingness to participate in the Zero Budget System, as well as to identify attributes that influence residents' acceptance of the charging system via a questionnaire survey. The second-step analysis was conducted to design the implementation plan for the Zero Budget System, and to identify its marginal charge and incentive amount by a conjoint analysis using attributes identified in the first-step analysis.

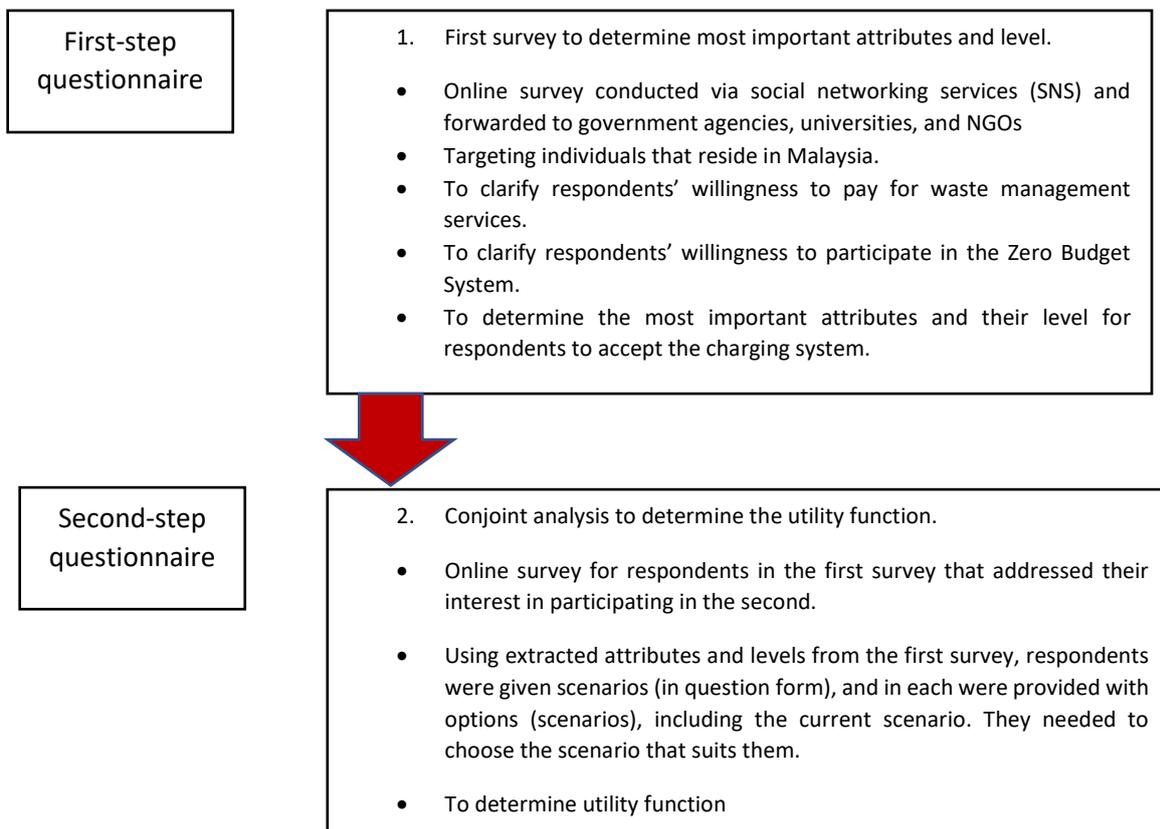


Fig. 4.1 Two-step questionnaire flow

## **4.3 First-step analysis**

### **4.3.1 Methodology**

Due to limitation by COVID-19 pandemic, the first-step analysis survey was conducted through an online platform as the only available method since mail services were affected by the pandemic and face-to-face interview will increase risk of infection. The questionnaire was distributed online from September 7 to November 1, 2020, through social networking services (SNS) and also forwarded to government agencies, universities, and non-government organizations including consumer association, environmental association, manufacturer association and workers' association.

In the questionnaire as Table 4.2, the respondents were asked about their willingness to pay for the waste they produced/disposed of, their opinion on the newly introduced Zero Budget System and whether they approve of such a system being implemented in Malaysia.

The respondents were then given 13 attributes as per and asked to choose the five most important ones that the government needs to consider in obtaining support from citizens support for this charge system.

The respondents were also asked about the level of the attributes by multiple-choice answers. If they did not agree with the choice given, they could also write down their own answer.

At the end of the questionnaire, the respondents were also asked about their willingness to participate in the second questionnaire.

Table 4.2 Questions used in First Survey

---

Question 1: Do you agree if household waste is charged, and the money will be used for waste management? (Separated recyclables such as plastic, paper and aluminium will not be charged)

Explanation: Zero Budget System' is a system proposed by us as one of PAYT system where you will be charged for your household waste, and you will be received monetary reward for separated recyclables. Ideally, if you separated your recyclables at certain level total cost will be balanced with reward and if you separate more, you may get more money than charge. In another word, there will be no cost increment if you fully separated your recyclables through 'Zero Budget System`

Question 2: Do you agree if 'Zero Budget System' is implemented Malaysia?

Question 3: If pay as you throw system (PAYT) is about to be implemented in Malaysia, please choose 5 main factors/ attributes from below that government need to focus to get citizens' support.

1. Residual waste collection method
2. Collection frequency of residual waste
3. Individual waste bin for residual waste provided by Government
4. Charging amount for residual waste
5. Charging method on residual waste
6. Type of recyclables accepted by recycling center
7. Collection method for recyclables
8. Acceptable distance of recycling center from home
9. Monetary incentive method for separated recyclables
10. Collection's frequency of recyclables
11. Amount of incentive to separated recyclables
12. Application of high technology waste treatment facility
13. Reduction/ elimination of illegal dumping cases in the living area

Question 4: Please choose the attributes level or please fill in your own answer if you do not agree with choice given

1. Residual waste collection method
  - i. Door to door collection
  - ii. Collection at designated point

- iii. Other (Please write)
2. Collection frequency of residual waste
    - i. Once per week
    - ii. Twice per week
    - iii. Three times per week
    - iv. Other (Please write)
  3. Individual waste bin provided by Government to each household (Government subsidy for waste bin in each household)
    - i. 100%
    - ii. 50%
    - iii. Other (Please write)
  4. It is estimated that total cost for waste management from collection to final disposal is about RM 30/month for residential household or RM 0.20 for each kilogram of waste. However, the amount may not enough to manage waste more properly and to minimize pollution. What is the payment rate that acceptable for you to manage your waste in a manner where environment is protected
    - i. MYR 60 per month or MYR 0.40/kg
    - ii. MYR 30 per month or MYR 0.20/kg
    - iii. MYR 15 per month or MYR 0.10/kg
    - iv. I don't want to be charged at all
    - v. Other (please write)
  5. Charging method on residual waste
    - i. Charge based on weight of waste
    - ii. Charge based on size of specified waste bag
    - iii. Charge based on waste bin size
    - iv. Other (Please write)
  6. Type of recyclables accepted by recycling centre
    - i. Only accepting recyclables with high market value such as paper, plastic and metal
    - ii. Accepts all separated recyclables exclude food waste
    - iii. Accepts all separated recyclables include food waste
  7. Collection method for recyclables
    - i. Door-to-door collection

- ii. Collection at designated point
  - iii. Other (please write)
8. Acceptable distance of recycling centre from home
- i. 0–500 m
  - ii. 501 m–5 km
  - iii. 5–10 km
  - iv. More than 10 km
9. Monetary incentive method
- i. Monetary incentive will be given when recyclables brought to recycling centre
  - ii. Monetary incentive will be given on separated recyclables at source on collection day without any need to bring it anywhere
  - iii. Other (Please write)
10. Collection's frequency of recyclables if it collected from door-to-door
- i. Once per fortnight
  - ii. Once per week
  - iii. Twice per week
11. In average, we estimate high value recyclables that consist of metal, plastic, paper etc. worth of MYR 0.59/kg (Depend on market value). How much incentive do you need to separate your recyclables
- i. MYR 0.30/kg
  - ii. MYR 0.60/kg
  - iii. MYR 0.90/kg
  - iv. More than MYR 0.90/kg
12. Application of high technology waste treatment facility
- i. Dump site
  - ii. Sanitary landfill
  - iii. Waste to energy facility
  - iv. Other (Please write)
13. Reduction/ Elimination of illegal dumping cases in the living are

- i. More public awareness campaign
- ii. Strengthen monitoring and enforcement system)
- iii. Cleansing of illegal dumping site
- iv. Others (Please write)

14. Please write if you have any proposal to encourage acceptance for pay as you throw system (PAYT) for waste management

Question 5: Do you agree to consider to participate in the 2<sup>nd</sup> phase of questionnaire?

---

### **4.3.2 Results and discussion**

#### **4.3.2.1 Number of respondents and distribution**

In this study, we achieved 451 respondents. All respondents were in the Malaysian current voting age range [22]. This means that all the results are politically crucial in estimating residents' responses to the proposed system. Respondents aged 31–40 years accounted for the largest group, followed by 41–50 years, with 2% of the respondents in the retiree age range.

In terms of economic background, the respondents represented all ranges of household income, with 20% coming from the low-income group, 37% from middle-income, and 43% from the high-income group. Details of respondent attributes are shown in Table 4.3.

We also need to address the limitation in this survey that unavoidably conducted via online that maybe an effect in term of bias from certain group such as high education background, high household income or age range.

Table 4.3 Respondent attributes for first questionnaire

		Percentage (%)
Age (years)	21–30	13
	31–40	55
	41–50	23
	51–60	7
	61 and above	2
Gender	Male	45
	Female	55
State of residence	Federalized state	44
	Non-federalized state	56
Household Income	B40 (MYR 4000/month or less)	20
	M40 (MYR 4001–8500/month)	37
	T20 (MYR 8501 and above)	43
Education level	Secondary school and below	7
	Diploma or equivalent	15
	Undergraduate degree or equivalent	44
	Postgraduate degree or equivalent	34

#### 4.3.2.2 Willingness to pay

As shown in Figure 4.2, nearly 57% of respondents from federalized states and 62% from non-federalized said that they agreed to be charged for waste management. These percentages are higher than that of a previous study where only 34% of respondents agreed that the PAYT system is appropriate for implementation in Malaysia [23].

This situation may be due to the success of the privatization of waste management from September 2011 and the enforcement of separation-at-source through mass media from September 2015, which raised awareness not only among residents of federalized states, but also those of non-federalized states.

However, as mentioned in subsection of 4.3.2.1, we need to admit that the effect in term of bias from certain group such as high education background, high household income or age range cannot be denied.

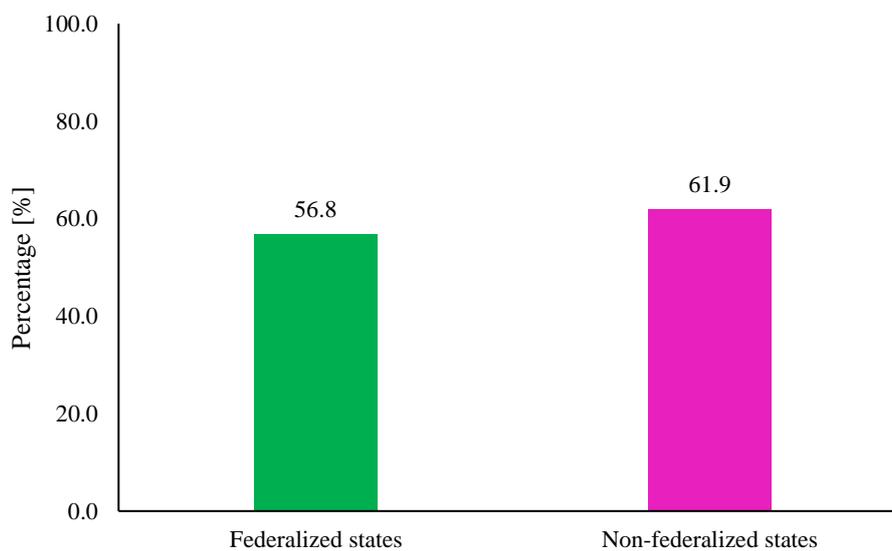


Figure 4.2: Citizens Willingness to Pay for Waste Management

In order to rectify the bias effect, we applied sample balancing or raking [24], using Malaysian 2014 household income structure [25] and population by gender 2021 [26] as Fig. 4.3 (Data highest education level for population above 21 years old and above, and population by age group 10 years gap for example 21-30 years old or 31-40 years old are currently unavailable). After rectified the data and considering economy background and gender effect, we found that respondents' willingness to pay for waste management in Federalized states varies from 55.8% to 56.7%. While in non-federalized states it varies from 60.9% to 61.6%.

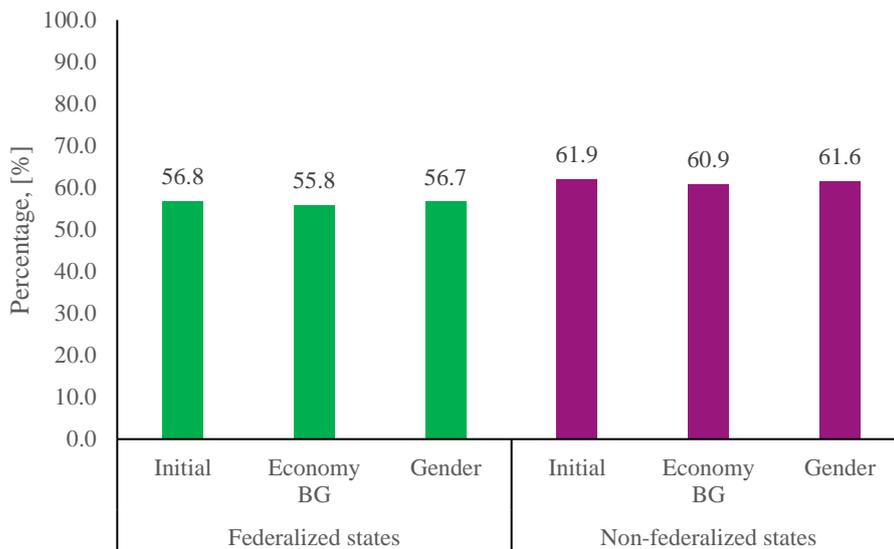


Figure 4.3: Citizen willingness to pay after considering bias effect

#### 4.3.2.3 Acceptance of the Zero Budget System

Even though it is admitted that was a possibility some bias in term of respondents' attributes might affected the results, as showed in Figure 4.4, after the Zero Budget System concept was explained to the respondents, 71% of those from federalized states,

and 70% of those from non-federalized states expressed their support for the new system if it was to be implemented in Malaysia. This level of support is higher than that for PAYT because the former may be considered a fairer system, where residents that separate their recyclables receive some benefit for their efforts instead of a charge alone.

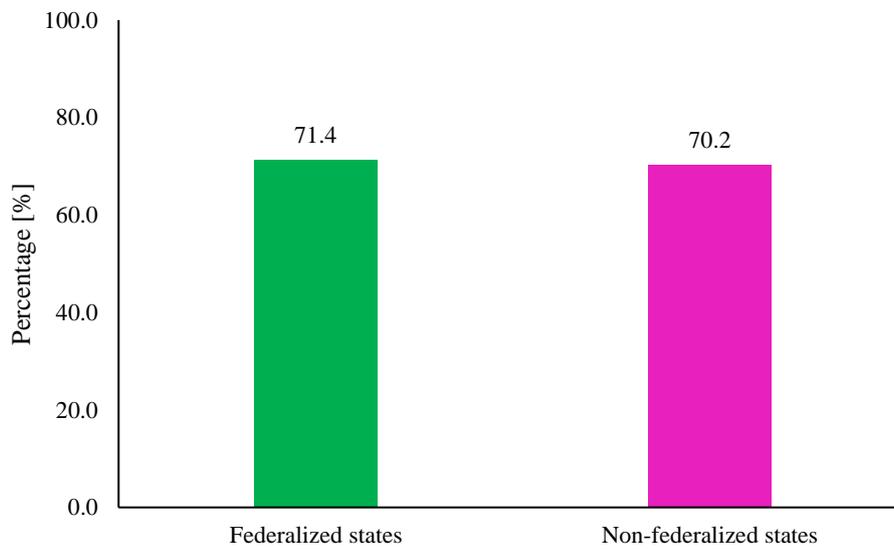


Figure 4.4: Citizens Support on Implementation of 'Zero Budget System' in Malaysia

Same as subsection of 4.3.2.2, in order to rectify the bias effect, we applied sample balancing or raking [24], using Malaysian 2014 household income structure [25] and population by gender 2021 [26] as Fig. 4.5. After the rectification considering economy background and gender effect, we found that the supporting percentage of 'Zero Budget System' vary from 64.6% to 71.3% in federalized states and 67.5% to 70.1% in non-federalized. However, the fact that 'Zero Budget System' showed higher support than just pay as you throw is not changed.

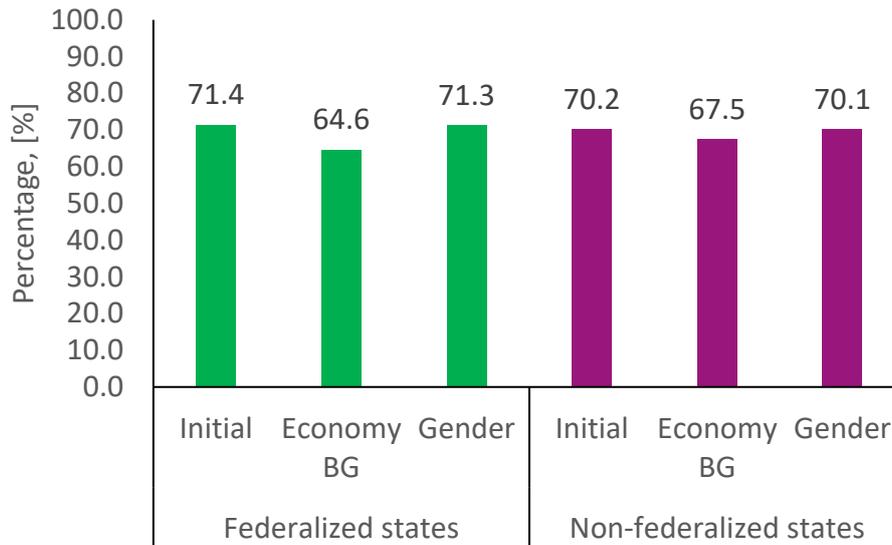


Fig. 4.5 Citizens Support on Implementation of 'Zero Budget System' in Malaysia after considering bias effect

#### 4.3.2.4 Most important attributes

As shown in Figure 4.6, the following five main attributes were chosen by respondents from both federalized and non-federalized states, when asked about the main factors that the government needs to focus on if charging system to dispose residual waste is implemented in Malaysia.

- i. Amount of monetary incentive for separated recyclables
- ii. Monetary incentive method for separated recyclables
- iii. Collection method for recyclables
- iv. Individual bin to be provided by government
- v. Collection frequency of household waste (residual waste)

These attributes were chosen based on five highest vote counts that it received among other attributes. Respondents in both federalized and non-federalized states had chosen

the same attributes. In other words, respondents from both kinds of states showed the same desire in terms of incentive amount for separated recyclables, collection method for separated recyclables, collection frequency of residual waste and individual waste bin.

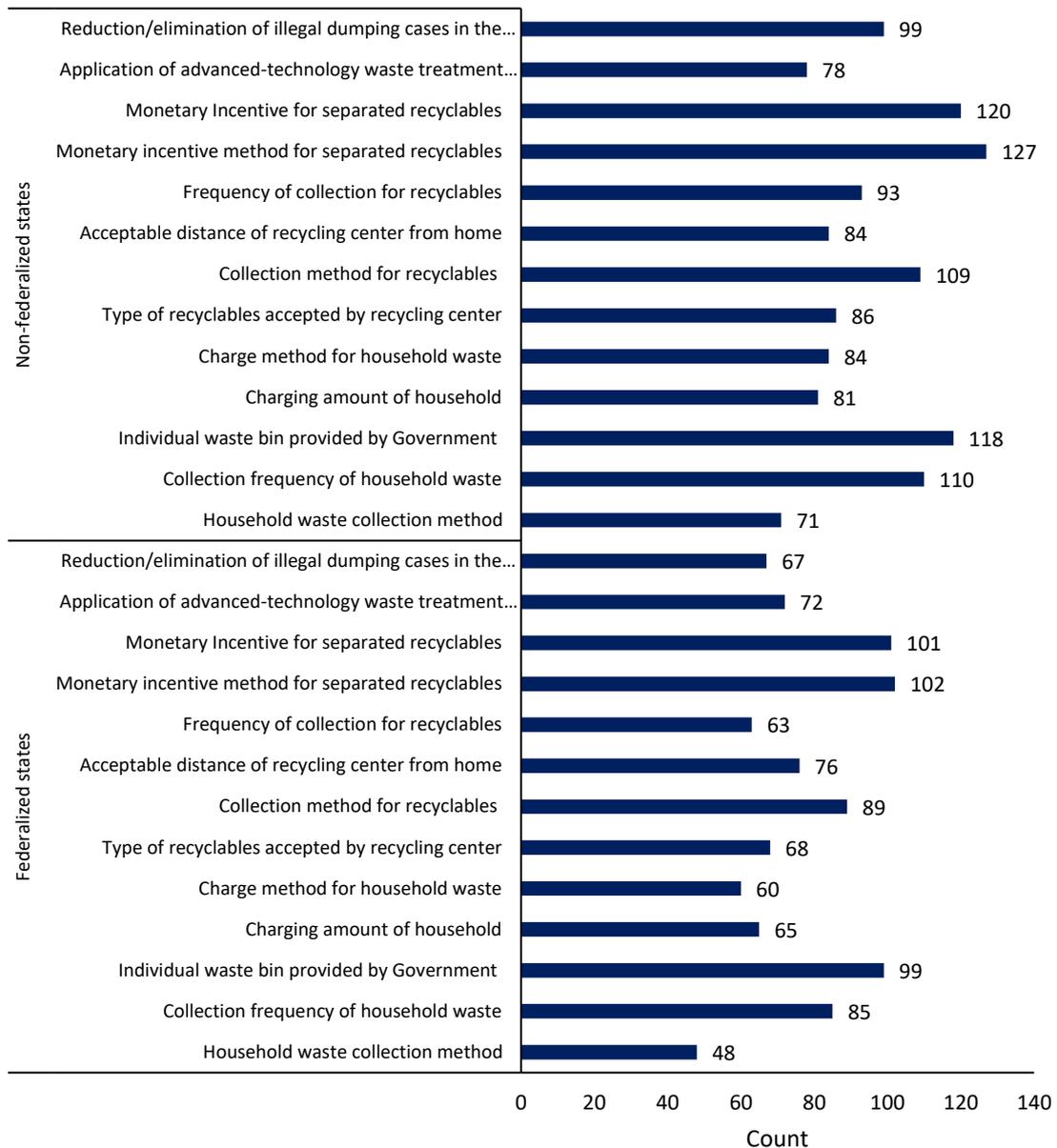


Figure 4.6 5 Main Factors that Government Needs to Focus to Secure citizens Support on Charging System

\*\*1 For respondents that choose more than 5 attributes, only the first five are considered in the analysis.

Using this method and by SPSS software (Hierarchical cluster using binary Euclidean distance), in federalized states, we clustered the attributes into 4 clusters namely, charging system, incentive for recycling, convenience to public and general support system as shown in Figure 4.7A. As charging system, incentive for recycling and convenience to public was considered as a very significant cluster that directly influenced the public, the chosen 5 attributes were from these 3 clusters.

While for non-federalized states, as shown in Figure 4.7B, we also clustered the attributes into 4 clusters which are consist of charging system, incentive for recycling, convenience to public and recycling facility. Since charging, incentive for recycling and convenience to public also considered as clusters that directly influenced the public, the chosen 5 attributes were from these 3 clusters.

As shown in Figure 4.6 also, 2 out of 5 chosen attributes were related to incentive method, and these 2 attributes also received the most vote counts compare to others. This mean that, incentive is the most crucial attributes to be focused and proved the concept of 'Zero Budget System' that combined positive and negative incentive is a more acceptable approach then only charged alone.

Because the monetary incentive method and the recyclables collection method are interrelated attributes, we combined them into one, meaning that the incentive method was based on the recyclables collection method. We also included the charged amount for residual waste as one of the attributes in the second-step analysis, as it is one of the most important factors to be considered in designing the system.

Finally, for both federalized and non-federalized states, we had selected 5 attributes namely,

1. Collection frequency of household (residual waste)
2. Individual waste bin provided by government
3. Charging amount of residual waste
4. Collection method for recyclables
5. Monetary incentive (amount) for separated recyclables

They come from 3 major clusters that had directly influenced the public financially (charge and incentive) and waste management services (convenience to public).

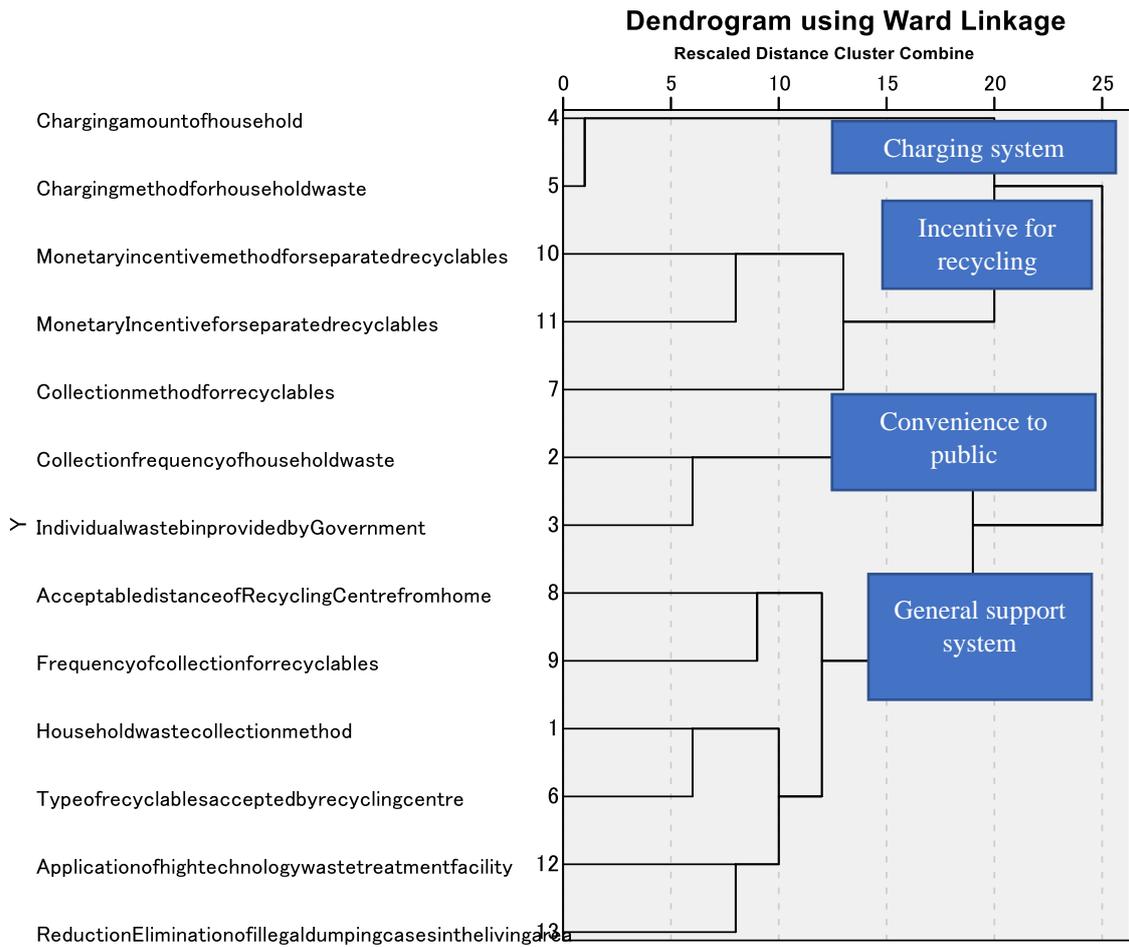


Figure 4.7A: Dendrogram of clustered attributes (Federalized)

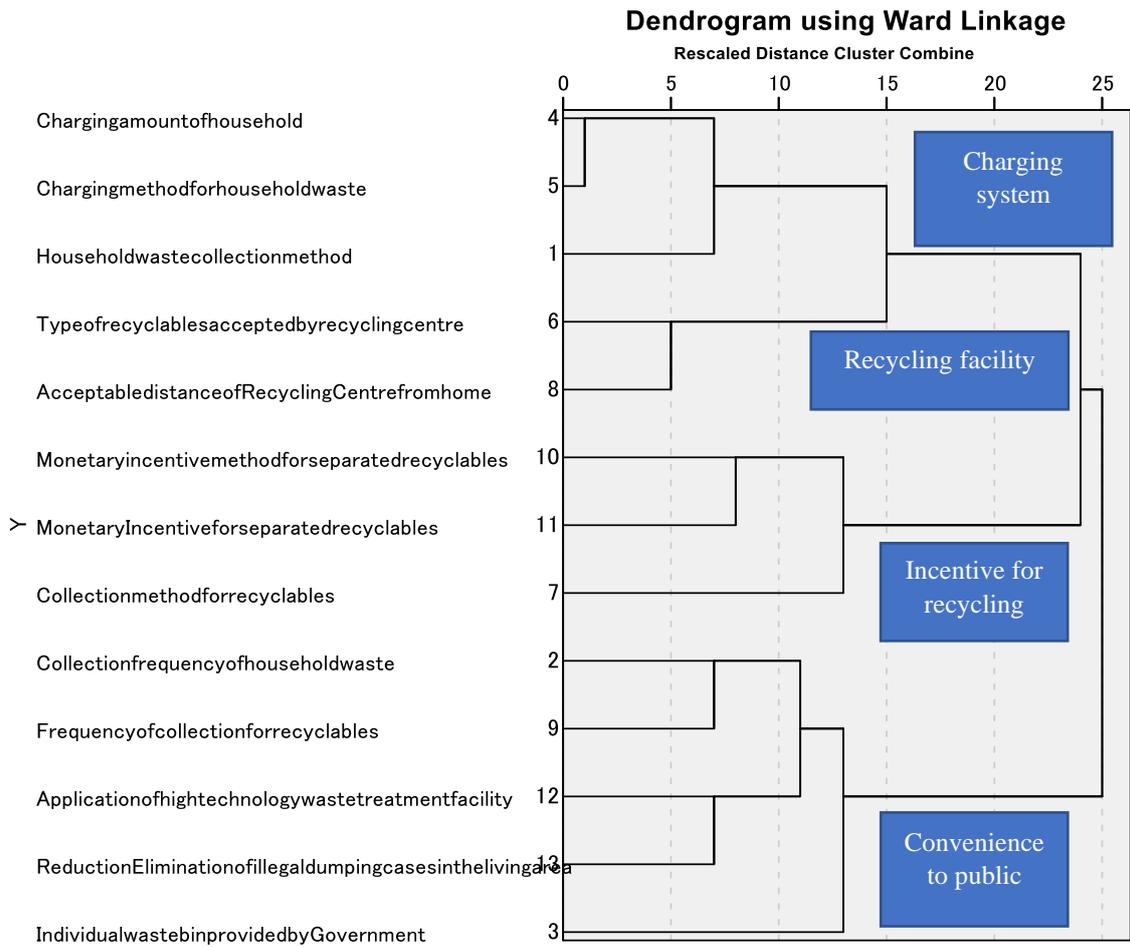


Figure 4.7B: Dendrogram of clustered attributes (Non-federalized)

— Attributes that marked underline with red was selected for second step-analysis

As showed in Figure 4.8A, level of percentage subsidy of waste bin was chosen the most chosen percentage which was 100%, 50% and 0%, while as showed in Figure 4.8B, we chose door-to-door and collection at designated points for separated recyclables. As indicated in Figure 4.8C, residual waste collection frequency was chosen between once per week to 3 times per week. However, as showed in Figure 4.8D, even though 16% of respondents chose monetary incentive amount more than MYR 0.90/kg, this level is considered unfeasible to be implemented. While as showed in Figure 4.8E, even though 30% of respondents chose not to be charged at all, charge amount at MYR 0/kg cannot be considered in the study. The final extracted attributes and level is summarized in Table 4.4.

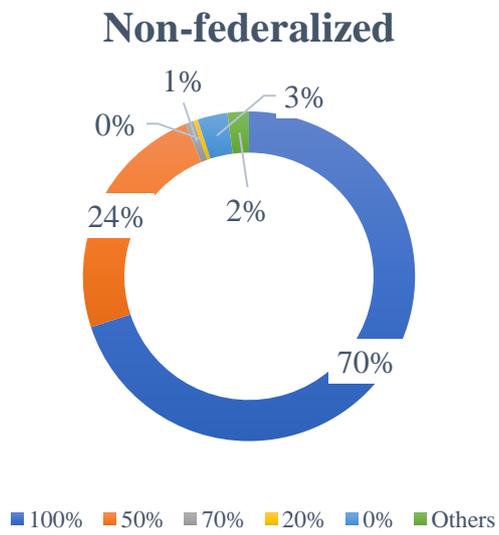
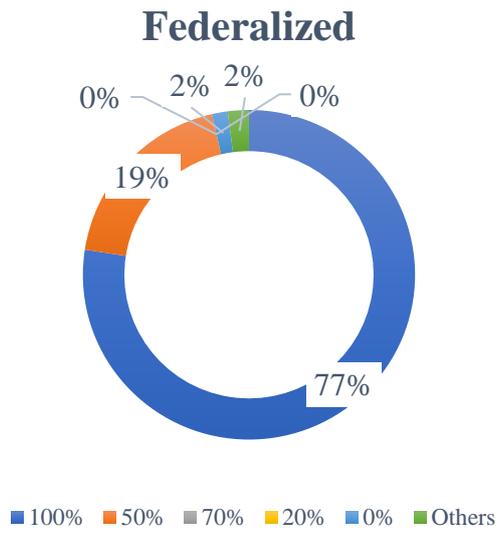
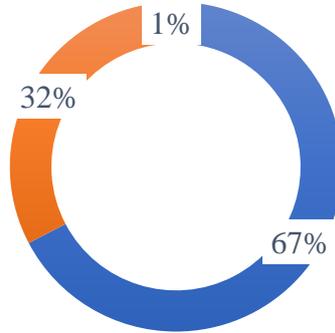


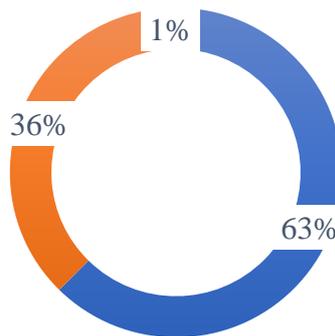
Figure 4.8A Level for Percentage of Subsidy on Waste Bin

### Federalized



■ Door-to-door ■ Collection at designated point ■ Others

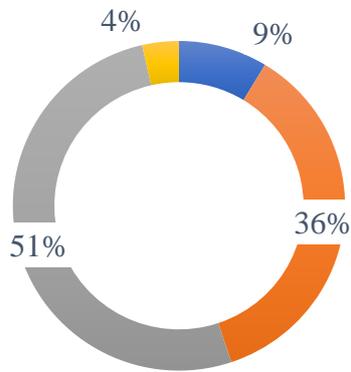
### Non-federalized



■ Door-to-door ■ Collection at designated point ■ Others

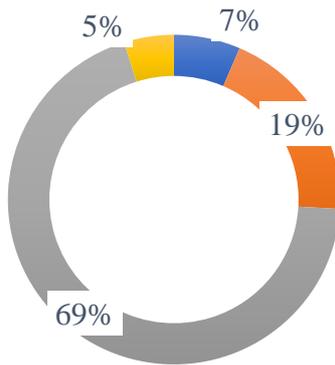
Figure 4.8B Level of collection method for recyclables

### Federalized



■ Once per week ■ Twice per week ■ Three times per week ■ Other

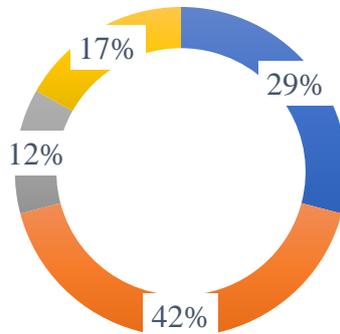
### Non-federalized



■ Once per week ■ Twice per week ■ Three times per week ■ Other

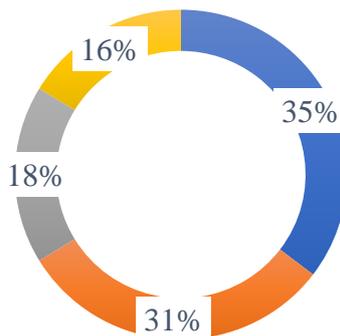
Figure 4.8C Level of frequency on collection of residual waste

### Federalized



■ MYR 0.30/kg ■ MYR 0.60/kg ■ MYR 0.90/kg ■ More than MYR 0.90/kg

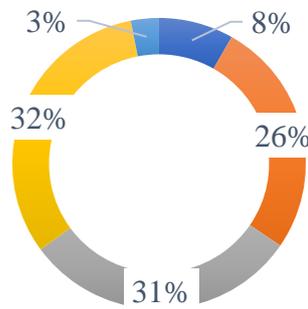
### Non-federalized



■ MYR 0.30/kg ■ MYR 0.60/kg ■ MYR 0.90/kg ■ More than MYR 0.90/kg

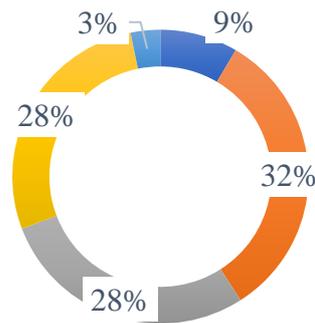
Figure 4.8D Level of incentive amount for separated recyclables

### Federalized



- MYR 60/month or MYR 0.40/kg
- MYR 30/month or MYR 0.20/kg
- MYR 15/month or MYR 0.10/kg
- I don't want to be charged at all
- Other

### Non-federalized



- MYR 60/month or MYR 0.40/kg
- MYR 30/month or MYR 0.20/kg
- MYR 15/month or MYR 0.10/kg
- I don't want to be charged at all
- Other

Figure 4.8E Level of charge amount for residual waste

Table 4.4: Extracted attributes and level

Attribute	Level		
Incentive amount for separated recyclables	MYR 0.30/kg	MYR 0.60/kg	MYR 0.90/kg
Subsidy for individual waste bins	0%	50%	100%
Collection method including incentive for recyclables	Door to door	At designated point	
Collection frequency for residual waste	Once per week	Twice per week	Three times per week
Charge amount for residual waste	MYR 15/month (MYR 0.10/kg)	MYR 30/month (MYR 0.20/kg)	MYR 60/month (MYR 0.40/kg)

## **4.4 Second-step analysis**

The questionnaire for the second-step analysis was also conducted on the web platform as a conducive method during the COVID-19 pandemic. The form was distributed online from December 28, 2020, to January 22, 2021, to the respondents that agreed to participate in the second questionnaire during the first.

With the selected combination, we conducted a second questionnaire by applying choice-based conjoint analysis using the R software (clogit from survival package). This method was applied because it is a tool for determining preferences that is often used in marketing research [18]; it is a technique for determining market favor for a service and product involving two or more variable quantities [17]; and furthermore, it is a cost-benefit approach that takes into account the trade-off between charge and the level of other attributes [19]. This method allows us to calculate the marginal charge that respondents are willing to pay for selected attributes and to determine the respondents' preference based on the utility function

### **4.4.1 Methodology**

#### **4.4.1.1 Design of choice model**

##### **1) Selection of scenarios**

As shown in Table 4.4, five attributes with two and three levels were chosen for the second-step analysis.

Because the full-factorial design of extracted attributes and level was not feasible (n=162), we applied the orthogonal array method using the R software to select 18 proposed combinations between attributes and level and compared them with the current scenarios of federalized and non-federalized states, as shown in Table 4.5.

Table 4.5 Selected 18 proposed and current scenarios of federalized and non-federalized states

Scenario	Charge amount	Residual waste collection frequency	Collection method for recyclables	Subsidy for individual waste bins	Incentive amount
1	MYR 15/month (MYR 0.10/kg)	1/w	Door to door	50%	MYR 0.60/kg
2	MYR 15/month (MYR 0.10/kg)	1/w	At designated point	50%	MYR 0.90/kg
3	MYR 15/month (MYR 0.10/kg)	2/w	Door to door	0%	MYR 0.60/kg
4	MYR 15/month (MYR 0.10/kg)	2/w	At designated point	100%	MYR 0.30/kg
5	MYR 15/month (MYR 0.10/kg)	3/w	Door to door	0%	MYR 0.30/kg
6	MYR 15/month (MYR 0.10/kg)	3/w	At designated point	100%	MYR 0.90/kg
7	MYR 30/month (MYR 0.20/kg)	1/w	Door to door	100%	MYR 0.30/kg
8	MYR 30/month (MYR 0.20/kg)	1/w	At designated point	0%	MYR 0.30/kg
9	MYR 30/month (MYR 0.20/kg)	2/w	Door to door	100%	MYR 0.90/kg
10	MYR 30/month (MYR 0.20/kg)	2/w	At designated point	50%	MYR 0.60/kg
11	MYR 30/month (MYR 0.20/kg)	3/w	Door to door	50%	MYR 0.90/kg
12	MYR 30/month (MYR 0.20/kg)	3/w	At designated point	0%	MYR 0.60 /kg
13	MYR 60/month (MYR 0.40/kg)	1/w	Door to door	0%	MYR 0.90/kg
14	MYR 60/month (MYR 0.40/kg)	1/w	At designated point	100%	MYR 0.60/kg
15	MYR 60/month (MYR 0.40/kg)	2/w	Door to door	50%	MYR 0.30/kg
16	MYR 60/month (MYR 0.40/kg)	2/w	At designated point	0%	MYR 0.90/kg
17	MYR 60/month (MYR 0.40/kg)	3/w	Door to door	100%	MYR 0.60/kg
18	MYR 60/month (MYR 0.40/kg)	3/w	At designated point	50%	MYR 0.30/kg
Current scenario (federalized states)	MYR 0	2/w	Door to door	100%	MYR 0
Current scenario (non-federalized states)	MYR 0	3/w	none	0%	MYR 0

## **2) Questionnaire survey**

Using these 18 scenarios, we created 36 forms. In each form, three scenarios were given, with two randomly chosen from the selected 18 without any repetition combination, and the current scenario was the third. These 36 forms were divided into 3 sets, with each set containing 12 forms as Table 4.6. Example of the questions used in the questionnaire are given in Table 4.7.

The questionnaire was then distributed by e-mail to 231 respondents who agreed to participate in the second survey.

Table 4.6 Forms used in 2<sup>nd</sup> Questionnaire

Set 1:

Form	Option A	Option B	Option C
1	Scenario 18	Scenario 9	Current
2	Scenario 4	Scenario 13	Current
3	Scenario 12	Scenario 3	Current
4	Scenario 1	Scenario 18	Current
5	Scenario 4	Scenario 15	Current
6	Scenario 7	Scenario 12	Current
7	Scenario 1	Scenario 16	Current
8	Scenario 15	Scenario 18	Current
9	Scenario 7	Scenario 17	Current
10	Scenario 17	Scenario 12	Current
11	Scenario 5	Scenario 4	Current
12	Scenario 11	Scenario 18	Current

Set 2:

Form	Option A	Option B	Option C
1	Scenario 2	Scenario 11	Current
2	Scenario 14	Scenario 5	Current
3	Scenario 8	Scenario 17	Current
4	Scenario 2	Scenario 17	Current
5	Scenario 5	Scenario 11	Current
6	Scenario 8	Scenario 14	Current
7	Scenario 11	Scenario 2	Current
8	Scenario 5	Scenario 10	Current
9	Scenario 13	Scenario 8	Current
10	Scenario 1	Scenario 8	Current
11	Scenario 7	Scenario 2	Current
12	Scenario 13	Scenario 14	Current

Set 3:

Form	Option A	Option B	Option C
1	Scenario 16	Scenario 7	Current
2	Scenario 6	Scenario 15	Current
3	Scenario 10	Scenario 1	Current
4	Scenario 3	Scenario 6	Current
5	Scenario 6	Scenario 13	Current
6	Scenario 9	Scenario 10	Current
7	Scenario 3	Scenario 14	Current
8	Scenario 12	Scenario 6	Current
9	Scenario 9	Scenario 4	Current
10	Scenario 3	Scenario 6	Current
11	Scenario 9	Scenario 16	Current
12	Scenario 15	Scenario 10	Current

Table 4.7: Example of Question used in 2<sup>nd</sup> Questionnaire

You will be given 12 forms of proposal on implementation of 'Zero Budget System'. In each form you will be given 3 options (situations). Please choose the option (situation) that suit you in each option.

Scenario 1:

	Option A	Option B	Option C (Current Situation in Federalized State)
Incentive amount	MYR 0.30/ kg	MYR 0.90/kg	None
Individual waste bin provided by Government	50% of its price subsidized by government	100% subsidized by government	100% subsidized by government
Collection method for recyclables	Collection at designated point	Door-to-door	Door-to-door
Collection frequency for residual waste	Three times per week	Twice per week	Twice per week
Charge amount	MYR 60/ month or MYR 0.40/kg	MYR 30/ kg or MYR 0.20/kg	None

#### 4.4.1.2 Analysing method

Using R software (survival data package: clogit), we had analysed the survey by conjoint analysis. We also applied Alternative-Specific Constant (ASC) as intercepts for attributes that may be not included in the suggested scenario [Aizaki and Nishimura 2007], where ASC=1 for suggested scenarios and ASC=0 for current. In the analysis, all the data was input as categorical data. The details of dummy that used in the analysis as per table 4.8.

Table 4.8: Dummy used in conjoint analysis

A. Dummy used for incentive (federalized and non-federalized states)

Incentive	dM1	dM2	dM3
MYR 0.90/kg	1	0	0
MYR 0.60/kg	0	1	0
MYR 0.30/kg	0	0	1
MYR 0/kg	0	0	0

B. Dummy used for charge (federalized and non-federalized states)

Charge	dC1	dC2	dC3
MYR 0/kg	1	0	0
MYR 0.10/kg	0	1	0
MYR 0.20/kg	0	0	1
MYR 0.40/kg	0	0	0

C. Dummy used for bin (federalized and non-federalized states)

Bin	dB1	dB2
0%	1	0
50%	0	1
100%	0	0

D. Dummy used for recyclables collection method (federalized states)

Recyclable Collection	dR
dtd	1
point	0

E. Dummy used for recyclables collection method (non-federalized states)

Recyclable Collection	dR1	dR2
dtd	1	0
point	0	1
none	0	0

F. Dummy for residual collection frequency

Residual collection frequency	dF1	dF2
1/w	1	0
2/w	0	1
3/w	0	0

#### 4.4.1.3 Utility function

When a respondent ( $n$ ) selects an acceptable proposed scenario ( $i$ ), the utility  $U_{in}$  of proposed scenario ( $i$ ) can be divided into two additive parts [27], as follows.

$$U_{in} = V_{in} + \varepsilon_{in} \quad (1)$$

$V_{in}$  = representative of utility of  $i$  for  $n$

$\varepsilon_{in}$  = a random component

Then, in federalized states,  $V_{in}$  is assumed as follows:

$$V = \beta_{dM1}X_{dM1} + \beta_{dM2}X_{dM2} + \beta_{dM3}X_{dM3} + \beta_{dC1}X_{dC1} + \beta_{dC2}X_{dC2} + \beta_{dC3}X_{dC3} + \beta_{dB1}X_{dB1} + \beta_{dR}X_{dR} + \beta_{dF1}X_{dF1} + \beta_{dF2}X_{dF2} \quad (2)$$

Whereas,

	X		Coef
Residual waste collection freq. ref. 3 times per week	$dF1$	Twice collection per week	$\beta_{F1}$
	$dF2$	Twice collection per week	$\beta_{F2}$
Recyclables' collection method, ref. collection at designated point	$dR$	door-to-door	$\beta_R$
Subsidy on Bin ref. 100% subsidy	$dB1$	0%	$\beta_{B1}$
	$dB2$	50%	$\beta_{B2}$
Charge for residual waste ref. MYR 0.4/kg	$dC1$	MYR 0/kg	$\beta_{C1}$
	$dC2$	MYR 0.1/kg	$\beta_{C2}$
	$dC3$	MYR 0.2/kg	$\beta_{C3}$
Incentive ref. MYR0/kg	$dM1$	MYR 0.9/kg	$\beta_{M1}$
	$dM2$	MYR 0.6/kg	$\beta_{M2}$
	$dM3$	MYR 0.3/kg	$\beta_{M3}$

While in non-federalized states,  $V_{in}$  is assumed as follows:

$$V = \beta_{dM1}X_{dM1} + \beta_{dM2}X_{dM2} + \beta_{dM1}X_{dM1} + \beta_{dM3}X_{dM3} + \beta_{dc1}X_{dc1} + \beta_{dc2}X_{dc2} + \beta_{dc3}X_{dc3} \\ + \beta_{db1}X_{db2} + \beta_{dR1}X_{dR1} + \beta_{dR2}X_{dR2} + \beta_{dF1}X_{dF1} + \beta_{dF2}X_{dF2} \quad (3)$$

Whereas,

	$X$		Coef
Residual waste collection freq. ref. 3 times per week	$dF1$	Twice collection per week	$\beta_{F1}$
	$dF2$	Twice collection per week	$\beta_{F2}$
Recyclables' collection method, ref. collection at designated point	$dR1$	door-to-door	$\beta_{R1}$
	$dR2$	Designated point	$\beta_{R2}$
Subsidy on Bin ref. 100% subsidy	$dB1$	0%	$\beta_{B1}$
	$dB2$	50%	$\beta_{B2}$
Charge for residual waste ref. MYR 0.4/kg	$dC1$	MYR 0/kg	$\beta_{C1}$
	$dC2$	MYR 0.1/kg	$\beta_{C2}$
	$dC3$	MYR 0.2/kg	$\beta_{C3}$
Incentive ref. MYR0/kg	$dM1$	MYR 0.9/kg	$\beta_{M1}$
	$dM2$	MYR 0.6/kg	$\beta_{M2}$
	$dM3$	MYR 0.3/kg	$\beta_{M3}$

#### 4.4.1.4 Monetary balance between incentive and charge

Definitions of all symbols, assumptions and values used in the calculation are shown in Table 4.9.

### **Waste generation per household per month**

The waste generation per household per month was derived to estimate the amount of potential waste that can be generated by each Malaysian household as follows.

$$W_h = W_G \times HS \times 30 \text{ days} \quad (8)$$

### **Residual waste generation per household per month**

The waste generation per household per month was derived to estimate the amount of potential residual waste that can be generated by each Malaysian household as follows:

$$RW_h = (1 - SR) \times W_h \quad (9)$$

### **Total benefit per household per month**

The total benefit per household per month was derived to estimate the amount of potential monetary incentive that each household can receive each month, as follows:

$$TB_h = W_h \times I_{rate} \times SR \quad (10)$$

### **Total charge per household per month**

The total charge per household per month was derived to estimate amount of potential charge that each household needs to pay every month as follows.

$$TC_h = RW_h \times C_{rate} \quad (11)$$

## Balance of benefit over charge

The balance of benefit over charge of the Zero Budget System was estimated as follows:

$$BL_h = TB_h - TC_h \quad (12)$$

Table 4.9 Explanation of symbols, assumptions, and values in this research

Symbols	Definitions, assumptions, and values
$W_G$ [kg/ca/day]	Waste generation per capita per day: 1.17 kg/ca/day [37]
$HS$ [person/household]	Household size: 4.31 persons/household [36]
$I_{rate}$ [MYR/kg]	Incentive rate for separated recyclables
$SR$ [%]	Separated recyclables ratio at source
$C_{rate}$ [MYR/kg]	Charge rate for residual waste

## 4.4.2 Results and discussion

### 4.4.2.1 Response rate

The second-step analysis response rate was 40.7%; 94 out of the 231 respondents to the first questionnaire that agreed to consider participating in a second responded to the survey with total 1,128 answers.

However, we need to admit that there was limitation in this survey that unavoidably conducted by online due to worldwide pandemic that had probability of bias in term of respondents' household income, educational background or age.

#### **4.4.2.2 Determination of parameters**

##### **1) Determination of coefficient in the model**

As showed in Table 4.10 (A) and (B), the concordance for federalized states' conjoint analysis was 0.632, whereas for non-federalized states it was 0.646. According to Therneau and Atkinson (2021) a model with a value less than 0.55 is considered not very remarkable [28]; both models achieved a concordance of more than 0.55, and therefore we assume that both models are acceptable.

Due to the limitation of the questionnaire structure, where charge amount at MYR 0/kg and incentive amount at MYR 0/kg only appear at current situation resulting non-appearance of dummy dC1 (that representing charge at MYR 0/kg) and dM3.

This was corroborated by the p-value of likelihood ratio test, Wald test and score test for both models, at less than 0.001, indicating that the models are valid.

Table 4.10A: Results of Conjoint Analysis (Federalized states)

	dummy	Content when dummy variable=1	Coefficient, $\beta$	p-value	Lower 95%	Upper 95%
ASC			-0.221	0.344	-0.680	0.237
Residual waste collection freq. ref. 3 times per week	dF1	Twice collection per week	-0.238	0.187	-0.590	0.115
	dF2	Twice collection per week	0.112	0.537	-0.243	0.467
Recyclables' collection method, ref. collection at designated point	dR	door-to-door	0.805	0.000	0.547	1.062
Subsidy on Bin ref. 100% subsidy	dB1	0%	-0.265	0.108	-0.588	0.058
	dB2	50%	-0.050	0.787	-0.410	0.311
Charge for residual waste ref. MYR 0.4/kg	dC1	MYR 0/kg	-	-	-	-
	dC2	MYR 0.1/kg	0.624	0.000	0.287	0.961
	dC3	MYR 0.2/kg	0.396	0.026	0.047	0.746
Incentive ref. MYR0/kg	dM1	MYR 0.9/kg	0.452	0.010	0.107	0.797
	dM2	MYR 0.6/kg	0.064	0.725	-0.293	0.421
	dM3	MYR 0.3/kg	-	-	-	-
Concordance			0.632			
N=		492 (41 respondents $\times$ 12 questions)				

Non-federalized states

\* Significant at  $p < 0.1$

\*\* Significant at  $p < 0.05$

\*\*\* Significant at  $p < 0.01$

Table 4.10B: Results of Conjoint Analysis (non-federalized states)

	dummy	Content when dummy variable=1	Coefficient, $\beta$	p-value	Lower 95%	Upper 95%
ASC			16.780	0.992	-3415.180	3448.740
Residual waste collection freq. ref. 3 times per week	dF1	Twice collection per week	-0.343	0.021	-0.635	-0.051
	dF2	Twice collection per week	-0.181	0.257	-0.493	0.131
Recyclables' collection method ref. no collection	dR1	door-to-door	-16.590	0.992	-3448.550	3415.370
	dR2	designated point	-17.400	0.992	-3449.360	3414.560
Subsidy on Bin ref. 100% subsidy	dB1	0%	-0.203	0.152	-0.481	0.075
	dB2	50%	-0.025	0.875	-0.339	0.289
Charge for residual waste ref. MYR 0.4/kg	dC1	MYR 0/kg	-	-	-	-
	dC2	MYR 0.1/kg	0.586	0.000	0.302	0.870
	dC3	MYR 0.2/kg	0.313	0.036	0.021	0.605
Incentive ref. MYR0/kg	dM1	MYR 0.9/kg	0.141	0.341	-0.149	0.431
	dM2	MYR 0.6/kg	-0.037	0.811	-0.343	0.269
	dM3	MYR 0.3/kg	-	-	-	-
Concordance		0.646				
N=		636 (53 respondents $\times$ 12 questions)				

Non-federalized states

\* Significant at  $p < 0.1$

\*\* Significant at  $p < 0.05$

\*\*\* Significant at  $p < 0.01$

## **2) Charge amount**

As showed in table 4.10A, as reference dummy for charge was set at MYR 0.4/kg, charge for dummy dC3 (dC3=1 when charge at MYR 0.2/kg) showed positive coefficient. The coefficient increased nearly twice for dummy dC2 (dC2=1 when charge at MYR 0.1/kg). This means respondents are more likely to support the system if charge is set at minimum level. Same result also observed in table 4.10B that representing non-federalized states.

## **3) Recyclables' collection method**

As indicated in Table 4.10A, the recyclables collection method is the attribute with the highest coefficient for federalized states (0.805), that already implemented the door-to-door collection system for recyclables

A study on the recycling behavior in Thailand also suggested that recycling facilities, services, and other support systems include its access play an important role in encouraging recycling participation [29].

We believe that the door-to-door collection method will assist in solving logistical issues for separated recyclables in term of transportation and storage, in particular for respondents from non-federalized states that currently are not receiving this service.

However, as indicated in table 4.10B, this attribute was not significantly important to respondents from non-federalized states that didn't receive these services.

## **4) Incentive amount**

As indicated in table 4.10A, dM1 for the dummy that representing incentive at MYR 0.9/kg showed positive coefficient (0.452) and low p-value. However, for dM2, dummy

that representing incentive at MYR 0.60/kg is considered insignificant. This means, respondents of from federalized states only accepting high incentive amount towards the system.

However, for respondents from non-federalized states, even though high incentive amount showed positive coefficient, the p-value of this attribute was more than 0.3 that considered high. This phenomenon might be due to the monetary incentive concept, which is not widely recognized by the respondents from non-federalized states compared with those from federalized states, where an incentive system had been systematically organized in some areas by waste management concessionaires appointed by the federal government.

#### **5) Residual waste collection frequency**

As indicated in table 4.10A as reference dummy was set at collection 3 times per week, respondents from federalized states showed negative coefficient with considerable p-value if collection frequency reduce to once per week. That's mean, that respondents from federalized states that currently received twice collection per week considered higher collection frequency as not important but refuse to have lower service level for only once collection per week.

While in non-federalized states that currently received 3 times residual waste collection per week showed negative coefficient for dummy that represent once and twice collection per week (dF1 and dF2). That also indicated respondents unwilling to accept lower service level than current.

## **6) Subsidy for residual waste bins**

Both models also showed that the subsidy for residual waste bins is not significantly important, as the p-values for this attribute for both models are greater than 0.1. This may be due to the standard size bin provided by government, which may not fit the design of certain types of residential premises. Furthermore, it also could be replaced with other affordable alternatives by residents themselves to suit the purpose of temporary storage before collection day.

### **4.4.2.3 Design of Zero Budget System**

According to Ben-Akiva and Lerman (1985) [27], a utility can be described as an index of attractiveness, whereas Andrejszki (2015) notes that a utility function can be used to define customer preference [30]. Using Equation 2, we calculated the value of the utility function for each scenario and compared it with the value of the current scenario in both federalized and non-federalized states to understand the respondents' preference toward a proposed scenario.

As indicated in Figure 4.9A and 4.9B, the current utility function for federalized and non-federalized states showed a large gap. This situation maybe due to current waste whereas respondents from federalized states received higher service level such collection door-to-door for separated recyclables, full subsidy on waste bin and furthermore, monitored by central government's agency

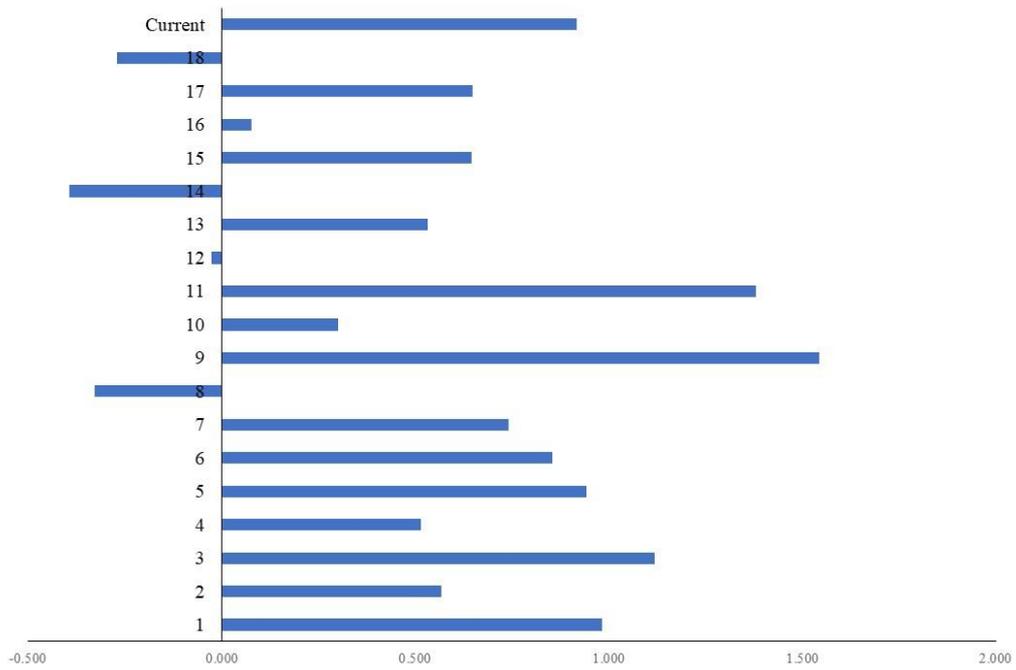
Figure 4.9A also indicated that proposed scenario No. 9, where recyclables are collected door to door, incentive for separated recyclables is MYR 0.90/kg, residual waste

collection is three times per week and residual waste charge is MYR 0.20/kg, with full subsidized for bin showed the highest utility followed by scenario No. 11, recyclables collected door to door, incentive for separated recyclables of MYR 0.90/kg, residual waste collection three times per week, and residual waste charge of MYR 0.20/kg with 50% subsidized on waste bin.

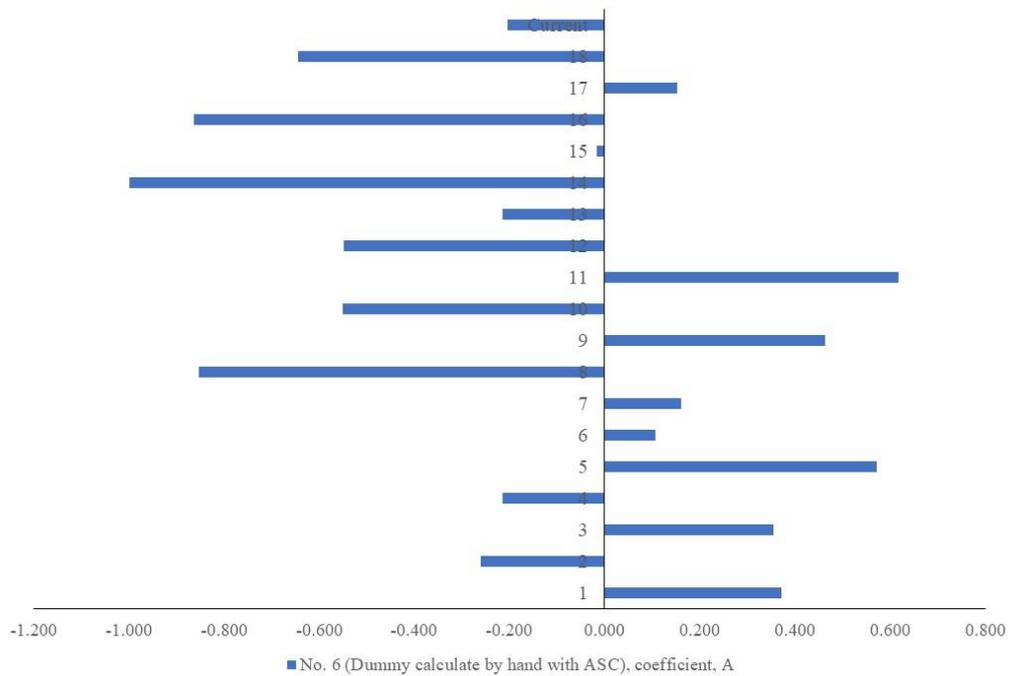
While for non-federalized states, as shown in Figure 4.5B, scenario No. 11, recyclables collected door to door, incentive for separated recyclables of MYR 0.90/kg, residual waste collection three times per week, and residual waste charge of MYR 0.20/kg with 50% subsidized on waste bin showed the highest utility followed by scenario No .5, where recyclables are collected door to door, incentive for separated recyclables is MYR 0.30/kg, residual waste collection is three times per week and residual waste charge is MYR 0.10/kg without subsidy on bin.

Because the preference between residents of federalized and non-federalized states differs, the government may consider a different policy during early implementation of the system to ensure that the proposed system receives support from residents.

The government also might reconsider a policy of full subsidy for residual waste bins; this could reduce some waste management expenses, as this study shows that it is not a significant attribute in utility function.



(A) Utility function for federalized states



(B) Utility function for non-federalized states

Figure 4.9 Utility function for proposed scenarios

#### **4.4.2.4 Balance of benefit over charge for recyclables separated at source**

Using equations 8–12 from sub-section 4.2.2.3, monetary incentive rate for separated recyclables at source of MYR 0.90/kg, residual waste charge of MYR 0.20/kg for federalized and non-federalized states, the balance of benefit over charge was calculated and is shown in Fig. 4.10.

Residents who do not separate their recyclables at all would need to pay about MYR 45.38 per month.

However (on the assumption that total waste generation is constant), for residents of federalized states, the benefit–charge balance would be zero if they separated 18.2% of recyclables from their waste. For non-federalized states, residents would need to separate 25% of recyclables from their waste for the same.

Ideally, if residents separated all high-value recyclables (about 26% of total waste generation that consists of plastic (13.2%), paper (8.5%), metal (2.7%), and Tetra Pak (1.6%) [31], the benefit–charge balance would be MYR 13.01 per month.

In other words, full cooperation by separating all high-value recyclables at source would result in receiving a monetary incentive higher than the charge. This is in line with the concept of the Zero Budget System.

Numerous studies have concluded that economic instruments are effective in improving recycling [32, 33, 34, 35]. We believe that a Zero Budget System that combines both positive and negative incentives will further improve the collection of recyclables and reduce residual waste from being directly disposed to landfills, especially in developing countries.

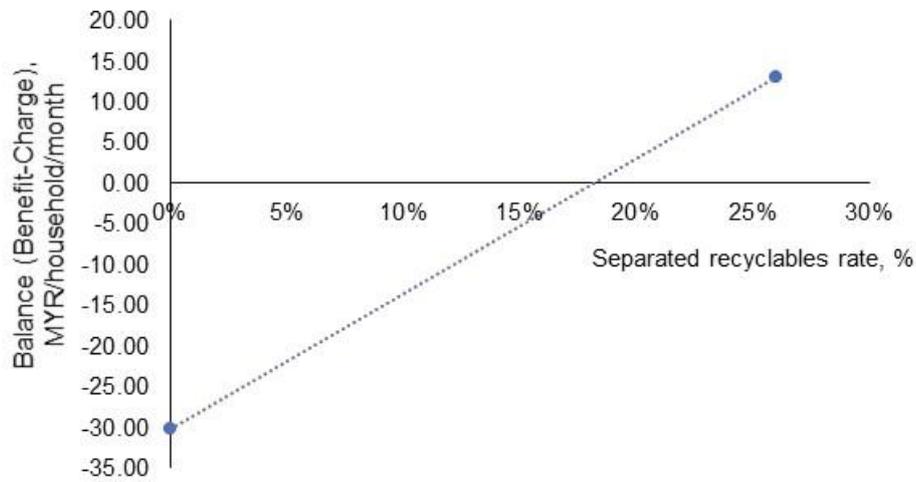


Figure 4.10 Benefit–charge balance for separated recyclables at source

#### 4.4 Summary

The following conclusions were reached based on the survey analysis of the implementation of the Zero Budget System in Malaysia:

- 1) “Zero budget system is a new promising system that combine charge and incentive system.
- 2) As indicated in conjoint analysis study, we found out charge amount played an important role that affecting respondents’ utility towards the system in both federalized and non-federalized states.

- 3) Respondents from both states also indicate the importance of maintaining current service level that their received for example specific collection frequency or recyclables collection method for federalized states.
- 4) Resident preferences in federalized and non-federalized states differ due to their current respective waste management systems. Different policies should be considered based on the situation in the area concerned.

## References

- [1] Ariffin, F. Bin, Ishii, K., Sato, M., & Ochiai, S. (2021). The effectiveness of the e-money incentive mechanism in promoting separation of recyclables at source in Malaysia. *Journal of Material Cycles and Waste Management*, 23(1), 371–385.
- [2] Suttibak S., Nitivattananon V. (2008) Assessment of Waste Recycling Performance: A Study of School Garbage Banks in Thailand, *GMSARN International Journal*, 2: 83–90.
- [3] Singsewo A., Klaoklang K. (2017) Promoting of a Waste Recycling Bank in Schools: A Case in a Municipality School in Thailand, *New Trends and Issues Proceedings on Humanities and Social Sciences*, 4: 329–334
- [4] IGES (2017A) Planning and Implementation of Integrated Solid Waste Management Strategies at Local Level: The Case of Surabaya Cities
- [5] Wijayanti D.R., Suryani S. (2015), Waste Bank as Community-based Environmental Governance: A Lesson Learned from Surabaya, *Procedia-Social and Behavioral Sciences*, 184: 171–179.
- [6] IGES (2017B) Development of Work Plan for Reducing SLCPs for MSWM in Surabaya, Indonesia
- [7] Eunomia Research & Consulting (2003). Waste Collection: To Charge or Not to Charge.
- [8] Dette B., Julich R., Buchert M., Bukhave M., Dopfer J., Roig J.E.I., Gerkens I., Kupperts P., Schneider M., Sorensen S.Y., Stevanato P., Villa L (1999). Waste

Prevention and Minimisation, Final Report. Commissioned by the European Commission, DG XI

- [9] Hogg D., Stark W., Callens A., Bogaert G., Christensen E.H., Heikkonen V., Ledore A., Stahl H., Economides D., Tsalas A., Favoino E., Ricci M., Carlsson M. (2002). Financing and Incentive Schemes for Municipal Waste Management: Case Studies, Final Report to DG Environment, European Commission
- [10] MOEJ (2013) Guidance on charged system for municipal solid waste
- [11] Kim J.H. (2004) Sustainable Urban Waste Management System in Metropolitan Seoul, South Korea, The Sustainable City III, 2004 WIT Press, ISBN 1-85312-720-5.
- [12] Puig-Ventosa I. (2008) Charging Systems and PAYT Experience for Waste Management in Spain, *Waste Management* 28: 2767–2771.
- [13] Morlok J., Schoenberger H., Styles D., Galvez–Martos J.-L., Zeschmar–Lahl B. (2017) The Impact of Pay-As-You-Throw Schemes on Municipal Solid Waste Management: The Exemplar Case of the County of Aschaffenburg, Germany, Resources 6: 8
- [14] OVAM (2014) Good Practice Flanders: PAYT [https://www.acrplus.org/images/project/R4R/Good\\_Practices/GP\\_OVAM\\_PAYT.pdf](https://www.acrplus.org/images/project/R4R/Good_Practices/GP_OVAM_PAYT.pdf)
- [15] Maskey B. and Singh M. (2017). Households' Willingness to Pay for Improved Waste Collection Service in Gorkha Municipality of Nepal, *Environments*, 4(77)
- [16] Ku S.J., Yoo S.H., Kwak S.J. (2009). Willingness to Pay for Improving Waste

Disposal System in Korea: A Choice Experiment Study, *Environmental Management*, 44:278–287

- [17] Moran, F. F. V. (2014). Application of Choice-Based Conjoint Analysis to Determine Consumers' Preferences and Willingness to Pay for Grass Fed Beef in the United States.
- [18] Halme, M., & Kallio, M. (2011). Estimation methods for choice-based conjoint analysis of consumer preferences. *European Journal of Operational Research*, 214(1), 160–167.
- [19] Ishii, K., Furuichi, T., & Nagao, Y. (2013). A needs analysis method for land-use planning of illegal dumping sites: A case study in Aomori-Iwate, Japan. *Waste Management*, 33(2), 445–455.
- [20] Yahaya, N. Bin, & Larsen, I. (2008). Federalising Solid Waste Management in Peninsular Malaysia. Proceedings of ISWA, Act 171, 1–13.
- [21] Ministry of Housing and Local Government of Malaysia (2005). National Strategic Plan for Waste Management 2005.
- [22] Suruhanjaya Pilihanraya Malaysia (SPR 2021),  
<https://www.spr.gov.my/ms/pilihan-roya/belum-daftar>, accessed April 23, 2021.
- [23] Fauziah, S. H., Zubaidah, S. B., Khairunnisa, A. K., & Agamuthu, P. (2009). Public Perception on Solid Waste and Public Cleansing Management Bill 2007 towards Sustainable Waste Management in Malaysia. Proceedings for ISWA Congress, 90–91.

- [24] Pewresearch (2018). <https://www.pewresearch.org/methods/2018/01/26/how-different-weighting-methods-work/> (access on 6<sup>th</sup> Feb. 2022)
- [25] DOSM (2014). [https://www.dosm.gov.my/v1/uploads/files/7\\_Publication/Technical\\_Paper/Kolokium\\_Statistik/2015/21.%20B40%20What%20StatisticsG%C3%87%C3%96%20Say.pdf](https://www.dosm.gov.my/v1/uploads/files/7_Publication/Technical_Paper/Kolokium_Statistik/2015/21.%20B40%20What%20StatisticsG%C3%87%C3%96%20Say.pdf) (access on 6<sup>th</sup> Feb. 2022)
- [26] DOSM (2021). [https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=155&bul\\_id=ZjJOSnpJR21sQWVUcUp6ODRudm5JZz09&menu\\_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09](https://www.dosm.gov.my/v1/index.php?r=column/cthemByCat&cat=155&bul_id=ZjJOSnpJR21sQWVUcUp6ODRudm5JZz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09) (access on 6<sup>th</sup> Feb. 2022)
- [27] Ben-Akiva M. and Lerman S.R. (1985). Discrete Choice Analysis: Theory and Application to Travel Demand. The MIT Press, Cambridge, Massachusetts.
- [28] Therneau T. & Atkinson E. (2021). Concordance, <https://cran.r-project.org/web/packages/survival/vignettes/concordance.pdf>
- [29] Ittiravivongs, A. (2012). Factors influence household solid waste recycling behaviour in Thailand: An integrated perspective. WIT Transactions on Ecology and the Environment, 167, 437–448.
- [30] Andrejski T., Torok A., Csete M. (2015). Identifying the utility function of transport services from stated preferences, Transport and Telecommunication, 16(2), 138–144.
- [31] GSR (2012) Survey on SW Composition. Characteristic and Existing Practice of SW Recycling in Malaysia, Malaysia
- [32] Mavropoulos A (2009) EPEM SA Recycling Behaviour: The Present Focus Brain and a Framework to Understand Personal Differences in Recycling. Proceedings of

ISWA World Conference 2009 October.

- [33] Happenhofer A., Beigl P., Salhofer S. (2017) Analysis of Economic Incentive Scheme to Promote Efficient Separation at Source. Proceeding Sardinia 2017.
- [34] Thøgersen J. (2003). Monetary incentive and recycling: behavioural and psychological reactions to a performance-dependent garbage fee. *J Consum Policy* 26:197–228.
- [35] Dijkgraaf E, Gradus RHJM (2004). Cost savings in unit-based pricing of household waste: the case of the Netherlands. *Res Energy Econ* 26:353–371.
- [36] DOSM (2010) Table 3: Average Household Size by State, 1980–2010.

## **CHAPTER 5**

### **Prediction on the effectiveness of 'Zero Budget System'**

#### **5.1 Introduction**

In the previous chapter, we had introduced 'Zero Budget System' as a new concept of pay as you throw system which hybrid charging system to dispose residual waste and monetary incentive system for separated recyclables.

Based on the previous chapter, we also found out that 'Zero Budget System' is a more acceptable system with supporting ratio from 70% (Non-federalized states) to 71% (Federalized states) compare with charging system alone that only supported by 57% (Federalized states) to 62% (Non-federalized states) of the respondents.

Even though it is undeniable that 'Zero Budget System' is a more acceptable approach, the effectiveness of the system is still questionable. Therefore, this chapter aims to predict the effectiveness of 'Zero Budget System' in reducing residual waste generation in Malaysia.

#### **5.2 Methodology**

As indicated in previous chapter, we also had identified four main attributes that are significant to the system as listed below:

1. Incentive amount;
2. Charging amount;

### 3. Residual waste collection frequency; and

Even though residual waste collection frequency indicated as one of the important attributes to gain citizens support toward ‘Zero Budget System’, increasing residual waste collection frequency is not a suitable policy, in order to achieve our final goal to reduce residual waste generation and to increase recovery of recyclables. Based on this, we discard residual waste collection frequency as one of the attributes to predict the effectiveness of the system.

Based on this, in this study, we develop a new model just focusing on charge and incentive as below:

Table 5.1: Attributes and level for federalized and non-federalized states

Attributes	Level		
Charge amount	MYR 0.10/kg	MYR 0.20/kg	
Incentive	MYR 0.30/kg	MYR 0.60/kg	MYR 0.90/kg

#### 5.2.1 Selection of scenarios

As showed in table 5.1, there is 2 attributes with 2 and 3 level for this model. In these models, we applied full factorial design that will produce 6 scenarios as table 5.2.

Table 5.2: Selected scenarios for federalized states and non-federalized states

<b>Scenario</b>	<b>Charge for residual waste, MYR/ kg</b>	<b>Incentive for separated recyclables, MYR/ kg</b>
1	0.1	0.3
2	0.2	0.3
3	0.1	0.6
4	0.2	0.6
5	0.1	0.9
6	0.2	0.9

### 5.2.2 Questionnaire survey

The questionnaires were conducted by online platform that cost effective, easy to access at any time and any where and can avoid physical contacts. The questionnaires were distributed by social networking services such as WhatsApp, Facebook, and LinkedIn. The links of questionnaires were also sent via e-mail to Government’s agencies, private companies, universities, and Non-Government Organizations (Consumer associations, workers union, welfare associations, environmental associations etc.)

Using scenarios as showed in tables 5.2, respondents were given 6 scenarios from table 5.3 and current scenario (No charge to dispose residual waste and no incentive for separated recyclables). Then, they were also had been asked to choose percentage of recyclables (Plastic, paper, metal and tetrapak) that they are willing to separate (0%, 25%, 50%, 75% or 100%).

Respondents’ attributes such as age range, economic background, gender and education level were also collected.

### 5.2.3 Analysing method

In this study, we applied conjoint analysis by ordered logistic regression using R software (ologit of RMS package). Where respondents' willingness to separate was analysed as dependent variable and the relation with independent variables such as charge amount, incentive amount and respondents' variable had been observed. The details of the dummy used in the analysis are as Table 5.3.

Table 5.3: Dummy used in conjoint analysis

Incentive	dM1	dM2	dM3
MYR 0.90/kg	1	0	0
MYR 0.60/kg	0	1	0
MYR 0.30/kg	0	0	1
MYR 0/kg	0	0	0

Charge	dC1	dC2
MYR 0/kg	1	0
MYR 0.10/kg	0	1
MYR 0.2/kg	0	0

Age	dI1	dI2
MYR 8501 and above	1	0
MYR 4001 to MYR 8500	0	1
MYR 4000 or less	0	0

Age	dA1	dA2	dA3	dA4
21-30 years old	1	0	0	0
31-40 years old	0	1	0	0
41-50 years old	0	0	1	0
51-60 years old	0	0	0	1
61 years old and above	0	0	0	0

Dummy for age (non-federalized)

Age	dA1	dA2	dA3
21-30 years old	1	0	0
31-40 years old	0	1	0
41-50 years old	0	0	1
51-60 years old	0	0	0

\* There was no respondent in the age range 61 years old and above for non-federalized states

Dummy for education

Age	dE1	dE2	dE3
Post graduate degree or equivalent	1	0	0
Undergraduate degree or equivalent	0	1	0
Diploma or equivalent	0	0	1
Secondary school or below	0	0	0

Dummy for gender

Age	dG
Male	1
Female	0

	Data used in program	Actual data
ASC	1, 0	1 (suggested scenario), 0 (current scenario)
Willingness to separate (Ordered)	1,2,3,4,5	0%, 25%, 50%, 75%, 100%

### 5.2.4 Probability of citizen willingness to separate

As mentioned by William R. (2021) referred to Menard, Barooah and Hamilton [1], dependent ordered variable can be interpreted as below:

$$Y^*_i = \sum \beta_k X_k + \varepsilon_i = Z + \varepsilon_i \quad (4)$$

$$Z_i = \sum \beta_k X_k = E(Y^*) \quad (5)$$

$$Z_{in} = \beta_{in1}X_{in1} + \beta_{in2}X_{in2} + \dots + \beta_m X_{im} \quad (6)$$

Whereas,

$\beta_m$  = coefficient for independent variable

$X_{im}$  = level for independent variable.

This model can be interpreted as below:

$$Z_{in} = \beta_{ASC}X_{ASC} + \beta_{dC1}X_{dC1} + \beta_{dC2}X_{dC2} + \beta_{dM1}X_{dM1} + \beta_{dM2}X_{dM2} + \beta_{dM3}X_{dM3} \quad (7)$$

Whereas,

$\beta_{ASC}$  = coefficient of intercept, ASC

$X_{ASC}$  = intercept level, ASC

$\beta_{dC1}$  = coefficient of dummy dC1 for charge

$X_{dC1}$  = level of dummy dC1 for charge

$\beta_{dC2}$  = coefficient of dummy dC2 for charge

$X_{dC2}$  = level of dummy dC2 for charge

$\beta_{dM1}$  = coefficient of dummy dM1 for incentive

$X_{dM1}$  = level of dummy dM1 for incentive

$\beta_{dM2}$  = coefficient of dummy dM2 for incentive

$X_{dM2}$  = level of dummy dM2 for incentive

$\beta_{dM3}$  = coefficient of dummy dM3 for incentive

$X_{dM3}$  = level of dummy dM3 for incentive

While probability of willingness to separate can be estimated as below:

$$P(Y_l > j) = \frac{\exp(X_i\beta - \gamma_j)}{1 + [\exp(X_i\beta - \gamma_j)]}, j = 1, 2, \dots, M - 1 \quad (8)$$

As the level of effects of respondents' attributes on incentive amount or charge amount

over willingness to pay can be assume as:

$$X_{d_i*d_j} = d_i \times d_j \quad (9)$$

whereas

$d_i$  =dummy variables of respondent' attribute

$d_j$  =dummy variables of charge or incentive

For example, the level of age effect (21-30 years old) over charge (MYR 0.10/kg) can be written as:

$$X_{dA1*dC2} = d_{A1} \times d_{C2} \quad (10)$$

Full integrated model that consists of all variables including respondents' attributes (federalized states):

$$\begin{aligned} Z_{in} = & \beta_{ASC}X_{ASC} + \beta_{dC1}X_{dC1} + \beta_{dC2}X_{dC2} + \beta_{dM1}X_{dM1} + \beta_{dM2}X_{dM2} + \beta_{dM3}X_{dM3} \\ & + \beta_{dA1*dC1}X_{dA1*dC1} + \beta_{dA1*dC2}X_{dA1*dC2} + \beta_{dA2*dC1}X_{dA2*dC1} + \beta_{dA2*dC2}X_{dA2*dC2} \\ & + \beta_{dA3*dC1}X_{dA3*dC1} + \beta_{dA3*dC2}X_{dA3*dC2} + \beta_{dA4*dC1}X_{dA4*dC1} + \beta_{dA4*dC2}X_{dA4*dC2} \\ & + \beta_{dA1*dM1}X_{dA1*dM1} + \beta_{dA1*dM2}X_{dA1*dM2} + \beta_{dA1*dM3}X_{dA1*dM3} + \beta_{dA2*dM1}X_{dA2*dM1} \\ & + \beta_{dA2*dM2}X_{dA2*dM2} + \beta_{dA2*dM3}X_{dA2*dM3} + \beta_{dA3*dM1}X_{dA3*dM1} + \beta_{dA3*dM2}X_{dA3*dM2} \\ & + \beta_{dA3*dM3}X_{dA3*dM3} + \beta_{dA4*dM1}X_{dA4*dM1} + \beta_{dA4*dM2}X_{dA4*dM2} \\ & + \beta_{dA4*dM3}X_{dA4*dM3} + \beta_{dE1dC1}X_{dE1dC1} + \beta_{dE1dC2}X_{dE1dC2} \\ & + \beta_{dE2dC1}X_{dE2dC1} + \beta_{dE2dC2}X_{dE2dC2} + \beta_{dE3dC1}X_{dE3dC1} + \beta_{dE3dC2}X_{dE3dC2} \\ & + \beta_{dE1dM1}X_{dE1dM1} + \beta_{dE1dM2}X_{dE1dM2} + \beta_{dE1dM3}X_{dE1dM3} + \beta_{dE2dM1}X_{dE2dM1} \\ & + \beta_{dE2dM2}X_{dE2dM2} + \beta_{dE2dM3}X_{dE2dM3} + \beta_{dE3dM1}X_{dE3dM1} + \beta_{dE3dM2}X_{dE3dM2} \\ & + \beta_{dE3dM3}X_{dE3dM3} + \beta_{dGdC1}X_{dGdC1} + \beta_{dGdC2}X_{dGdC2} + \beta_{dGdM1}X_{dGdM1} \\ & + \beta_{dGdM2}X_{dGdM2} + \beta_{dGdM3}X_{dGdM3} + \beta_{dI1dC1}X_{dI1dC1} + \beta_{dI1dC2}X_{dI1dC2} \\ & + \beta_{dI2dC1}X_{dI2dC1} + \beta_{dI2dC2}X_{dI2dC2} + \beta_{dI1dM1}X_{dI1dM1} + \beta_{dI1dM2}X_{dI1dM2} \\ & + \beta_{dI1dM3}X_{dI1dM3} + \beta_{dI2dM1}X_{dI2dM1} + \beta_{dI2dM2}X_{dI2dM2} + \beta_{dI2dM3}X_{dI2dM3} \end{aligned} \quad (11)$$

Full integrated model that consists of all variables including respondents' attributes (non-federalized states):

$$\begin{aligned}
Z_{in} = & \beta_{ASC}X_{ASC} + \beta_{dC1}X_{dC1} + \beta_{dC2}X_{dC2} + \beta_{dM1}X_{dM1} + \beta_{dM2}X_{dM2} + \beta_{dM3}X_{dM3} \\
& + \beta_{dA1*dC1}X_{dA1*dC1} + \beta_{dA1*dC2}X_{dA1*dC2} + \beta_{dA2*dC1}X_{dA2*dC1} + \beta_{dA2*dC2}X_{dA2*dC2} \\
& + \beta_{dA3*dC1}X_{dA3*dC1} + \beta_{dA3*dC2}X_{dA3*dC2} + \beta_{dA1*dM1}X_{dA1*dM1} + \beta_{dA1*dM2}X_{dA1*dM2} \\
& + \beta_{dA1*dM3}X_{dA1*dM3} + \beta_{dA2*dM1}X_{dA2*dM1} + \beta_{dA2*dM2}X_{dA2*dM2} \\
& + \beta_{dA2*dM3}X_{dA2*dM3} + \beta_{dA3*dM1}X_{dA3*dM1} + \beta_{dA3*dM2}X_{dA3*dM2} \\
& + \beta_{dA3*dM3}X_{dA3*dM3} + \beta_{dE1dC1}X_{dE1dC1} + \beta_{dE1dC2}X_{dE1dC2} + \beta_{dE2dC1}X_{dE2dC1} \\
& + \beta_{dE2dC2}X_{dE2dC2} + \beta_{dE3dC1}X_{dE3dC1} + \beta_{dE3dC2}X_{dE3dC2} + \beta_{dE1dM1}X_{dE1dM1} \\
& + \beta_{dE1dM2}X_{dE1dM2} + \beta_{dE1dM3}X_{dE1dM3} + \beta_{dE2dM1}X_{dE2dM1} + \beta_{dE2dM2}X_{dE2dM2} \\
& + \beta_{dE2dM3}X_{dE2dM3} + \beta_{dE3dM1}X_{dE3dM1} + \beta_{dE3dM2}X_{dE3dM2} + \beta_{dE3dM3}X_{dE3dM3} \\
& + \beta_{dGdC1}X_{dGdC1} + \beta_{dGdC2}X_{dGdC2} + \beta_{dGdM1}X_{dGdM1} + \beta_{dGdM2}X_{dGdM2} \\
& + \beta_{dGdM3}X_{dGdM3} + \beta_{dI1dC1}X_{dI1dC1} + \beta_{dI1dC2}X_{dI1dC2} + \beta_{dI2dC1}X_{dI2dC1} \\
& + \beta_{dI2dC2}X_{dI2dC2} + \beta_{dI1dM1}X_{dI1dM1} + \beta_{dI1dM2}X_{dI1dM2} + \beta_{dI1dM3}X_{dI1dM3} \\
& + \beta_{dI2dM1}X_{dI2dM1} + \beta_{dI2dM2}X_{dI2dM2} + \beta_{dI2dM3}X_{dI2dM3}
\end{aligned} \tag{12}$$

### 5.2.5 The effectiveness of 'Zero Budget System'

Using probability of willingness to separate from (3), residual reduction at source were predicted as follows:

$$\begin{aligned}
R = & [(P_{PRF} \times PC) + (P_{PrRF} \times PrC) + (P_{MRF} \times MC) + (P_{TRF} \times TC)]FCR + \\
& [(P_{PNRF} \times PC) + (P_{PrNRF} \times PrC) + (P_{MNRF} \times MC) + (P_{TRNF} \times TC)]NFCR
\end{aligned} \tag{13}$$

The explanation and assumption as follow:

*P<sub>PRF</sub>*: Predicted recycling ratio of plastic in Fed. States

*P<sub>PrRF</sub>*: Predicted recycling ratio of paper in Fed. States

*P<sub>MRF</sub>*: Predicted recycling ratio of metal in Fed. States

*P<sub>TRF</sub>*: Predicted recycling ratio of tetrapak in Fed. States

*FCR*: Federalized states citizen ratio: 10.61 millions [2]: 39.6%

*P<sub>PRNF</sub>*: Predicted recycling ratio of plastic in Non-Fed. States

*P<sub>PrRNF</sub>*: Predicted recycling ratio of paper in Non-Fed. States

*P<sub>MRNF</sub>*: Predicted recycling ratio of metal in Non-Fed. States

*P<sub>TRNF</sub>*: Predicted recycling ratio of tetrapak in Non-Fed. States

*NFCR*: Non-Federalized states citizen ratio: 16.18 millions [2]: 60.4%

PC: Plastic component: 13.2% [3]

PrC: Paper component: 8.5% [3]

MC: Metal component: 2.7% [3]

TC: Tetrapak component: 1.6% [3]

## **5.3 Results and Discussion**

### **5.3.1 Number of respondents and distribution**

In this survey we had achieved in total 174 respondents. As showed in Table 5.4, all respondents in this study are 21 years old and above whom are eligible to cast vote in Malaysian Election [4] that can determine Malaysian future policy.

In this study, 10.9% of respondents was come from age range 21-30 years old, 48.9% (31- 40 years old), 31.6% (41-50 years old), 8% (51-60 years old) and 0.6% come from age range 61 years old and above.

Respondents for this survey was also come from various economic background where low household income represented by 21.8% of respondents, middle household income represented by 33.9% and high household income by 44.3%.

In term of education background, 9.8% of respondents with secondary school or lower education level, 17.2% (diploma), 39.7% (undergraduate degree) and 33.3% hold postgraduate degree.

Overall, the respondents' attributes showed that the respondents in this survey was represented Malaysian in various background. However, we cannot deny the probability of online survey bias as research limitation during this pandemic era.

Table 5.4: Respondents' attributes

		Percentage (%)
Age (years)	21–30	10.9
	31–40	48.9
	41–50	31.6
	51–60	8.0
	61 and above	0.6
Gender	Male	55.2
	Female	44.8
State of residence	Federalized state	52.9
	Non-federalized state	47.1
Household Income	B40 (MYR 4000/month or less)	21.8
	M40 (MYR 4001–8500/month)	33.9
	T20 (MYR 8501 and above)	44.3
Education level	Secondary school and below	9.8
	Diploma or equivalent	17.2
	Undergraduate degree or equivalent	39.7
	Postgraduate degree or equivalent	33.3

### **5.3.2 Determination of coefficient**

As showed in all table 5.5 and 5.6, regardless type of recyclables dummy variable for incentive dM1 that representing incentive at MYR 0.9/kg showed the highest coefficient with very low p-value that indicate its signification in respondents' willingness to separate. We also observed that coefficient of charge become positive, when charge reduce from MYR 0.2/kg to MYR 0.1/kg. This result was consistent with chapter 4 that respondents unlikely to support the system if charge amount increase.

We believe this phenomenon was due to the fact as country that does not implement pay as you throw system for waste management, most of the respondents didn't see that source separation is a way to reduce cost that they need to pay if the charging system implemented.

This is different from an incentive system that with more easier concept, recyclables as source of income. This proved that to balance this matter, 'Zero Budget System' is the only practical answer.

(Due to limitation on questionnaire structure, that only allow respondents to choose charge at MYR 0/kg and incentive at MYR 0/kg, we didn't apply dummy dM3, dC1 in the analysis. We also didn't apply dummy dA4 (federalized states) in the analysis for the effect of age with incentive amount due to limited number of respondents above 61 years involve in this study).

Table 5.5A: Result of conjoint analysis (federalized) (plastic)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.356	0.428	5.510	<0.0001	1.517	3.195
	y>=3		1.482	0.420	3.530	0.000	0.660	2.305
	y>=4		0.278	0.416	0.670	0.503	-0.536	1.093
	y>=5		-0.626	0.416	-1.510	0.132	-1.440	0.188
Intercept	ASC2		-0.330	0.246	-1.340	0.180	-0.813	0.153
Charge ref. MYR 0.2/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.219	0.154	1.420	0.156	-0.084	0.522
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.946	0.195	4.860	<0.0001	0.565	1.327
	dM2	MYR 0.6/kg	0.385	0.186	2.070	0.039	0.020	0.750
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.5B: Result of conjoint analysis (federalized) (paper)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.203	0.421	5.230	<0.0001	1.378	3.028
	y>=3		1.392	0.414	3.370	0.001	0.582	2.203
	y>=4		0.200	0.410	0.490	0.626	-0.604	1.004
	y>=5		-0.679	0.410	-1.650	0.098	-1.483	0.126
Intercept	ASC2		-0.302	0.244	-1.240	0.216	-0.780	0.176
Charge ref. MYR 0.3/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.235	0.155	1.520	0.128	-0.068	0.539
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.931	0.194	4.790	<0.0001	0.550	1.312
	dM2	MYR 0.6/kg	0.379	0.187	2.030	0.042	0.014	0.745
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.5C: Result of conjoint analysis (federalized) (metal)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.2791	0.4312	5.29	<0.0001	1.434	3.124
	y>=3		1.1749	0.4216	2.79	0.0053	0.349	2.001
	y>=4		0.0368	0.4199	0.09	0.9303	-0.786	0.860
	y>=5		-0.7755	0.4201	-1.85	0.0649	-1.599	0.048
Intercept	ASC2		-0.2494	0.2477	-1.01	0.314	-0.735	0.236
Charge ref. MYR 0.3/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.1877	0.1539	1.22	0.2228	-0.114	0.489
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.9695	0.1941	5	<0.0001	0.589	1.350
	dM2	MYR 0.6/kg	0.4176	0.1857	2.25	0.0245	0.054	0.782
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.5D: Result of conjoint analysis (federalized) (tetrapak)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.2601	0.4297	5.26	<0.0001	1.418	3.102
	y>=3		1.1446	0.4192	2.73	0.0063	0.323	1.966
	y>=4		-0.0507	0.4172	-0.12	0.9032	-0.868	0.767
	y>=5		-0.8558	0.4181	-2.05	0.0407	-1.675	-0.036
Intercept	ASC2		-0.2503	0.2469	-1.01	0.3106	-0.734	0.234
Charge ref. MYR	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.2317	0.1541	1.5	0.1326	-0.070	0.534
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.9751	0.1946	5.01	<0.0001	0.594	1.357
	dM2	MYR 0.6/kg	0.4907	0.1863	2.63	0.0084	0.126	0.856
	dM3	MYR 0/kg	-	-	-	-	-	-

\* 1 respondent that choose willingness to separate at 50% for every scenario in every type of recyclables but accidentally left blank for scenario 1 in tetrapak. We assume his/her willingness to separate for scenario 1 (tetrapak) at 50%.

Table 5.6A: Result of conjoint analysis (non-federalized) (plastic)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		1.9378	0.4462	4.34	<0.0001	1.063	2.812
	y>=3		1.105	0.4377	2.52	0.0116	0.247	1.963
	y>=4		0.0809	0.4357	0.19	0.8528	-0.773	0.935
	y>=5		-0.893	0.4369	-2.04	0.041	-1.749	-0.037
Intercept	ASC2		-0.0038	0.2558	-0.01	0.9883	-0.505	0.498
Charge ref. MYR 0.2/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.27	0.163	1.66	0.0975	-0.049	0.589
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.6345	0.2015	3.15	0.0016	0.240	1.029
	dM2	MYR 0.6/kg	0.1829	0.1958	0.93	0.3502	-0.201	0.567
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.6B: Result of conjoint analysis (non-federalized) (paper)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.3477	0.4486	5.23	<0.0001	1.468	3.227
	y>=3		1.5894	0.4393	3.62	0.0003	0.728	2.450
	y>=4		0.4585	0.4338	1.06	0.2906	-0.392	1.309
	y>=5		-0.4887	0.4331	-1.13	0.2591	-1.338	0.360
Intercept	ASC2		-0.2385	0.2556	-0.93	0.3509	-0.739	0.262
Charge ref. MYR 0.2/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.2993	0.1638	1.83	0.0676	-0.022	0.620
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.7529	0.2026	3.72	0.0002	0.356	1.150
	dM2	MYR 0.6/kg	0.2826	0.1971	1.43	0.1517	-0.104	0.669
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.6C: Result of conjoint analysis (non-federalized) (metal)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.0526	0.444	4.62	<0.0001	1.182	2.923
	y>=3		1.2313	0.4356	2.83	0.0047	0.378	2.085
	y>=4		0.257	0.4323	0.59	0.5522	-0.590	1.104
	y>=5		-0.6216	0.4325	-1.44	0.1506	-1.469	0.226
Intercept	ASC2		-0.1129	0.2553	-0.44	0.6583	-0.613	0.387
Charge ref. MYR 0.2/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.2015	0.1634	1.23	0.2175	-0.119	0.522
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.6516	0.2018	3.23	0.0012	0.256	1.047
	dM2	MYR 0.6/kg	0.2857	0.1977	1.45	0.1483	-0.102	0.673
	dM3	MYR 0/kg	-	-	-	-	-	-

Table 5.6D: Result of conjoint analysis (non-federalized) (tetrapak)

		Content when dummy variable=1	Coef	S.E.	Wald Z	Pr(> Z )	lower 95%	upper 95%
Cut-off	y>=2		2.2053	0.4439	4.97	<0.0001	1.335	3.075
	y>=3		1.3366	0.4366	3.06	0.0022	0.481	2.192
	y>=4		0.2471	0.4342	0.57	0.5693	-0.604	1.098
	y>=5		-0.6304	0.4347	-1.45	0.147	-1.482	0.222
Intercept	ASC2		-0.3389	0.2554	-1.33	0.1844	-0.839	0.162
Charge ref. MYR 0.2/kg	dC1	MYR 0/kg	-	-	-	-	-	-
	dC2	MYR 0.1/kg	0.1937	0.1609	1.2	0.2287	-0.122	0.509
Incentive ref. MYR 0.3/kg	dM1	MYR 0.9/kg	0.7895	0.1996	3.96	<0.0001	0.398	1.181
	dM2	MYR 0.6/kg	0.2698	0.1949	1.38	0.1663	-0.112	0.652
	dM3	MYR 0/kg	-	-	-	-	-	-

### 5.3.3 The result of distribution of Willingness to separate

As showed in table 5.7 and 5.8, when Y=1, indicated 0% willingness to separate, Y=2 (25%), Y=3 (50%), Y=4 (75%) and Y=5 (100%), we observed that in all models for all recyclables in federalized and non-federalized states, that there is a trend that probability of citizens' willing to separate their recyclables at source increase when incentive amount increased, and charge amount reduced.

Scenario with highest incentive at MYR 0.90/kg and lowest charge at MYR 0.10/kg showed the highest probability of respondents' willingness to separate and lowest unwillingness to separate recyclables at all.

We also observed that there are about 9 to 11% of respondents that are willing to separate their 100% of their recyclables without any charge or incentive. This group of citizens can be categorized as high environmental awareness group that can become community mobilizer if 'Zero Budget System' implemented in the future.

We also observed about 14 to 19% of respondents are not willing to separate their recyclables at all even in the scenario with highest incentive and lowest charge that maybe can be considered as act of protest. However, we believe that this percentage will reduce once the system is implemented as environmental awareness will also be increased gradually.

Table 5.7A: Respondents' willingness to separate (plastic)(federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.09	0.08	0.11	0.18	0.06	0.09	0.15
75%	0.10	0.09	0.12	0.16	0.08	0.10	0.15
50%	0.25	0.23	0.27	0.29	0.21	0.25	0.29
25%	0.22	0.22	0.21	0.18	0.22	0.22	0.19
0%	0.35	0.37	0.29	0.19	0.43	0.34	0.22

Table 5.7B: Respondents' willingness to separate (paper)(federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.10	0.09	0.13	0.21	0.08	0.11	0.17
75%	0.10	0.09	0.12	0.16	0.08	0.11	0.15
50%	0.25	0.25	0.27	0.29	0.22	0.26	0.29
25%	0.21	0.21	0.20	0.16	0.22	0.21	0.18
0%	0.34	0.35	0.27	0.18	0.41	0.32	0.21

Table 5.7C: Respondents' willingness to separate (metal)(federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.09	0.09	0.13	0.20	0.07	0.11	0.17
75%	0.14	0.14	0.18	0.23	0.12	0.16	0.21
50%	0.25	0.25	0.27	0.27	0.23	0.27	0.28
25%	0.19	0.20	0.18	0.14	0.20	0.19	0.15
0%	0.32	0.33	0.24	0.16	0.37	0.28	0.18

Table 5.7D: Respondents' willingness to separate (tetrapak)(federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.09	0.09	0.14	0.21	0.08	0.12	0.18
75%	0.15	0.15	0.19	0.24	0.12	0.17	0.22
50%	0.27	0.27	0.29	0.28	0.25	0.28	0.29
25%	0.19	0.19	0.16	0.13	0.20	0.18	0.14
0%	0.30	0.30	0.21	0.14	0.35	0.25	0.17

- \* 1 respondent that choose willingness to separate at 50% for every scenario in every type of recyclables but accidentally left blank for scenario 1 in tetrapak. We assume his/her willingness to separate for scenario 1 (tetrapak) at 50%.

Table 5.8A: Respondents' willingness to separate (plastic)(non-federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.13	0.16	0.18	0.26	0.13	0.15	0.21
75%	0.12	0.14	0.16	0.19	0.12	0.14	0.17
50%	0.23	0.24	0.25	0.25	0.23	0.24	0.25
25%	0.23	0.21	0.20	0.16	0.23	0.22	0.19
0%	0.29	0.24	0.21	0.14	0.29	0.26	0.18

Table 5.8B: Respondents' willingness to separate (paper)(non-federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.09	0.09	0.12	0.18	0.07	0.09	0.14
75%	0.08	0.09	0.10	0.14	0.07	0.08	0.12
50%	0.22	0.22	0.25	0.27	0.19	0.22	0.26
25%	0.23	0.23	0.23	0.20	0.23	0.23	0.22
0%	0.38	0.37	0.30	0.21	0.44	0.37	0.27

Table 5.8C: Respondents' willingness to separate (metal)(non-federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.11	0.12	0.16	0.21	0.10	0.13	0.18
75%	0.11	0.12	0.14	0.17	0.10	0.13	0.15
50%	0.21	0.22	0.23	0.24	0.20	0.22	0.24
25%	0.21	0.21	0.20	0.18	0.22	0.21	0.19
0%	0.35	0.33	0.27	0.20	0.38	0.31	0.24

Table 5.8D: Respondents' willingness to separate (tetrapak)(non-federalized states)

	Current	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 6
Charge	MYR 0/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.1/kg	MYR 0.2/kg	MYR 0.2/kg	MYR 0.2/kg
Incentive	MYR 0/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg	MYR 0.3/kg	MYR 0.6/kg	MYR 0.9/kg
100%	0.10	0.09	0.11	0.17	0.07	0.09	0.15
75%	0.11	0.10	0.12	0.16	0.08	0.10	0.14
50%	0.23	0.22	0.24	0.26	0.20	0.22	0.26
25%	0.21	0.22	0.21	0.18	0.21	0.22	0.20
0%	0.35	0.38	0.32	0.22	0.43	0.36	0.25

### 5.3.4 Influence of respondents' attributes on citizen willingness to separate

According to the p-value in Table 5.9A, 5.9B, 5.9C and 5.9D, in federalized states, education affected the incentive most in all respondents' attribute. Particularly, undergraduate degree affected the incentives of both MYR 0.9/kg and MYR 0.6/kg more than secondary school or below. Diploma or equivalent also affected the incentive of MYR 0.9/kg. While post graduate degree or equivalent affected by incentive of MYR 0.9/kg, in term of willingness to separate metal and tetrapak. Overall, incentive amount is a sensitive factor in the education levels.

On the other hand, the education levels did not affect the charge. The incentive was more sensitive the charge in terms of education levels.

As showed in Table 5.9B, 5.9C and 5.9D, the household incentive of MYR 4001 to MYR 8500 was affected by the charge, suggesting that the middle income layer (MYR 4001 to MYR 8500) tended to accept the charge more than the low income layer. As showed in Table 5.9B, we also observed that middle income layer also affected by incentive at MYR 0.6/kg.

There seemed to be no significance in influence of the other response's attribute, such as age and gender, on the result in federalized states.

As shown in Table 5.10A, 5.10B, 5.10C and 5.10D, in non-federalized states, we observed that gender affected by incentive especially at MYR 0.6/kg with negative coefficient. As female was used as reference, this means that female in non-federalized states are willing to separate if given incentive at MYR 0.6/kg.

In term of willingness to separate paper, we also observed that age also affected by incentive amount at MYR 0.6/kg for all age range. As showed in Table 5.10C, post graduate degree or equivalent and undergraduate degree, was affected by incentive amount at MYR 0.9/kg. While Table 5.10D showed post graduate degree or equivalent and diploma or equivalent, was affected by incentive amount at MYR 0.9/kg.

We also observed that was no significant influence on household income and willingness to separate in non-federalized states.

Table 5.9A: Influenced of respondents' attributes towards willingness to separate (federalized) (plastic)

		Content when dummy variable =1		Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%	
Cut-off	y>=2			2.46	0.44	5.64	<0.0001	1.61	3.32	
	y>=3			1.57	0.43	3.67	0.00	0.73	2.41	
	y>=4			0.30	0.42	0.70	0.48	-0.53	1.13	
	y>=5			-0.69	0.42	-1.63	0.10	-1.52	0.14	
Intercept	ASC2			-0.36	0.25	-1.43	0.15	-0.85	0.13	
Charge	dC1		MYR 0/kg	-	-	-	-	-	-	
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	-0.13	1.67	-0.08	0.94	-3.42	3.15	
Incentive	dM1		MYR 0.90/kg	0.29	0.69	0.41	0.68	-1.07	1.64	
	dM2		MYR 0.60/kg	-0.14	0.66	-0.21	0.83	-1.44	1.16	
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-	-	
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-	-	
	dA1dC2	21-30 years old	MYR 0.10/kg	0.23	1.70	0.14	0.89	-3.10	3.56	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-	-	
	dA2dC2	31-40 years old	MYR 0.10/kg	0.15	1.65	0.09	0.93	-3.08	3.38	
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-	-	
	ref. 61 years old and above	dA3dC2	41-50 years old	MYR 0.10/kg	-0.14	1.66	-0.09	0.93	-3.40	3.12
Age*Incentive	dA4dC1	51-60 years old	MYR 0/kg	-	-	-	-	-	-	
	dA4dC2	51-60 years old	MYR 0.10/kg	0.48	1.65	0.29	0.77	-2.76	3.72	
	dA1dM1	21-30 years old	MYR 0.90/kg	-0.18	0.75	-0.24	0.81	-1.65	1.29	
	dA1dM2	21-30 years old	MYR 0.60/kg	0.15	0.71	0.21	0.83	-1.24	1.54	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.58	0.61	-0.95	0.34	-1.77	0.62	
ref. 61 years old and above	dA2dM2	31-40 years old	MYR 0.60/kg	-0.09	0.58	-0.16	0.88	-1.22	1.04	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA3dM1	41-50 years old	MYR 0.90/kg	-0.84	0.65	-1.29	0.20	-2.12	0.43	
	dA3dM2	41-50 years old	MYR 0.60/kg	-0.79	0.62	-1.27	0.21	-2.00	0.43	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA4dM1	51-60 years old	MYR 0.90/kg	-	-	-	-	-	-	
	dA4dM2	51-60 years old	MYR 0.60/kg	-	-	-	-	-	-	
	dA4dM3	51-60 years old	MYR 0.30/kg	-	-	-	-	-	-	
	Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-	-
		ref. Female	dGdC2	Male	0.06	0.29	0.22	0.83	-0.50	0.62
Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.35	0.33	-1.06	0.29	-1.00	0.30	
	ref. Female	dGdM2	Male	0.07	0.31	0.22	0.83	-0.54	0.68	
	dGdM3	Male	MYR 0.30/kg	-	-	-	-	-	-	
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	-0.13	0.34	-0.39	0.70	-0.80	0.54	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-	-	
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.11	0.28	0.40	0.69	-0.44	0.67	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	-0.14	0.34	-0.41	0.68	-0.82	0.53	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	0.72	0.51	1.41	0.16	-0.28	1.71	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.32	0.49	0.66	0.51	-0.63	1.27	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-	-	
	dE2dM1	undergraduate degree	MYR 0.90/kg	1.99	0.49	4.03	<0.0001	1.02	2.96	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.93	0.46	2.04	0.04	0.04	1.83	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-	-	
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.27	0.49	2.59	0.01	0.31	2.23	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	0.25	0.46	0.53	0.60	-0.66	1.15	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-	-	
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-	-	
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.38	0.42	0.91	0.36	-0.44	1.20	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-	-	
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.54	0.37	1.47	0.14	-0.18	1.25	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	0.51	0.51	1.01	0.31	-0.48	1.50	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	0.38	0.47	0.80	0.42	-0.54	1.29	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-	-	
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	0.51	0.43	1.19	0.23	-0.33	1.36
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	0.57	0.40	1.41	0.16	-0.22	1.36	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-	-	

Table 5.9B: Influenced of respondents' attributes towards willingness to separate  
(federalized) (paper)

		Content when dummy variable =1	Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%		
Cut-off	y>=2		2.32	0.43	5.40	<0.0001	1.48	3.16		
	y>=3		1.49	0.42	3.52	0.00	0.66	2.31		
	y>=4		0.23	0.42	0.54	0.59	-0.59	1.05		
	y>=5		-0.74	0.42	-1.76	0.08	-1.56	0.09		
Intercept	ASC2		-0.33	0.25	-1.35	0.18	-0.82	0.15		
Charge	dC1	MYR 0/kg	-	-	-	-	-	-		
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	-1.35	1.70	-0.80	0.43	-4.68	1.98	
Incentive	dM1	MYR 0.90/kg	0.36	0.69	0.53	0.60	-0.99	1.72		
	dM2	MYR 0.60/kg	-0.36	0.67	-0.54	0.59	-1.68	0.96		
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-		
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-		
	dA1dC2	21-30 years old	MYR 0.10/kg	1.48	1.72	0.86	0.39	-1.90	4.86	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-		
	dA2dC2	31-40 years old	MYR 0.10/kg	1.28	1.67	0.77	0.44	-2.00	4.56	
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-		
	ref. 61 years old and above	dA3dC2	41-50 years old	MYR 0.10/kg	1.12	1.69	0.67	0.51	-2.18	4.43
	dA4dC1	51-60 years old	MYR 0/kg	-	-	-	-	-		
	dA4dC2	51-60 years old	MYR 0.10/kg	1.66	1.68	0.99	0.32	-1.63	4.95	
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	-0.19	0.75	-0.26	0.79	-1.66	1.27	
	dA1dM2	21-30 years old	MYR 0.60/kg	0.36	0.71	0.51	0.61	-1.03	1.75	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-		
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.61	0.61	-1.00	0.32	-1.80	0.58	
	dA2dM2	31-40 years old	MYR 0.60/kg	0.08	0.58	0.15	0.88	-1.05	1.22	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-		
	ref. 61 years old and above	dA3dM1	41-50 years old	MYR 0.90/kg	-0.88	0.65	-1.35	0.18	-2.16	0.40
	dA3dM2	41-50 years old	MYR 0.60/kg	-0.56	0.62	-0.89	0.37	-1.78	0.66	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
	dA4dM1	51-60 years old	MYR 0.90/kg	-	-	-	-	-		
dA4dM2	51-60 years old	MYR 0.60/kg	-	-	-	-	-			
dA4dM3	51-60 years old	MYR 0.30/kg	-	-	-	-	-			
Gender*Charge	ref. Female	dGdC1	Male	MYR 0/kg	-	-	-	-		
	dGdC2	Male	MYR 0.10/kg	0.09	0.29	0.30	0.77	-0.48	0.65	
Gender*Incentive	ref. Female	dGdM1	Male	MYR 0.90/kg	-0.41	0.33	-1.23	0.22	-1.06	0.24
	dGdM2	Male	MYR 0.60/kg	0.03	0.31	0.10	0.92	-0.58	0.64	
	dGdM3	Male	MYR 0.30/kg	-	-	-	-	-		
Education*Charge	ref. secondary school or below	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-		
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	-0.15	0.34	-0.45	0.65	-0.82	0.51	
	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-	-		
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.05	0.28	0.19	0.85	-0.50	0.61	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-		
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	-0.06	0.34	-0.19	0.85	-0.74	0.61	
Education*Incentive	ref. secondary school or below	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	0.71	0.51	1.41	0.16	-0.28	1.71
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.23	0.49	0.46	0.64	-0.73	1.18	
	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-	-		
	dE2dM1	undergraduate degree	MYR 0.90/kg	2.01	0.49	4.07	<0.0001	1.04	2.97	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.97	0.46	2.10	0.04	0.07	1.86	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-		
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.20	0.49	2.45	0.01	0.24	2.16	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	0.29	0.47	0.62	0.54	-0.63	1.20	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-		
Income*Charge	ref. MYR 4000 or less	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-		
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.39	0.42	0.94	0.35	-0.43	1.21	
	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-	-		
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.64	0.37	1.75	0.08	-0.08	1.35	
Income*Incentive	ref. MYR 4000 or less	dI1dM1	MYR 8501 and above	MYR 0.90/kg	0.49	0.50	0.97	0.33	-0.50	1.48
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	0.46	0.47	0.98	0.33	-0.46	1.37	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-		
	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	0.49	0.43	1.13	0.26	-0.36	1.33	
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	0.66	0.41	1.62	0.10	-0.14	1.46	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-		

Table 5.9C: Influenced of respondents' attributes towards willingness to separate  
(federalized) (metal)

		Content when dummy variable =1	Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%		
Cut-off	y>=2		2.40	0.44	5.44	<0.0001	1.53	3.26		
	y>=3		1.25	0.43	2.91	0.00	0.41	2.10		
	y>=4		0.04	0.43	0.10	0.92	-0.80	0.88		
	y>=5		-0.84	0.43	-1.96	0.05	-1.68	0.00		
Intercept	ASC2		-0.27	0.25	-1.09	0.27	-0.77	0.22		
Charge	dC1	MYR 0/kg	-	-	-	-	-	-		
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	-2.74	1.69	-1.62	0.10	-6.05	0.57	
Incentive	dM1	MYR 0.90/kg	0.13	0.69	0.19	0.85	-1.22	1.47		
	dM2	MYR 0.60/kg	-0.24	0.67	-0.37	0.71	-1.55	1.06		
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-		
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-		
	dA1dC2	21-30 years old	MYR 0.10/kg	2.76	1.71	1.61	0.11	-0.60	6.12	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-		
	dA2dC2	31-40 years old	MYR 0.10/kg	2.45	1.66	1.47	0.14	-0.81	5.71	
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-		
	ref. 61 years old and above	dA3dC2	41-50 years old	MYR 0.10/kg	2.44	1.68	1.46	0.15	-0.85	5.73
	dA4dC1	51-60 years old	MYR 0/kg	-	-	-	-	-		
	dA4dC2	51-60 years old	MYR 0.10/kg	2.69	1.67	1.61	0.11	-0.58	5.97	
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	-0.03	0.74	-0.04	0.97	-1.49	1.43	
	dA1dM2	21-30 years old	MYR 0.60/kg	0.15	0.71	0.21	0.84	-1.24	1.53	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-		
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.60	0.61	-0.99	0.32	-1.79	0.59	
	dA2dM2	31-40 years old	MYR 0.60/kg	-0.15	0.58	-0.25	0.80	-1.28	0.99	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-		
	ref. 61 years old and above	dA3dM1	41-50 years old	MYR 0.90/kg	-0.91	0.65	-1.41	0.16	-2.18	0.35
	dA3dM2	41-50 years old	MYR 0.60/kg	-0.78	0.62	-1.25	0.21	-1.99	0.44	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
	dA4dM1	51-60 years old	MYR 0.90/kg	-	-	-	-	-		
	dA4dM2	51-60 years old	MYR 0.60/kg	-	-	-	-	-		
	dA4dM3	51-60 years old	MYR 0.30/kg	-	-	-	-	-		
Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-		
	ref. Female	dGdC2	Male	MYR 0.10/kg	0.26	0.29	0.90	0.37	-0.31	0.82
Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.19	0.33	-0.56	0.58	-0.83	0.46	
	ref. Female	dGdM2	Male	MYR 0.60/kg	0.22	0.31	0.70	0.48	-0.39	0.83
	dGdM3	Male	MYR 0.30/kg	-	-	-	-	-		
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-		
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	-0.16	0.34	-0.48	0.63	-0.82	0.50	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-		
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.05	0.28	0.18	0.86	-0.51	0.61	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-		
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	-0.02	0.35	-0.06	0.95	-0.70	0.66	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	1.05	0.50	2.10	0.04	0.07	2.04	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.43	0.49	0.88	0.38	-0.53	1.38	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-		
	dE2dM1	undergraduate degree	MYR 0.90/kg	2.06	0.49	4.22	<0.0001	1.10	3.01	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.92	0.46	2.03	0.04	0.03	1.81	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-		
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.36	0.49	2.80	0.01	0.41	2.32	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	0.43	0.47	0.91	0.36	-0.49	1.34	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-		
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-		
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.45	0.42	1.08	0.28	-0.36	1.26	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-		
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.69	0.37	1.85	0.06	-0.04	1.41	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	0.33	0.50	0.66	0.51	-0.65	1.31	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	0.30	0.46	0.65	0.51	-0.60	1.21	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-		
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	0.58	0.43	1.35	0.18	-0.26	1.42
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	0.65	0.41	1.59	0.11	-0.15	1.45	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-		

Table 5.9D: Influenced of respondents' attributes towards willingness to separate  
(federalized) (tetrapak)

		Content when dummy variable =1		Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%	
Cut-off	y>=2			2.37	0.44	5.40	<0.0001	1.51	3.23	
	y>=3			1.22	0.43	2.86	0.00	0.38	2.06	
	y>=4			-0.05	0.43	-0.11	0.91	-0.88	0.79	
	y>=5			-0.93	0.43	-2.17	0.03	-1.76	-0.09	
Intercept	ASC2			-0.28	0.25	-1.12	0.26	-0.77	0.21	
Charge	dC1	MYR 0/kg		-	-	-	-	-	-	
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	-2.32	1.69	-1.37	0.17	-5.63	0.99	
Incentive	dM1	MYR 0.90/kg		0.14	0.69	0.20	0.84	-1.22	1.49	
	dM2	MYR 0.60/kg		-0.06	0.67	-0.09	0.93	-1.37	1.25	
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-	-	
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-	-	
	dA1dC2	21-30 years old	MYR 0.10/kg	2.44	1.71	1.42	0.16	-0.93	5.80	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-	-	
	dA2dC2	31-40 years old	MYR 0.10/kg	2.22	1.66	1.33	0.18	-1.04	5.48	
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-	-	
	dA3dC2	41-50 years old	MYR 0.10/kg	2.21	1.68	1.32	0.19	-1.08	5.50	
	dA4dC1	51-60 years old	MYR 0/kg	-	-	-	-	-	-	
	dA4dC2	51-60 years old	MYR 0.10/kg	2.54	1.67	1.52	0.13	-0.74	5.82	
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	0.03	0.75	0.05	0.96	-1.43	1.50	
	dA1dM2	21-30 years old	MYR 0.60/kg	0.15	0.71	0.22	0.83	-1.24	1.55	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.65	0.61	-1.07	0.28	-1.84	0.54	
	dA2dM2	31-40 years old	MYR 0.60/kg	-0.26	0.58	-0.45	0.65	-1.40	0.88	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA3dM1	41-50 years old	MYR 0.90/kg	-0.90	0.65	-1.39	0.16	-2.18	0.37	
	dA3dM2	41-50 years old	MYR 0.60/kg	-0.81	0.62	-1.30	0.19	-2.03	0.41	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA4dM1	51-60 years old	MYR 0.90/kg	-	-	-	-	-	-	
	dA4dM2	51-60 years old	MYR 0.60/kg	-	-	-	-	-	-	
	dA4dM3	51-60 years old	MYR 0.30/kg	-	-	-	-	-	-	
Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-	-	
	ref. Female	dGdC2	Male	MYR 0.10/kg	0.07	0.29	0.24	0.81	-0.50	0.63
Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.35	0.33	-1.06	0.29	-1.00	0.30	
	ref. Female	dGdM2	Male	MYR 0.60/kg	0.09	0.31	0.30	0.77	-0.52	0.70
		dGdM3	Male	MYR 0.30/kg	-	-	-	-	-	
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	-0.13	0.34	-0.39	0.69	-0.79	0.53	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-	-	
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.09	0.29	0.30	0.76	-0.47	0.65	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	-0.06	0.35	-0.18	0.86	-0.74	0.62	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	0.97	0.50	1.92	0.06	-0.02	1.96	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.43	0.49	0.89	0.37	-0.52	1.39	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-	-	
	dE2dM1	undergraduate degree	MYR 0.90/kg	2.15	0.49	4.37	<0.0001	1.18	3.11	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.98	0.46	2.13	0.03	0.08	1.87	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-	-	
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.48	0.49	3.01	0.00	0.52	2.44	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	0.46	0.47	0.97	0.33	-0.46	1.38	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-	-	
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-	-	
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.39	0.42	0.92	0.36	-0.43	1.20	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-	-	
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.63	0.37	1.71	0.09	-0.09	1.36	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	0.55	0.50	1.10	0.27	-0.43	1.54	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	0.33	0.46	0.71	0.48	-0.58	1.24	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-	-	
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	0.60	0.43	1.38	0.17	-0.25	1.44
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	0.63	0.41	1.53	0.13	-0.17	1.43	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-	-	

\* 1 respondent that choose willingness to separate at 50% for every scenario in every type of recyclables but accidentally left blank for scenario 1 in tetrapak. We assume his/her willingness to separate for scenario 1 (tetrapak) at 50%.

Table 5.10A: Influenced of respondents' attributes towards willingness to separate  
(non-federalized) (plastic)

		Content when dummy variable =1	Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%		
Cut-off	y>=2		1.97	0.45	4.39	<0.0001	1.09	2.85		
	y>=3		1.13	0.44	2.56	0.01	0.26	1.99		
	y>=4		0.08	0.44	0.19	0.85	-0.78	0.94		
	y>=5		-0.92	0.44	-2.10	0.04	-1.78	-0.06		
Intercept	ASC2		0.00	0.26	0.00	1.00	-0.50	0.50		
Charge	dC1	MYR 0/kg	-	-	-	-	-	-		
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	0.01	1.02	0.01	0.99	-1.99	2.01	
Incentive	dM1	MYR 0.90/kg	1.04	1.15	0.91	0.36	-1.21	3.29		
	dM2	MYR 0.60/kg	2.45	1.11	2.20	0.03	0.27	4.62		
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-		
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-		
	dA1dC2	21-30 years old	MYR 0.10/kg	-0.42	0.81	-0.51	0.61	-2.01	1.18	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-		
	ref. 51-60 years old	dA2dC2	31-40 years old	MYR 0.10/kg	-0.08	0.67	-0.11	0.91	-1.39	1.24
Age*Incentive	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-		
	dA3dC2	41-50 years old	MYR 0.10/kg	0.21	0.67	0.31	0.75	-1.11	1.53	
	dA1dM1	21-30 years old	MYR 0.90/kg	-0.82	0.92	-0.89	0.37	-2.62	0.98	
	dA1dM2	21-30 years old	MYR 0.60/kg	-1.30	0.87	-1.49	0.13	-3.00	0.40	
ref. 51-60 years old	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-		
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.93	0.75	-1.24	0.22	-2.40	0.54	
	dA2dM2	31-40 years old	MYR 0.60/kg	-1.08	0.73	-1.49	0.14	-2.50	0.34	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-		
	dA3dM1	41-50 years old	MYR 0.90/kg	-1.11	0.75	-1.48	0.14	-2.58	0.36	
	dA3dM2	41-50 years old	MYR 0.60/kg	-1.45	0.73	-1.98	0.05	-2.87	-0.02	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-		
	ref. Female	dGdC2	Male	MYR 0.10/kg	-0.05	0.30	-0.18	0.86	-0.65	0.54
Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.46	0.35	-1.31	0.19	-1.14	0.23	
	ref. Female	dGdM2	Male	MYR 0.60/kg	-0.75	0.34	-2.21	0.03	-1.42	-0.09
	dGdM3	Male	MYR 0.30/kg	-	-	-	-	-		
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-		
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	0.10	0.71	0.14	0.89	-1.29	1.49	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-		
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.13	0.77	0.17	0.87	-1.38	1.63	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-		
Education*Incentive	dE3dC2	Diploma or equivalent	MYR 0.10/kg	0.46	0.82	0.57	0.57	-1.14	2.07	
	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	1.15	0.80	1.43	0.15	-0.42	2.72	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	-0.35	0.78	-0.44	0.66	-1.89	1.19	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-		
	dE2dM1	undergraduate degree	MYR 0.90/kg	1.30	0.87	1.50	0.13	-0.40	2.99	
	dE2dM2	undergraduate degree	MYR 0.60/kg	-0.25	0.85	-0.29	0.77	-1.92	1.42	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-		
dE3dM1	Diploma or equivalent	MYR 0.90/kg	0.82	0.91	0.91	0.36	-0.96	2.60		
dE3dM2	Diploma or equivalent	MYR 0.60/kg	-0.59	0.90	-0.66	0.51	-2.36	1.17		
dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-			
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-		
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	-0.03	0.66	-0.04	0.97	-1.32	1.26	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-		
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.48	0.65	0.74	0.46	-0.80	1.77	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	-0.23	0.78	-0.29	0.77	-1.75	1.30	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	-0.29	0.71	-0.40	0.69	-1.68	1.11	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-		
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	-0.55	0.77	-0.72	0.47	-2.05	0.95
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	-0.53	0.71	-0.74	0.46	-1.92	0.87	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-		

Table 5.10B: Influenced of respondents' attributes towards willingness to separate (non-federalized) (paper)

		Content when dummy variable =1	Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%		
Cut-off	y>=2		2.40	0.45	5.31	<0.0001	1.51	3.28		
	y>=3		1.63	0.44	3.69	0.00	0.77	2.50		
	y>=4		0.48	0.44	1.09	0.27	-0.38	1.33		
	y>=5		-0.51	0.44	-1.18	0.24	-1.37	0.34		
Intercept	ASC2		-0.25	0.26	-0.96	0.34	-0.75	0.26		
Charge	dC1	MYR 0/kg	-	-	-	-	-	-		
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	0.00	1.01	0.00	1.00	-1.98	1.98	
Incentive	dM1	MYR 0.90/kg	1.70	1.14	1.49	0.14	-0.53	3.93		
	dM2	MYR 0.60/kg	2.82	1.13	2.49	0.01	0.60	5.04		
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-		
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-		
	dA1dC2	21-30 years old	MYR 0.10/kg	-0.37	0.82	-0.46	0.65	-1.97	1.23	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-		
	ref. 51-60 years old	dA2dC2	31-40 years old	MYR 0.10/kg	-0.20	0.67	-0.30	0.77	-1.52	1.12
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-		
dA3dC2	41-50 years old	MYR 0.10/kg	0.09	0.68	0.14	0.89	-1.23	1.42		
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	-0.88	0.92	-0.96	0.34	-2.69	0.92	
	dA1dM2	21-30 years old	MYR 0.60/kg	-1.59	0.88	-1.81	0.07	-3.31	0.13	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-		
	dA2dM1	31-40 years old	MYR 0.90/kg	-1.12	0.75	-1.49	0.14	-2.59	0.35	
	dA2dM2	31-40 years old	MYR 0.60/kg	-1.27	0.73	-1.74	0.08	-2.70	0.16	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-		
	ref. 51-60 years old	dA3dM1	41-50 years old	MYR 0.90/kg	-1.11	0.76	-1.46	0.14	-2.59	0.38
	dA3dM2	41-50 years old	MYR 0.60/kg	-1.45	0.74	-1.97	0.05	-2.90	-0.01	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
	dA3dM2	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-		
	ref. Female	dGdC2	Male	MYR 0.10/kg	-0.26	0.31	-0.85	0.40	-0.86	0.34
	Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.61	0.35	-1.74	0.08	-1.30	0.08
ref. Female		dGdM2	Male	MYR 0.60/kg	-0.78	0.34	-2.29	0.02	-1.45	-0.11
dGdM3		Male	MYR 0.30/kg	-	-	-	-	-		
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-		
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	0.07	0.71	0.10	0.92	-1.32	1.46	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-		
	dE2dC2	undergraduate degree	MYR 0.10/kg	-0.02	0.77	-0.02	0.98	-1.52	1.49	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-		
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	0.25	0.82	0.30	0.76	-1.36	1.86	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	1.16	0.79	1.46	0.14	-0.39	2.71	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.32	0.80	0.41	0.68	-1.24	1.89	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-		
	dE2dM1	undergraduate degree	MYR 0.90/kg	1.34	0.86	1.56	0.12	-0.34	3.01	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.37	0.86	0.43	0.66	-1.31	2.05	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-		
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	0.76	0.90	0.84	0.40	-1.01	2.52	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	-0.34	0.91	-0.37	0.71	-2.12	1.44	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-		
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-		
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.40	0.66	0.61	0.54	-0.88	1.69	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-		
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.83	0.65	1.28	0.20	-0.44	2.11	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	-0.53	0.77	-0.68	0.49	-2.05	0.99	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	-1.08	0.76	-1.42	0.16	-2.57	0.42	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-		
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	-1.03	0.76	-1.35	0.18	-2.53	0.46
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	-1.21	0.75	-1.61	0.11	-2.68	0.26	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-		

Table 5.10C: Influenced of respondents' attributes towards willingness to separate (non-federalized) (metal)

		Content when dummy variable =1	Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%		
Cut-off	y>=2		2.09	0.45	4.67	<0.0001	1.21	2.96		
	y>=3		1.26	0.44	2.88	0.00	0.40	2.12		
	y>=4		0.27	0.43	0.62	0.53	-0.58	1.12		
	y>=5		-0.64	0.43	-1.48	0.14	-1.50	0.21		
Intercept	ASC2		-0.12	0.26	-0.46	0.65	-0.62	0.38		
Charge	dC1	MYR 0/kg	-	-	-	-	-	-		
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	0.12	0.99	0.12	0.91	-1.83	2.06	
Incentive	dM1	MYR 0.90/kg	0.97	1.15	0.85	0.40	-1.28	3.23		
	dM2	MYR 0.60/kg	1.85	1.09	1.69	0.09	-0.29	4.00		
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-		
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-		
	dA1dC2	21-30 years old	MYR 0.10/kg	-0.42	0.81	-0.52	0.60	-1.99	1.16	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-		
	ref. 51-60 years old	dA2dC2	31-40 years old	MYR 0.10/kg	-0.42	0.65	-0.64	0.52	-1.69	0.86
	dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-		
dA3dC2	41-50 years old	MYR 0.10/kg	-0.10	0.66	-0.16	0.88	-1.40	1.19		
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	-1.02	0.92	-1.11	0.27	-2.81	0.78	
	dA1dM2	21-30 years old	MYR 0.60/kg	-0.84	0.88	-0.96	0.33	-2.56	0.87	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-		
	dA2dM1	31-40 years old	MYR 0.90/kg	-1.03	0.74	-1.39	0.16	-2.47	0.42	
	dA2dM2	31-40 years old	MYR 0.60/kg	-1.09	0.71	-1.53	0.12	-2.48	0.30	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-		
	ref. 51-60 years old	dA3dM1	41-50 years old	MYR 0.90/kg	-0.72	0.75	-0.96	0.34	-2.19	0.75
	dA3dM2	41-50 years old	MYR 0.60/kg	-1.01	0.72	-1.40	0.16	-2.43	0.41	
	dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-		
Gender*Charge	dGdC1	Male	MYR 0/kg	-	-	-	-	-		
	ref. Female	dGdC2	Male	MYR 0.10/kg	-0.06	0.30	-0.21	0.84	-0.66	0.53
	Gender*Incentive	dGdM1	Male	MYR 0.90/kg	-0.40	0.35	-1.15	0.25	-1.08	0.28
ref. Female		dGdM2	Male	MYR 0.60/kg	-0.65	0.34	-1.92	0.06	-1.31	0.01
dGdM3	Male	MYR 0.30/kg	-	-	-	-	-			
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-		
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	0.26	0.70	0.37	0.71	-1.11	1.63	
	ref. secondary school or below	dE1dC3	undergraduate degree	MYR 0/kg	-	-	-	-		
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.30	0.75	0.40	0.69	-1.17	1.78	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-		
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	0.24	0.80	0.30	0.77	-1.33	1.81	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	1.31	0.80	1.63	0.10	-0.27	2.88	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	0.57	0.78	0.73	0.46	-0.95	2.09	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-		
	dE2dM1	undergraduate degree	MYR 0.90/kg	1.56	0.86	1.80	0.07	-0.14	3.25	
	dE2dM2	undergraduate degree	MYR 0.60/kg	0.64	0.84	0.77	0.44	-1.00	2.28	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-		
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.20	0.91	1.32	0.19	-0.59	2.98	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	0.39	0.89	0.44	0.66	-1.35	2.13	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-		
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-		
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	0.08	0.66	0.13	0.90	-1.21	1.38	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-		
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.27	0.65	0.41	0.68	-1.00	1.53	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	-0.42	0.80	-0.53	0.60	-1.98	1.14	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	-0.69	0.76	-0.92	0.36	-2.17	0.79	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-		
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	-0.90	0.78	-1.16	0.25	-2.42	0.62
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	-1.04	0.74	-1.40	0.16	-2.48	0.41	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-		

Table 5.10D: Influenced of respondents' attributes towards willingness to separate  
(non-federalized) (tetrapak)

		Content when dummy variable =1		Coef.	S.E.	Wald Z	P <sub>r</sub> (> Z )	lower 95%	upper 95%	
Cut-off	y>=2			2.25	0.45	5.04	<0.0001	1.38	3.13	
	y>=3			1.37	0.44	3.11	0.00	0.51	2.23	
	y>=4			0.24	0.44	0.56	0.58	-0.61	1.10	
	y>=5			-0.66	0.44	-1.51	0.13	-1.52	0.20	
	Intercept	ASC2			-0.34	0.26	-1.33	0.18	-0.85	0.16
Charge	dC1		MYR 0/kg	-	-	-	-	-	-	
	ref. MYR 0.2/kg	dC2	MYR 0.10/kg	-0.31	1.01	-0.31	0.76	-2.30	1.68	
Incentive	dM1		MYR 0.90/kg	0.76	1.15	0.66	0.51	-1.50	3.01	
	dM2		MYR 0.60/kg	2.43	1.13	2.16	0.03	0.22	4.63	
	ref. MYR 0.0/kg	dM3	MYR 0.30/kg	-	-	-	-	-	-	
Age*Charge	dA1dC1	21-30 years old	MYR 0/kg	-	-	-	-	-	-	
	dA1dC2	21-30 years old	MYR 0.10/kg	-0.31	0.80	-0.38	0.70	-1.87	1.26	
	dA2dC1	31-40 years old	MYR 0/kg	-	-	-	-	-	-	
	ref. 51-60 years old	dA2dC2	31-40 years old	MYR 0.10/kg	0.31	0.68	0.45	0.65	-1.02	1.63
		dA3dC1	41-50 years old	MYR 0/kg	-	-	-	-	-	-
	dA3dC2	41-50 years old	MYR 0.10/kg	0.43	0.69	0.63	0.53	-0.91	1.78	
Age*Incentive	dA1dM1	21-30 years old	MYR 0.90/kg	-0.04	0.92	-0.04	0.97	-1.83	1.76	
	dA1dM2	21-30 years old	MYR 0.60/kg	-0.93	0.88	-1.05	0.29	-2.65	0.80	
	dA1dM3	21-30 years old	MYR 0.30/kg	-	-	-	-	-	-	
	dA2dM1	31-40 years old	MYR 0.90/kg	-0.34	0.75	-0.46	0.65	-1.81	1.13	
	dA2dM2	31-40 years old	MYR 0.60/kg	-1.10	0.75	-1.47	0.14	-2.57	0.37	
	dA2dM3	31-40 years old	MYR 0.30/kg	-	-	-	-	-	-	
	ref. 51-60 years old	dA3dM1	41-50 years old	MYR 0.90/kg	-0.23	0.75	-0.30	0.76	-1.71	1.25
		dA3dM2	41-50 years old	MYR 0.60/kg	-1.26	0.76	-1.66	0.10	-2.75	0.23
		dA3dM3	41-50 years old	MYR 0.30/kg	-	-	-	-	-	-
Gender*Charge ref. Female	dGdC1	Male	MYR 0/kg	-	-	-	-	-	-	
	dGdC2	Male	MYR 0.10/kg	0.01	0.30	0.05	0.96	-0.57	0.60	
	dGdM1	Male	MYR 0.90/kg	-0.43	0.34	-1.27	0.20	-1.09	0.23	
Gender*Incentive ref. Female	dGdM2	Male	MYR 0.60/kg	-0.87	0.33	-2.62	0.01	-1.52	-0.22	
	dGdM3	Male	MYR 0.30/kg	-	-	-	-	-	-	
Education*Charge	dE1dC1	Post graduate degree or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE1dC2	Post graduate degree or equivalent	MYR 0.10/kg	0.15	0.70	0.22	0.83	-1.23	1.54	
	ref. secondary school or below	dE1dC1	undergraduate degree	MYR 0/kg	-	-	-	-	-	
	dE2dC2	undergraduate degree	MYR 0.10/kg	0.19	0.76	0.25	0.80	-1.30	1.69	
	dE3dC1	Diploma or equivalent	MYR 0/kg	-	-	-	-	-	-	
	dE3dC2	Diploma or equivalent	MYR 0.10/kg	0.34	0.82	0.41	0.68	-1.26	1.94	
Education*Incentive	dE1dM1	Post graduate degree or equivalent	MYR 0.90/kg	1.31	0.79	1.66	0.10	-0.24	2.86	
	dE1dM2	Post graduate degree or equivalent	MYR 0.60/kg	-0.07	0.80	-0.09	0.93	-1.63	1.49	
	ref. secondary school or below	dE1dM3	Post graduate degree or equivalent	MYR 0.30/kg	-	-	-	-	-	
	dE2dM1	undergraduate degree	MYR 0.90/kg	1.35	0.85	1.59	0.11	-0.32	3.01	
	dE2dM2	undergraduate degree	MYR 0.60/kg	-0.11	0.86	-0.13	0.90	-1.80	1.57	
	dE2dM3	undergraduate degree	MYR 0.30/kg	-	-	-	-	-	-	
	dE3dM1	Diploma or equivalent	MYR 0.90/kg	1.55	0.91	1.71	0.09	-0.23	3.33	
	dE3dM2	Diploma or equivalent	MYR 0.60/kg	-0.99	0.91	-1.09	0.28	-2.76	0.79	
	dE3dM3	Diploma or equivalent	MYR 0.30/kg	-	-	-	-	-	-	
Income*Charge	dI1dC1	MYR 8501 and above	MYR 0/kg	-	-	-	-	-	-	
	dI1dC2	MYR 8501 and above	MYR 0.10/kg	-0.20	0.65	-0.31	0.76	-1.47	1.08	
	ref. MYR 4000 or less	dI2dC1	MYR 4001 to MYR 8500	MYR 0/kg	-	-	-	-	-	
	dI2dC2	MYR 4001 to MYR 8500	MYR 0.10/kg	0.47	0.65	0.72	0.47	-0.80	1.73	
Income*Incentive	dI1dM1	MYR 8501 and above	MYR 0.90/kg	-0.68	0.79	-0.86	0.39	-2.23	0.87	
	dI1dM2	MYR 8501 and above	MYR 0.60/kg	-0.44	0.71	-0.62	0.54	-1.83	0.96	
	dI1dM3	MYR 8501 and above	MYR 0.30/kg	-	-	-	-	-	-	
	ref. MYR 4000 or less	dI2dM1	MYR 4001 to MYR 8500	MYR 0.90/kg	-0.93	0.78	-1.19	0.24	-2.47	0.61
	dI2dM2	MYR 4001 to MYR 8500	MYR 0.60/kg	-0.40	0.71	-0.57	0.57	-1.78	0.98	
	dI2dM3	MYR 4001 to MYR 8500	MYR 0.30/kg	-	-	-	-	-	-	

### 5.3.5 The effectiveness of ‘Zero Budget System’

As showed in figure 5.1, using equation 3 and 4, we predicted that ‘Zero Budget System’ had potential to reduce residual waste generation from 8.4% to 13%. That are much higher than e-money incentive systems that effective to reduce residual waste generation from 0.08% to 3.4% [5].

This means, with proper setting of charge and incentive amount, the combination between charge and incentive will encourage citizens to separate more recyclables and source and reduce residual waste generation that directly disposed to the landfill.

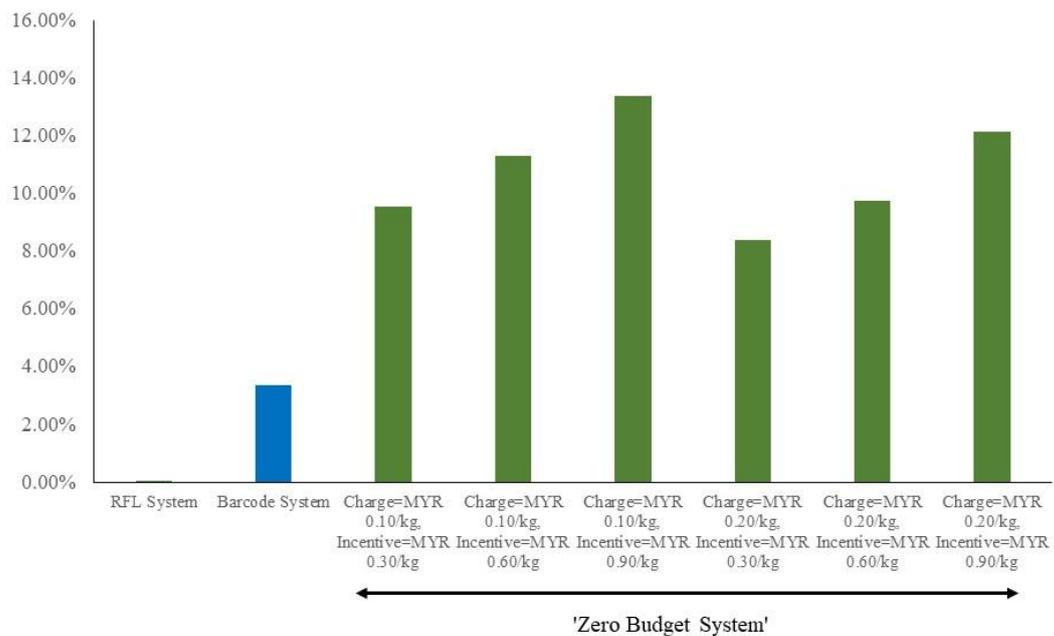


Figure 5.1: Prediction of residual waste reduction by ‘Zero Budget System’

## 5.4 Summary

The effectiveness of 'Zero Budget System' can be concluded as below:

- 1) 'Zero Budget System' is effective to reduce residual waste generation from 8.4% to 13% that more than 4 times more effective than e-money incentive systems.
- 2) Even though, the system showed promising result, we need to admit that there is a need for researchers and policy makers to further improve the situation in term of recyclables facilities, market creation and education.

## References

- [1] William R. (2021). <https://www3.nd.edu/~rwilliam/stats3/Ologit01.pdf> (date access: 8<sup>th</sup> Feb. 2022)
- [2] Jabatan Perangkaan Malaysia (DOSM) (2010). Chart 3: Population distribution by state, Malaysia, 2010. [https://www.dosm.gov.my/v1/index.php?r=column/cthem&menu\\_id=L0pheU43NWJwRWVVSZklWdzQ4TlhUUT09&bul\\_id=MDMxdHZjWTK1SjFzTzNkRXYzcVZjdz09](https://www.dosm.gov.my/v1/index.php?r=column/cthem&menu_id=L0pheU43NWJwRWVVSZklWdzQ4TlhUUT09&bul_id=MDMxdHZjWTK1SjFzTzNkRXYzcVZjdz09) (Access on 30<sup>th</sup> November 2021).
- [3] GSR (2012) Survey on SW Composition, Characteristic & Existing Practice of SW Recycling in Malaysia
- [4] SPR (2021). Syarat layak mengundi. <https://www.spr.gov.my/en/node/219> (Access on 30<sup>th</sup> November 2021).
- [5] Ariffin, F. Bin, Ishii, K., Sato, M., & Ochiai, S. (2021). The effectiveness of the e-money incentive mechanism in promoting separation of recyclables at source in Malaysia. *Journal of Material Cycles and Waste Management*, 23(1), 371–385.

## **CHAPTER 6**

### **Conclusion**

As the result of our research on the evaluation of e-money incentive systems practised in northern region of Malaysia, designing new approach that cooperate charging and incentive system through 'Zero Budget System' and prediction on the effectiveness of the proposed system, we had come into conclusion as followed:

- 1) E-money incentive systems is effective to reduce residual waste generation from 0.08% (RFL System) to 3.4% (Barcode System).
- 2) The effectiveness of the systems considered low if compared with pay as you throw system that practised in developed countries.
- 3) To improve the situation, we had introduced 'Zero Budget System' that combined charging and incentive system.
- 4) The system is predicted effective to reduce residual waste generation from 8.4% to 13%.
- 5) In other to further improve source separation and recovery of recyclables other approach such as extended producer responsibility (EPR), market creation for recyclables and adaption of technologies need to be explored.

- 6) Even though that this survey that had been conducted through online that had risk of sample bias as the research limitation, as indicated in chapter 5, we believe that this new system had potential to further improve source separation and recovery of recyclables in Malaysia and also other developing countries.