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Bangkok Recycling Program: An Empirical Study of an Incentive-Based Recycling Program

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Abstract
Environmental impacts have been considered by many as the world's most serious issues. The world is running out of many of its natural resources. One of the best ways to extend the lives of natural resources is recycling. Recycling is a highly effective strategy. Not only does it reduce the amount of virgin materials in the production process, but it also reduces waste generation, health risks, and pollution. Increased waste generation is a serious concern in developing countries. Environmental and economic opportunities for recyclables in waste management that have not been captured are substantial. Bangkok, the fastest growing city in Thailand, has witnessed accumulating problems in solid waste management and disposal. The city's municipal solid waste (MSW) generation shows an increasing trend parallel to the development of economic conditions, urbanization, and rapid growth of population. Adopting an innovative incentive-based recycling program as part of the municipal waste management system is a potential solution to solve a high level of waste generation and to draw communities to participate in the program. The Bangkok Recycling Program (BRP) is a unique incentive-based recycling program that includes a collaboration program among communities, local authorities, and businesses; an environmental reward program; and a performance tracking system. This research aims to appraise the response of Bangkok residents towards the incentive-based recycling program, to ensure that the Bangkok Recycling Program is an excellent alternative to alleviate MSW related concerns, and to create value from collected waste for all stakeholders in a sustainable way. Results from the survey show that about 90 percent of the total respondents want to participate in the incentive-based recycling program. Communities are aware of the impact of waste on the environment and think that waste reduction at source is a way to reduce household waste generation. Introducing the incentive-based Bangkok Recycling Program into the waste management system in Bangkok is indeed an exceptionally new approach; however, the Program is an alternative solution that might well suit to the characteristics of the City of Bangkok and might work well with the residents.

Disciplines
Economics | Environmental Education | Environmental Law | Environmental Monitoring | Environmental Policy | Environmental Sciences | Environmental Studies | Natural Resources and Conservation | Natural Resources Management and Policy | Place and Environment | Policy Design, Analysis, and Evaluation | Sustainability

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AN EMPIRICAL STUDY OF AN INCENTIVE-BASED RECYCLING PROGRAM

Pitchayanin Sukholthaman

Spring 2012

Stanley Laskowski
Yvette Bordeaux

DEDICATION

This thesis is dedicated to my family, especially my parents who have supported me all the way since the beginning of my studies. This thesis is also dedicated to my professors and friends who have been a great source of guidance, motivation, and inspiration.

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ABSTRACT

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Environmental impacts have been considered by many as the world's most serious issues. The world is running out of many of its natural resources. One of the best ways to extend the lives of natural resources is recycling. Recycling is a highly effective strategy. Not only does it reduce the amount of virgin materials in the production process, but it also reduces waste generation, health risks, and pollution. Increased waste generation is a serious concern in developing countries. Environmental and economic opportunities for recyclables in waste management that have not been captured are substantial. Bangkok, the fastest growing city in Thailand, has witnessed accumulating problems in solid waste management and disposal. The city's municipal solid waste (MSW) generation shows an increasing trend parallel to the development of economic conditions, urbanization, and rapid growth of population. Adopting an innovative

incentive-based recycling program as part of the municipal waste management system is a potential solution to solve a high level of waste generation and to draw communities to participate in the program. The Bangkok Recycling Program (BRP) is a unique incentive-based recycling program that includes a collaboration program among communities, local authorities, and businesses; an environmental reward program; and a performance tracking system. This research aims to appraise the response of Bangkok residents towards the incentive-based recycling program, to ensure that the Bangkok Recycling Program is an excellent alternative to alleviate MSW related concerns, and to create value from collected waste for all stakeholders in a sustainable way. Results from the survey show that about 90 percent of the total respondents want to participate in the incentive-based recycling program. Communities are aware of the impact of waste on the environment and think that waste reduction at source is a way to reduce household waste generation. Introducing the incentive-based Bangkok Recycling Program into the waste management system in Bangkok is indeed an exceptionally new approach; however, the Program is an alternative solution that might well suit to the characteristics of the City of Bangkok and might work well with the residents.

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1. INTRODUCTION

1.1 Problem statements

The massive amount of waste generated in urban areas is one of the key environmental problems in developing countries. Thus, the author wants to answer the following questions:

- Is the incentive-based recycling program that was successfully implemented in some developed countries (e.g. the United States, England) a good alternative to reduce waste and create values from collected waste for all stakeholders in urban areas of emerging countries?
- How can the incentive-based recycling program be implemented in developing countries in a sustainable way?

1.2 Research objectives

- To assess the response of residents who live in urban areas of developing countries towards the incentive-based recycling program
- To determine a sustainable way for Bangkok Recycling Program implementation in developing countries
- To analyze the impact of Bangkok Recycling Program implementation from environmental (e.g., waste reduction) social, and financial perspectives

1.3 Scope of the research

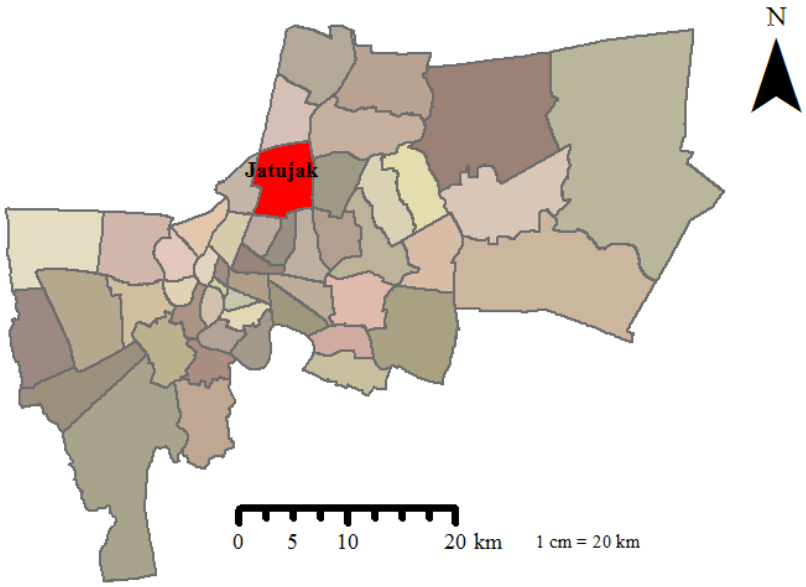

Figure1: Jatujak District, Bangkok, Thailand [1]

- A Developing Country: Thailand
- An Urban Area: Jatujak district, Bangkok
- Issue: Bangkok Recycling Program

1.4 Research Methodology

1.4.1 Data collection

1.4.2 Conducting research includes secondary and primary data analysis. Secondary data analysis is done by doing literature and document review from official and other reliable sources. For primary data analysis, it is done by launching a large-scale survey. Population frame for the survey is categorized into two groups: (1) number of

[1] Retrieved data from http://www.bangkokgis.com/, 04/02/12

students in Jatujak district, from the Secondary Educational, the Office of the Basic Education Commission (population frame for the children group), and (2) registered population, from Department of Provincial Administration (population frame for the adult group). The children group sample is people who are between 7 – 15 years old. The adult group sample is people who are older than 15 years old. Size of each group of sample is 400. Sampling method of this survey is simple random sampling method. Personal interview is the method for data collection.

1.5 Data Analysis

A survey with SPSS analysis on public awareness towards sustainable household waste management system, possibility of public participation, and factors that affect their life style towards sustainable waste management

2. LITERATURE REVIEW

2.1 Overview of incentive-based recycling programs

The term incentive-based recycling program refers to a program that encourages people to take positive environmental actions on waste. For example, household waste recycling, electronic waste recycling, or home energy conservation, by rewarding them with incentives that can be redeemed from participating partners. The expansion of incentive-based recycling programs has reflected the overall increase of environmental concerns, for example, increasing pollution levels, depleting natural resources, and the rising price of raw materials for manufacturers. Over the past few decades, recycling programs have been introduced in every part of the world, running as both for profit and not for profit organizations. Recycling programs can range from a small-scale local program to a large company that offers services at the national level. Many programs have associated communities, making the programs a form of social activity beyond an individual action.

The rise in state-of-the-art technologies for waste management systems, adequate means of communication and cooperation among institutional and business sectors, have led to a revolution where people have alternatives for disposing of their waste. This revolution has paved the way for every sector that wants to extract value from the waste, from either environmental or economic concerns, to offer recycling programs to consumers. No matter which way people decide to take action to recycle their waste and earn rewards, the point is intrinsically the same; it is environmental solutions that promote economic opportunities.

2.2 Bangkok Recycling Program

The idea of Bangkok Recycling Program (BRP) was inspired by RecycleBank, an incentive-based recycling program that has successfully implemented in the United States and other developed countries. An incentive-based recycling program is not a new concept, as it can be seen in every region of the world as a reward and recognition scheme. Applying the same idea to cities in less developed countries and making it successful is a challenge.

Bangkok contributes a remarkably high amount of waste compared to the total generation from the whole country. Recyclable waste accounts for about 40 percent of waste composition (Strategy and Evaluation Department: Bangkok Environment, 11/14/2011). Waste is not widely sorted before disposal. This, the recycle rate is still low. BRP is a waste recycling program that plans could be implemented primarily by the Bangkok Metropolitan Administration (BMA), by using its resources, fleets, and facilities; and by applying current recycling, waste collection, waste disposal, and waste management practices. Pilot programs are likely to be executed in some districts of the City.

2.2.1 How does the Bangkok Recycling Program (BRP) work?

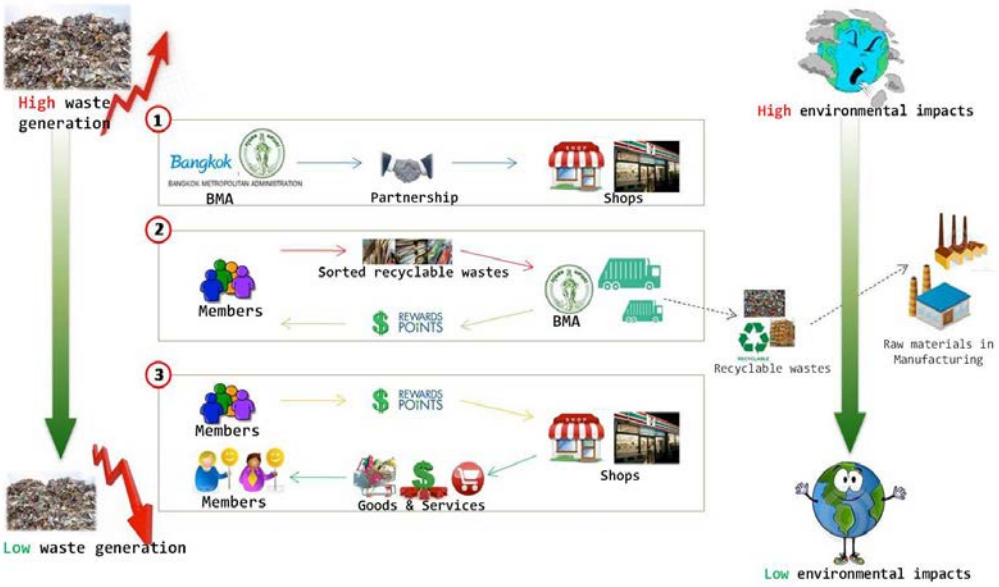

Figure2: Bangkok Recycling Program

Because of the differences in geographical areas, composition of waste, waste streams, and citizens' perceptions towards waste and recycling, the recycling programs that exist in different regions need different strategic plans for operation and management. Thus, the BRP needs to be implemented in stages, which are discussed in detail in following sections. In Bangkok, those who wish to participate in the program must become members first. There are three main steps in the BRP.

The first stage is sorting waste for recycling. Members sort their recyclable waste into different types specified by the BMA. They must then dispose of the sorted recyclable waste separately in recycle bins that have an ID to match with their addresses and account numbers. The second stage is recording what has been collected. Responsible parties, managed by the BMA, collect recyclables and other types of waste on a regular basis. Special collection services are provided in some areas where there is a

high waste volume. The responsible parties record the amount of recyclable waste collected from each member. Using a weight-based scheme, the BMA awards recycle points to members based on the weight of waste they have recycled. These points are recorded in the BRP system. Finally, members can redeem the rewards. BRP members can find out how many points they have earned through the BMA website or the BRP call center. Members can then redeem their points at a number of participating organizations and business partners.

2.2.2 Who is involved in the Bangkok Recycling Program?

The success of the BRP depends on the participation of all stakeholders. Also, it is a key to achieve sustainable waste management, which eventually helps the City to develop a better environment. There are two main groups of stakeholders.

2.2.2.1 Government Stakeholders

National Government

Support systems from national government are necessary for an appropriate system for waste generation, facilities, and waste disposal and marketing. The systems should be established in order to make the waste management operation succeed as a whole (Managing of Hazardous Waste in Thailand, 11/14/2011). From what we have seen, the national government has worked on waste management at some level; therefore, the government still needs to focus more on waste management as a one of the nation's critical problems. Moreover, one of the most important tasks of the government is to ensure that all plans

and processes are measurable, governed in a transparent manner, and open to public scrutiny.

Legislative System

Although the laws and regulations can be legally enforced on violators, in practice they are very weak. As mentioned in section 2.4.4.2 of this report, the laws enacted since 1992 and some of their requirements are outdated; the punishments are very lax and not stringent enough to make people comply. Besides, there are no laws or regulations that specifically regulate the social and health impacts caused by Municipal Solid Waste (MSW) or directly mandate recycling waste.

Local Government

The local or municipal authorities have multiple responsibilities linked with several different roles in the waste management system. The authorities act as the middlemen between communities and the central government. These authorities report what has actually happened in the communities to the government; they monitor, assess, and evaluate the progress of activities and projects. Consequently, information is distributed throughout the waste management chain and eventually it will act as a factor that supports the effectiveness of the waste management system as a whole.

Bangkok is one of the two distinct administrative areas in the country in that has its own elected governor and an elected Bangkok Metropolitan Council, which has power over municipal ordinances and the city's budget. As the BMA, the government of Bangkok has the power to regulate the city. More than 80 percent of waste is collected by the BMA (Public Cleansing Department, 2005; Pollution Control Department, 2011). Consequently, for the BRP, BMA can be one of the major players in the waste management system in

Bangkok. Thus, applying existing recycling rules, new waste collection practices, and suitable human resources to BRP is an excellent way to make the program happens.

2.2.2.2 Non-government Stakeholders

Non-governmental stakeholders in BRP include households, the private sector, waste haulers, and waste recyclers.

Households

Households, or Bangkok residents, play the most prominent role in BRP. As they are waste generators, the amount of waste depends on how they consume goods and how they discard unwanted goods. If all residents became part of the waste management system, separated waste into types before disposal, and reused some materials, the amount of waste generated in Bangkok would be considerably reduced.

Private sector

The private sector includes business partners, institutions, and partnered organizations that create or set up rewards to be redeemed by BRP members. Although implementing the incentive-based recycling program in a big way is a new practice for Bangkok, from a business partner's perspective, it is a way to attract new customers or increase purchases when a reward is redeemed. Companies can communicate with customers without spending more on advertising. Moreover, companies will get a positive image, as BRP is an economic and environmental concern program.

Waste recycler

Partnering with the BMA for the Program is an excellent way to recycle materials from the household waste stream. This recyclable waste will be put through a

remanufacturing process, which is the end of the cradle-to-cradle loop. Not only do waste recyclers get a new source of materials, they also play an important role in the waste management system, and significantly reduce the amount of illegal waste dumping, which instead is dumped in landfills or sent to incinerators. In short, the companies can improve both their businesses and the environment.

Additionally, manufacturers and distributors also are a part of the waste minimization process. For example, manufacturers produce better-designed products by using less materials or using reusable or recycled packaging.

2.3 Industry analysis

2.3.1 History of recycling

Recycling today is a strategy or a method of solid waste management that is as useful as other waste management methods, such as landfilling or incineration, and is more environmentally friendly (Solid Waste Management: A Local Challenge With Global Impacts, 01/21/12; Lund, 2001).

In the past, as humans began to settle in permanent communities with higher concentrations of waste-generating activities, the need for waste management became evident. By 500 B.C. Athens organized the first municipal dump in the western world, and scavengers were required to dispose of waste at least one mile from city walls. During the middle ages, waste disposal continued to be an individual responsibility with the lack of government authority. In 1388, the English Parliament banned waste disposal

in public waterways and ditches. This indicates a desire on the part of government to assume responsibility for this element of the health and safety of the people.

The growth in governmental concern for health and safety with regard to waste disposal led to additional regulations and operations. By the 1840s the western world began to enter the age of sanitation as filthy conditions began to be seen as a city nuisance and the public demanded that government resolve it. Government's increasing assumption of solid waste management let to systematic approaches, including the destructor, an incineration system in Nottingham, England, in 1874. America's first municipal incinerator, on Governor's Island in New York, was built in 1885.

The fast growing population, vastly enhanced scientific understanding of the environment, and the concept of finite resources combined to afford an excellent opportunity for a conscious examination of the detrimental nature of land or ocean disposal practices, which occurred after World War II. However, in many areas open dumping and ocean disposal of solid waste were still acceptable practices in the 1970s.

The inability of local government to deal with these increasing problems quickly became a federal interest. The Solid Waste Disposal Act (SWDA) of 1965, which authorized research and provided state grants, was the first federal solid waste management law. In 1968, the U.S. National Survey of Community Solid Waste Practices was the first comprehensive data on solid waste on a national basis (Solid Waste Management: A Local Challenge With Global Impacts, 01/21/12; Lund, 2001).

2.3.2 Definition and reasons for recycling

Recycling is defined as processes that require any recovery operation by which waste materials are reprocessed into products, materials, or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials (Department for Environment Food and Rural Affairs, 01/21/12). This concept gives rise to other terms required to implement the concept fully, for example, the terms recyclable materials or recovered materials.

Recycling occurs for three basic reasons: altruistic reasons, economic imperatives, and legal considerations. Altruistic reasons include protecting the environment and conserving resources, which have become general interests of society. Economic imperatives mean avoiding the cost of environmentally unacceptable disposal of waste, which has risen to a level where, when combined with the other costs associated with recycling. Finally, legal considerations mean responding to public demand and a growing lack of alternative waste disposal methods. Government requires recycling to be provided for and imposes a wide variety of economic and civil penalties and incentives in order to encourage recycling (The Determinants of Municipal Recycling: a Time Series Approach, 01/21/12).

2.3.3 Types of recycling programs

Municipalities have considered and implemented recycling programs for many reasons; for example, improving markets for recovered materials, shrinkage of budget allocations for supporting municipal recycling programs, high recycling goals set by governments, and the inefficient waste management systems of municipalities.

A variety of recycling options is available. However, it is most likely that there is no single option that is best for everyone at every time. Finding the best solution needs a combination of options with a careful evaluation of different circumstances. Nowadays, both residential and commercial establishments can participate in recycling by sorting each type of material before it is mixed and disposed of with other wastes. Sorted materials are kept in separate containers for collection or before being transported to waste processing facilities.

In terms of MSW, there are two main recycling flows. In the first flow, recyclable materials are collected at source by collectors, including those in the informal sector. In the second flow, materials are separated and recycled by the municipal authority after MSW collection. As long as the materials have a certain economic value, they are likely to be collected by the informal sector.

There are different categories of recycling programs, of which the principal three types are residential recycling programs, programs in the workplace (schools or offices), and programs for commercial organizations. In each category, there are options of recycling program methods, such as backyard composting, self-haul yard waste, self-haul dump and pick-up operations, curbside recycling, buyback programs, and drop-off recycling (Promoting Recycling to Local Businesses, 01/21/12). Some types of recycling programs are as follows:

2.3.3.1 Drop-off recycling program

This option requires waste producers to take recyclable waste to a central location, which is called a drop-off point. The drop-off point can be an installed or mobile collection station or a reprocessing plant.

2.3.3.2 Buy-back recycling program

A buy-back program differs from a drop-off recycling program in that recyclables are cleaned and are purchased. These purchased materials can be sold to recyclers or reprocessing plants.

2.3.3.3 Curbside recycling program

Curbside recycling refers to the process by which waste collectors receive comingled recyclables or a single waste stream system from waste producers, a term commonly applied to residential waste. Recyclables are put into a collection vehicle and kept separately from other waste; they are either mixed or separated into types. Curbside recycling programs generally yield much more material per capita than drop-off and buy-back recycling programs but are more expensive. Quantity and marketability of the collected recyclables are of vital concern in all recycling programs (Lund, 2001; Baud, I. S. A., J. Post, and Christine, 2004; Wastes - Resource Conservation - Tools for Local Government Recycling Programs, 01/22/12).

2.3.4 Recycling in a global context

The more developed a country, the more waste it produces. Developed countries produce on average 500 kilograms of municipal waste per person per year. As is to be expected, the highest figure is for the United States: 730 kilograms. In general, the most advanced emerging countries are ranged between 300 and 400 kilograms per person. Other emerging countries, such as China, are at between 200 and 300 kilograms. As for the developing countries, particularly for the urban areas, the figure is around 150 kilograms per person. However, the nature of the waste differs substantially according to

the degree of development of the countries concerned (From waste to resource, 01/20/12; Challenges and Opportunities in Transforming a City into a "Zero Waste City, 01/21/2012).

Waste management is not just a question of managing waste flows and disposing of unwanted products. We must realize that part of our future depends on this waste: four billion tons of waste is produced each year worldwide, of which scarcely one-quarter is recovered or recycled. Every country recognizes the importance of recycling, as it is an effective means to reduce energy use, GHGs emissions, and also waste at the same time.

Countries around the world have developed national policies and strategies in line with a 3R (reduce, reuse, recycle) approach to waste. The 3R policy in Germany has stabilized waste volumes over the past 15 years and the country hopes to end landfilling by 2020. The Brazilian government promotes separated garbage collection in municipalities. This puts Brazil among the ranks of the world's recycling leaders (Waste Management, 01/20/12). With the establishment of the Containers and Packaging Recycling Act, Japan promotes recycling as good citizenship behavior, while Brazil uses economic incentives to encourage recycling (National Mobilization and Global Engagement: Understanding Japan's Response to Global Climate Change Initiatives, 12/05/11).

In most countries, plastics, glass, papers, and metals are well collected by either the informal sector or municipalities, and these materials are recycled. Nonetheless, not as many countries record data on recycling rates for each type of material. For example, the global recycling rate for steel cans was 68 percent in 2007. The recycling of 7.2 million metric tons of steel cans across 37 countries who report to the World Steel Association avoided approximately 13 million metric tons of CO_2 emissions in 2007. In many OECD countries, steel can recycling rates on the national level have increased

substantially. Belgium and Germany achieve the highest steel can recycling (World Steel Association: Global steel can recycling rate reaches highest recorded level, 12/05/11).

In the case of other recyclable materials, such as glass, paper, and cardboard, Ireland (81 percent of glass and 78 percent of paper and cardboard), Sweden (96 percent of glass and 74 percent of paper and cardboard) and Switzerland (95 percent of glass and 74 percent of paper and cardboard) lead the countries with the highest rates of waste recycling (Waste Management, 01/20/12).

2.3.5 Recycling in developing countries

Only between 1 and 2 percent of the urban population in developing countries is involved in urban material recycling. The municipal recyclable waste produced in developing countries and, in particular, in Asian cities, is generally largely managed by reuse and informal recycling methods (Routray, Mohanty, 2006; What a Waste: Solid Waste Management in Asia, 12/05/11).

Recovery and recycling methods in developing countries range from barter trade between households, charity donations, and sorting of waste in the landfill sites, at transfer centers, waste hoppers, and on streets. They also include the sale of materials by households or small stores, institutions, or small traders and the sale of materials between structured dealers, agents, and recycling operators. Moreover, trading of materials between industries or auction of scrap can be found (From waste to resource, 01/20/12).

2.3.6 Recycling industry trends

The record high oil prices, volatile commodity prices, resource scarcity, and global environmental concerns have come together, and have led to the exploration of

alternative resources, more environmentally friendly methods to tackle the problems. Recycling is rapidly becoming a key element in the drive.

Over the past decade, with the beginning of corporate environmental responsibility, businesses have come to rely on recycling to lower energy costs, use fewer raw materials, minimize waste streams, and reduce pollution. Now, with a global market, very high costs for virgin materials, and overwhelming demand, recycling has gone far beyond municipal recycling: it helps companies to achieve competitive advantage and profitability.

As a driver of economic activity, the recycling industry compares favorably to other key industries, such as automobile manufacturing and mining. In terms of energy efficiency, recycling vastly reduces the amount of energy required. For example, making aluminum from scrap uses 96 percent less energy than from virgin minerals, while making iron and steel from scrap requires 74 percent less energy (Recycling Industry Offers Recession Proof Investing, 12/06/11).

In the United States, the recycling and reuse industry consists of approximately 56,000 establishments that employ more than 1.1 million people, generate an annual payroll of nearly $37 billion, and gross over $236 billion in annual revenues. Cannacord Adams estimates that the industry accounts for about 2 percent of the $12.36 trillion U.S. gross domestic product (The Recycling Industry Grows Up, 12/06/11; Wastes - Resource Conservation - Reduce, Reuse, Recycle: Results of National REI Study, 12/05/11). This represents recycling as a significant force in the American economy and makes a vital contribution to job creation and economic development.

Across America, the number of curbside recycling programs has grown 500 percent over the past five years. Recycling is estimated to create nearly five times as many jobs as landfilling. One study reports that 103,000 jobs, or 2.7 percent of all manufacturing jobs in the Northeast region of the United States, are attributed to recycling (Wastes - Resource Conservation - Reduce, Reuse, Recycle, 12/05/11). Underscoring the importance of resource optimization and sustainability, Waste Management (WM), the largest waste management firm in North America, believes it will significantly increase recycling volumes and waste-to-energy production over the next 12 years. The company will increase its recycling from 8 million tons a year to 20 million tons a year by 2020, through single stream recycling and e-cycling, and it plans to double waste-to-energy production, with an emphasis on landfill gas (2010 Fact Sheet: Environmental Performance, 12/06/11).

In many OECD countries, recycling rates on the national level have increased substantially. For example, Belgium and Germany steel can recycling rates of 93 percent and 91 percent (Waste Management, 01/20/12). In Australia there was an 825 percent increase of recycling for all types of waste between 1996-1997 and 2002-2003 (Recycling Statistics, 12/04/11). The number of recycling companies in Brazil increased 24 percent from 2003 to 2004 (Materials recycling: main trends of a new industrial sector in Brazil, 01/20/12).

The recycling rates in Asia have been heading in the same direction as in other regions, with China at 75 percent, Japan at 85 percent, and South Korea at 69 percent (Waste Management, 01/20/12). Within Asia, a great disparity in the extent of recycling efforts is observed. Countries such as Taiwan, Japan, and South Korea have more dynamic waste management and recycling industries as a result of extensive environmental regulations. In other emerging economies, such as the Philippines and Indonesia, the basic legal

infrastructure necessary is still lacking. Even where regulations are in place, the success of enforcement still varies, as is most clearly seen in India and China. Japan, one of the world's leading countries in recycling, has built more than 300 waste-to-energy plants, in which 40 percent of the country's wastes are burned and an estimated 30 percent recycled (The New York Times: ideas & trends; as recycling becomes a growth industry, its paradoxes also multiply, 01/20/12).

2.3.7 Recycling programs

Although there are many recycling programs in every country, the number of programs has not been well recorded. Many resources state that recycling programs have been dramatically increased, since recycling is considered a secondary source of material and a source of income. According to national reports, countries have enacted laws and regulations, set goals, or initiated programs towards recycling.

For example, in the United States, 12,000 recyclable drop-off locations, more than 9,000 curbside recyclables collection programs, and more than 3,000 community composting programs were documented in 2010. The recycling rate has improved from 28.6 percent in 2000 to 34 percent in 2010 (Municipal Solid Waste Generation, Recycling, and Disposal in the United States, 01/21/12). In China, there are over 5,000 waste resources recovery companies, over 2,000 processing factories, and a network of 1.6 million recyclable waste collection stations (Waste Management, 01/20/12).

In the United Kingdom, although there is no record of the number of recycling programs, the recycling rate has significantly spiked up in the last ten years. Composting household waste recycling has increased from 1.6 percent in 1998 to 15.7 percent in 2010, whilst recycling of dry household materials has increased from 6.6 percent to 24

percent over the same period (Household waste: green and dry recycling rates, 01/21/12). In Singapore, the overall recycling rate rose from 40 percent to 49% between 2000 and 2005 (The Singapore Green Plan 2012, 01/20/12). In the Republic of Korea, the country's waste volume has gradually risen since 2000; the percentage of total waste volume recycled has also significantly increased. In 1995, 72.3 percent of MSWs were landfilled and 23.7 percent were recycled, whereas in 2007, 23.6 percent were landfilled and 57.8 percent were recycled (Waste Management in Republic of Korea, 12/04/11).

2.3.8 Successful recycling programs

2.3.8.1 Palm Beach County, Florida

Overview

Palm Beach County is largest county in the state of Florida in area, with a population of almost 13 million. There are more than 600,000 housing units. The County's Solid Waste Authority (SWA), which was established by special state statute in 1993, provides solid waste disposal and recycling collection services to both incorporated and unincorporated areas through private haulers under exclusive franchise agreements. The County collects a 3 percent franchise fee on total hauler revenue (Palm Beach County, 01/27/12).

The SWA provides service for approximately 181,000 single-family units, 85,000 multi-family units, and 185,000 commercial establishments. It has built an award-winning integrated system of facilities combining recycling, composting, converting waste to energy through incineration, and landfilling to manage the county's waste effectively. The $420 million integrated system includes a waste-to-energy facility, landfills, a vegetation processing facility, a composting facility, two materials recycling

facilities (MRF), household hazardous waste collection facilities, and a network of five transfer stations (The Solid Waste Authority of Palm Beach County, 01/27/12).

Recycling programs

Recycling programs, developed and implemented by the SWA, are designed to integrate with solid waste management to achieve 50 percent recycling and waste reduction goals (The Solid Waste Authority of Palm Beach County, 01/27/12). The SWA encourages recycling by providing desk side collection bins, central collection bins, educational materials, and posters. It subsidizes recycling container rentals to commercial establishments and provides free waste audits to commercial establishments. Households receive solid waste and recycling services from the franchised hauler. The hauler collects from single-family homes, multifamily units, and commercial establishments. All residents are provided with the opportunity to recycle, but participation is voluntary.

Single-family households pay between $129 and $166 per year for weekly collection of garbage, bulk, recyclables, and yard waste from two 18 gallon bins. Multifamily units have twice per week garbage pick-up, once per week bulk pick-up, and once per week recycling pick-up with a set of two 95 gallon containers. The annual collection fees range from $40 to $109 per unit, plus a $53 per year disposal fee that includes recycling services. Commercial establishments pay a dedicated assessment to cover disposal costs. These costs have varied from $0.89/yard to $2.09/yard in the last contract. Commercial recycling is open to any hauler in the county (Recycling Success Story—Palm Beach County, Florida, 01/27/12).

Outcomes

Like other counties, Palm Beach County is providing the same recycling opportunities to every resident. The uniqueness of the program in Palm Beach County is that the County has made the recycling program convenient, simple, and socially acceptable. It provides recycling bins to households throughout the county. In an effort to educate new residents in this growing community about the recycling program, the county has begun an extensive television advertising campaign. The County is also unique in its operation of a commercial MRF and willingness to enter into materials sales agreements with individual commercial generators. This provides a powerful economic incentive for individual businesses to recycle.

In 2009, there were approximately 1,686,000 tons of MSW generated, of which 24 percent of this amount was landfilled, 35 percent was recycled, and 41 percent was incinerated. This 35 percent recycling rate and the five key materials rates (newspaper 62 percent, glass 12 percent, aluminum cans 31 percent, plastic bottles 29 percent, and steel cans 82 percent) are well above the State average. About 80 percent of single-family and 75 percent of multifamily units participated in this curbside recycling program. For commercial establishments, there was 25 percent participation in the scheduled collection recycling program.

2.3.8.2 RecycleBank – The City of Philadelphia, Pennsylvania

Overview

RecycleBank LLC is a Philadelphia based company that was founded in 2004. RecycleBank's headquarters are in New York and it has three locations in New York, Philadelphia, and London, UK, with 8 existing investors. To date, RecycleBank has more

than 3 million global members, has served more than 300 communities worldwide, and has worked with more than 3,000 local and national reward partners. RecycleBank seeks to promote increased recycling and local business development, decreased landfill/incinerator usage, and the education of communities on sustainable business, social and living practices by merging technology with incentives, using innovative environmental practices, and developing creative partnerships (Philadelphia Sustainability Awards, 01/28/12; Get to Know Recyclebank, 01/28/12).

The City of Philadelphia, with about 1,500,000 residents, provides residential waste collection services to over 550,000 households, small businesses, municipal buildings, and public housing throughout the City. Yearly, about 1.6-1.8 million tons of waste are managed by the City – approximately 40 percent by the City and the other 60 percent by private haulers. Recently, the City entered into a partnership with RecycleBank, which offers monetary rewards for recycling (Solid Waste Authority of Palm Beach County Response to the Florida Chapter of the Sierra Club, 01/28/12).

Program

In 2004, RecycleBank launched the first pilot program in Philadelphia after getting a $100,000 grant from the Eugene Lang Entrepreneurial Fund of Columbia University. The trial program, which was launched in Chestnut Hill and West Oak Lane neighborhoods, included 2,500 households. RecycleBank provided each home with a 35, 64, or 96 gallon RecycleBank Container that has an imbedded barcode to keep track of the amount each home recycles. The Company also supported a single stream recycling system that enables members to deposit all their recyclables (paper, cardboard, plastic, glass, tin, aluminum) in the container. Within two months, the Chestnut Hill participation

rates rose from 30 percent to 90 percent and weekly recycling rates rose from 10 pounds per household to 35 pounds per household. For West Oak Lane, participation rates rose to 90 percent, and daily recycling rates rose from 3 pounds per household to nearly 20 pounds (Philadelphia Sustainability Awards, 01/28/12).

RecycleBank proposed to expand its program in Philadelphia. The company would provide carts, computerized documentation, education, advertising, and its incentive programs. In the meantime, to increase residential participation further, the City of Philadelphia has set goals with the Green Works Philadelphia initiative, which has a recycling goal of reaching a 25 percent diversion rate by 2015 and diverting 70 percent of solid waste from landfill (Green Works Philadelphia, 01/28/12).

Although the Streets Department expressed concerns about the cost of the program, it was feasible that the City would not incur additional costs due to saving related to waste disposal costs, since the environmental, economic, and social benefits of the RecycleBank program were obvious.

In 2010, RecycleBank partnered with the Philadelphia Streets Department to launch the Philadelphia Recycling Rewards Program. The City provides recycling collection services; the program allows residents to earn points based on the amount members recycle. The points can be redeemed for discounts, full-value gift cards, or charitable contributions at hundreds of local and national stores.

The Philadelphia Recycling Rewards is a single stream waste collection program that accepts mixed recyclables – mixed paper, glass, plastic, and cans. To become members, residents have to sign up to the program; then they receive free tracking stickers that have an embedded Radio Frequency Identification (RFID) chip that records

each homeowner's address information. Once recyclable materials are placed in a stickered bin, the recyclables are collected by waste collection trucks that are equipped with specifically designed computers. Computers scan the chip, calculate the weight of the recyclable materials, store the information in a database, and credit the household for the amount of materials recycled. This credit amount becomes redeemable points.

Outcome

In the first six months of the Philadelphia Recycling Rewards Program, the city's diversion rate increased by 16 percent over the same period the year before. In January 2011, the actual diversion rate eclipsed 20 percent, the first time in Philadelphia's history. As of April 2011, the Philadelphia Recycling Rewards has been a monumental success with 128,000 households enrolled, more than 1 million points redeemed, and more than 16,000 rewards redeemed. The curbside diversion rate was just over 20 percent, four times higher than the 2006 rate. Some sections of the city achieved diversion rates over 30 percent, and many neighborhoods have seen double digit increases in recycling in the past years. The City's recycling rate for commercial customers served by private haulers is reported to have risen to higher levels, from 35.9 percent in 2006 to 50 percent in 2010. On average, RecycleBank's members save more than $130 a year through the Rewards Program (Green Works Philadelphia, 01/28/12).

Savings from avoided disposal costs as a result of the Recycling Rewards Program run by RecycleBank have offset some of the costs of services provided by the City for solid waste management.

The uniqueness of RecycleBank and the Philadelphia Recycling Rewards Programs is that RecycleBank has a well-developed system that attracts consumers by

providing monetary incentives, together with making the program simple, convenient, and reliable. It provides a free tracking sticker to all members to track the amount of recyclables for each household accurately. Moreover, the continuous effort to educate the residents about the recycling program of both RecycleBank and the City of Philadelphia has led to a significant increase in awareness among the residents. Almost 60 percent of new members surveyed said they are highly likely to take environmentally friendly actions as a result of participating in the program.

2.3.8.3 Let's Talk Less Rubbish - A Municipal Waste Management Strategy for the City of York and North Yorkshire, England

Overview

The York and North Yorkshire Waste Partnership (also known as YNYWP) was first formed in 1998. The joint municipal waste management strategy (JMWMS) between North Yorkshire County Council (NYCC) and the City of York Council (YCC) called Let's Talk Less Rubbish was adopted in 2006. The partnership comprises all of the nine local authorities in the area and will work together until 2026 to deliver the aims, objectives and targets set out in this strategy (York and North Yorkshire Waste Partnership, 02/02/12).

The key targets within the strategy are to:

- Reduce waste creation
- Recycle or compost 45 percent of household waste by 2013
- Recycle or compost 50 percent of household waste by 2020
- Divert 75 percent of municipal waste away from landfill by 2013

Let's Talk Less Rubbish deals with the strategic vision for managing wastes, and improving the recovery of those wastes as resources, for the period of 2006-2026. The focus of the strategy is municipal waste. The majority of this type of waste comes from the household, but there are also some elements from commercial and industrial sources. The strategy has been developed in response to the significant challenges facing the management of municipal waste. Within the partnership area there are also a number of specific local challenges, including a growing population, a predominance of rural areas, and areas of low population density. The Partnership is aiming towards an overall vision to work with the community and stakeholders of York and North Yorkshire to meet waste needs and deliver a high quality, sustainable, customer centric, and cost effective waste management service.

North Yorkshire is England's largest County and is home to 576,000 people in an area covering about 8,654 square kilometers. The population is rapidly growing. The County, however, is one of the most sparsely populated areas in England. Unemployment is below the national average. The City of York is a Unitary Authority covering approximately 272 square kilometers with a population of 185,000. The population density in York averages 680 people per square kilometer. The majority of the population resides within the urban area, the others being located in the numerous villages surrounding the City (Let's Talk Less Rubbish: a municipal waste management strategy for the City of York and North Yorkshire 2006 – 2026, 02/02/12).

Program

The program aims to promote the value of waste as a natural and viable resource by reusing, recycling, and composting the maximum practicable amount of household waste; maximizing opportunities for reuse of unwanted items and waste by working closely with community and other groups; and maximizing the recovery of materials and/or energy from waste that is not reused, recycled, or composted so as to reduce the amount of waste sent to landfill further.

The County Council and the District and Borough Councils are responsible for the management of municipal waste. The County Council, as Waste Disposal Authority (WDA), is responsible for:

- The recycling and disposal of waste and street cleansing activities
- Providing household waste recycling centers (HWRC)
- Managing the aftercare of some closed landfill sites that have the potential to pollute the environment
- Encouraging others to recycle and reuse waste through the payment of recycling credits
- Giving advice to members of the public, commerce and industry in all matters relating to waste management

A total of 396,391 tons of municipal waste was generated in 2005 in North Yorkshire. Waste is currently managed through 20 household waste recycling centers (HWRCs), 430 recycling bring bank sites, and 2 materials recycling facilities (MRFs) with disposal of residue to 9 landfills. The City of York managed 123,510 tons of

municipal waste in 2005. It has 3 household waste recycling centers and 60 recycling bring bank sites. In total, the authorities currently manage about 505,000 tons of MSW of which 433,000 tons is household waste. In terms of waste collection, 75 percent of the waste is collected by the Districts/Boroughs with 25 percent deposited by the residents at the HWRCs (North Yorkshire County Council, 02/02/12).

The partnership has launched many programs to encourage people to reduce, reuse, and recycle. The people receive credits from joining any programs or schemes. These credits can be used or redeemed at shops in the partnership area. Some of the programs and schemes are listed below:

- Reduce
    - Love Food Hate Waste: provides training to help people reduce food waste.
    - Smart Shopping: promotes ways to reduce waste sent to landfill, for example, thinking about what to buy, using a reusable bag, buying items that come with less packaging.
    - Real nappies: promotes the use of reusable diapers made from breathable materials, which are absorbent and kind to delicate skin.
    - Junk mail: promotes ways to stop receiving junk mail.
    - Home composting: offers help and assistance with composting by providing a team of fully trained volunteers.
- Reuse
    - Reuse organizations and charities: donates unwanted items to charity shops or reuse organizations.

- Household waste recycling center reuse project: a tools reuse scheme which helps people in developing countries to earn a living and support their families.
- Choose2Reuse: promotes reuse as a way of saving money and the environment by reusing items from buying and selling or giving and receiving secondhand items.
- Community reuse fund: provides financial support to community groups and charities already involved in reuse to improve existing projects and to those organizations who are not traditionally involved in reuse but have new and innovative ideas. The maximum grant available from the Community Reuse Fund is about $8,000 for capital or revenue expenses and the maximum project costs must not exceed £20,000. The maximum percentage the Community Reuse Fund will pay towards project costs is 75 percent. Organizations have to raise at least 25 percent match funding towards project costs which must be in cash (Community Reuse Fund 2012). (Community Reuse Fund, 02/02/12).

Charities and community groups can benefit further from donations as they can claim third party reuse and recycling credits for the items they reuse or recycle and divert from landfill. Organizations can claim credits for many waste materials and reusable goods, including paper, aluminum cans and packaging, steel cans, glass bottles, textiles, furniture, and electrical goods. To claim reuse and/or recycling credits, organizations must register with the third party reuse and

recycling credit scheme by first reading all of the requirements of the scheme and then completing the third party registration form.

- Recycle
    - Household waste recycling centers: accept over 20 types of materials. More than 60 percent of waste collected at the sites is reused, recycled, or composted.
    - Bring banks: are small recycling centers, which provide facilities for recycling between 3 and 5 materials. They are usually in supermarkets, community centers, or parking lots.

Municipal waste collection and management services in York and North Yorkshire cost local council taxpayers about £85 per household per year. In view of the increasing legislative and policy developments impacting on waste management activities, this is primarily designed to improve the environmental performance of municipal waste management services.

Outcome

Approximately 253,000 tons of food waste is managed annually, costing the average family with children £680 a year, or £50 a month. Since the launch of the Love Food Hate Waste campaign in 2007, there has been a nationwide saving of almost £400 million of food avoided from landfill, with the 2 million households who have reduced their waste preventing 950,000 tons of greenhouse gases being emitted (Love Food Hate Waste, 02/02/12).

A considerable improvement in recycling and composting performance has been achieved. Recent studies have shown that a higher level of recycling is the most cost effective long- term solution to delivering the Partnership's obligations. The residents of York and North Yorkshire are amongst the best recyclers in the country. For example, the Ryedale District achieved high performance in 2010 and received an additional $483,000 as part of an incentive bonus in addition to recycling credits (Ryedale District Council, 02/02/12).

Municipal waste collection and management services in York and North Yorkshire cost local council taxpayers about £85 per household per year. In view of the increasing legislative and policy developments impacting on waste management activities, this is primarily designed to improve the environmental performance of municipal waste management services. (Incentives for recycling and reducing household waste, 03/02/12).

The table below compares and contrasts the three successful recycling programs in different perspectives.

	Palm Beach County, Florida	**RecycleBank, Philadelphia, Pennsylvania**	**Let's Talk Less Rubbish, the City of York & North Yorkshire, England**
Establishment	Initiated by government agency	Initiated by private sector	Initiated by government agency
Major roles	Government agency	Private sector	Government agency
Uniqueness	Less incentives	More incentives	More incentives
	Government own facilities	Private own facilities	Government own facilities
	Continuously communicate/educate to community	Continuously communicate/educate to community	Continuously communicate/educate to community
	Convenient	Convenient	Convenient
	Voluntary basis	Voluntary basis	Voluntary basis
	No additional cost	No additional cost	No additional cost
Process	Register, recycle, redeem	Register, recycle, redeem	Register, recycle, redeem
	Trackable data	Trackable data	Trackable data
Outcome	Increase in participation		
	Increase recycling rates		Increase recycling rates
	Less waste to landfills	Less waste to landfills	Less waste to landfills
	Financial benefits (city, members, partners)	Financial benefits (city, members, partners)	Financial benefits (city, members, partners, social)

Table1: Compare and contrast three successful recycling programs

Although these three projects are different in some ways, overall they have the same objectives, namely to increase recycling, to decrease landfill usage, to increase citizens' awareness, and finally to have sustainable waste management.

2.4 Recycling program, in Bangkok, Thailand

2.4.1 Current situation of municipal solid waste management in Bangkok

Bangkok, the fastest growing city in Thailand with a current population of 5.7 million, has witnessed an accumulating problem with solid waste management and disposal (Department of Provincial Administration: Thailand Population 2011, 02/05/12). The city's MSW generation shows an increasing trend parallel to the development of economic conditions, urbanization, and the rapid growth of population.

The quality of the environment is therefore a matter of growing concern. Bangkok is increasing its awareness of the important role of solid waste management; it seeks to avoid environmental pollution by encompassing various strategies, such as the 3Rs project, efficient waste collection and disposal system campaigns, and effective participation of government, public, and private sectors. However, while those strategies have been successful at some level, solid waste problems need further planning through the involvement of related parties, a long-term master plan, and an integrated waste management system that suits the characteristics of the City of Bangkok and works well with the residents.

2.4.2 Summary of municipal solid waste management in Bangkok

2.4.2.1 Definition of municipal solid waste (household waste) management

According to the Thailand Public Health Act 1992, MSW includes waste from community activities, such as residential households, commercial and business establishments, fresh markets, institutional facilities, and construction and demolition activities, excluding industrial waste (Public Cleansing Department, Bangkok Metropolitan

Administration, 2005). MSW in Bangkok is classified into four types as general waste, recyclable waste, hazardous waste, and infectious waste.

- General waste: non-hazardous, noninfectious, or non-recyclable waste that poses no risk of injury or infections. Examples include used paper towels, wet plastic and food-related trash
- Recyclable waste: waste that can be processed into raw materials. Examples include paper, metal, glass, and plastic
- Hazardous waste: waste that is generated from households that is contaminated with hazardous, explosive, flammable, or radioactive materials. Examples include light bulbs, batteries, and spray bottles
- Infectious waste: waste that is contaminated with body fluids containing disease-causing microorganisms or viruses. Examples include band aids, gauze, sanitary napkins, or diapers

However, in this research the author focuses primarily on waste that is generated from households only.

However, in this research the author focuses primarily on waste that is generated from households only.

The BMA is organized in accordance with the Bangkok Metropolitan Administration Act 1985 to be responsible for management of the city and the well-being of Bangkok residents. Under the BMA, the Department of Public Cleansing (DPC), together with the 50 Bangkok City districts, is responsible for cleansing the city. It reports the amount of waste collected from 50 districts. The collected waste is first transferred to three transfer stations, namely On Nuch, Nong Kham, and Tha Rang. Then

it is transported to landfill sites at Latkrabang and Kampangsan. The DPC accounts for 80 percent of the municipal cleansing services; the remaining waste is accounted for by private companies (Department of Environment, Bangkok Metropolitan Administration, 11/24/11).

The BMA is able to collect more than 75 percent of the waste generated in all areas. Nonetheless, the continually increasing amount of solid waste in the City causes serious problems in solid waste management as the amount of generated solid waste outstrips the collection capacity by more than 2,000 tons per day. BMA has realized that the problem of waste is increasing; hence, it has specified strategies and goals to deal with such problems in the Bangkok Metropolitan Development Plan as follows:

- Collecting solid waste regularly: sweeping, cleansing, and vacuum cleaning walkways and bridges frequently.
- Promotion of waste minimization and separation for the purpose of reuse, including campaigning for public awareness and cooperation.
- Enhancing the efficiency of solid waste disposal by appropriate technology and by encouraging the private sector to participate in improving solid waste management.
- Developing a hazardous and infectious waste collection and disposal system that collects all such material and disposes of it by an appropriate method.
- Developing an information technology system as the cleansing network center for supporting solid waste.
- Aiming to reduce the amount of waste by10 percent per year.

Waste management at all levels is still a key problem in the current situation. The problem of MSW management is caused by various factors; for example, waste that is

difficult to dispose of; insufficient equipment for collection, transportation and disposal; limited budget for operation; and lack of public participation.

2.4.3 Current performance

BMA has responsibility to control the cost of waste management. Since 1998, the average collection costs have been about $51million a year and the average disposal costs were at $23.51 million a year, whereas the average revenue from fees was $4 million, representing only 5 percent of the collection and disposal costs. Due to the imbalance of income and expenses, BMA had to compensate for excessive costs by using other income at an average of $70.32 million baht, and the cost has increased every year (Suaykakaoy, Maneewong, 11/30/11; Department of Environment, Bangkok Metropolitan Administration, 2005). Because of this, BMA is acting on these problems by increasing waste collection fees and improving the efficiency of fee collection, which will be implemented at all houses in the relevant areas.

2.4.3.1 Municipal solid waste generation

The quantity of generated solid waste in Bangkok mainly depends on the population, economic growth, the lifestyle of the people, and the efficiency of the waste management system. MSW comprises almost 67 percent of the total waste generated, while the remaining 33 percent consists of hazardous and non-hazardous industrial waste. Bangkok has the MSW generation rate of a typical metropolis in comparable developing countries. According to the Department of Public Cleansing's study, the average per capita generation rate increased from 1.19 kilograms per capita per day in 1995 to 1.54 kilograms per capita per day in 2009 (Public Cleansing Department, Bangkok Metropolitan Administration, 2005; Thailand Environment Monitor, 11/15/11).

Area	Waste Generation (Tons/Day)							
	2005	2006	2007	2008	2009		2010	
Bangkok	**8,291**	**8,403**	**8,532**	**8,780**	**8,834**	**21%**	**8,766**	**21%**
Pattaya	12,635	12,912	13,600	14,915	16,368	40%	16,620	40%
Central and Eastern	5,499	5,619	5,780	5,258	5,830	14%	5,918	14%
Northern	2,148	2,195	2,346	2,931	3,255	8%	3,315	8%
North Eastern	2,906	2,970	3,167	4,267	4,700	11%	4,768	11%
Southern	2,082	2,128	2,307	2,459	2,583	6%	2,619	6%
Outside municipal area	18,295	18,697	18,200	17,369	16,208	39%	16,146	39%
Total	**39,221**	**40,012**	**40,332**	**41,064**	**41,410**	**100%**	**41,532**	**100%**

Table2: Total waste generated in Thailand [2]

District	2009		2010	
	Tons	%	Tons	%
Jatujak	**120,313**	**4%**	**121,823**	**4%**
Bangkapi	106,336	3%	102,315	3%
Klongtoey	104,987	3%	101,396	3%
Bangkae	91,574	3%	91,790	3%
Bangkhuntien	86,799	3%	89,416	3%
Dindang	85,668	3%	83,473	3%
Bangkhen	84,091	3%	85,333	3%
Wattana	80,427	2%	80,695	3%
Patumwan	80,231	2%	76,844	2%
Prawet	78,642	2%	78,607	2%
Total top 10 districts	**919,071**	**29%**	**911,692**	**28%**
Total Bangkok	**3,224,410**		**3,199,590**	

Table3: Household waste generated from top ten districts in Bangkok [3]

The total waste generated in 2010 from the 50 districts of Bangkok was 3.2 million tons; from this amount about one third of the total waste was generated from 10 districts, of which Jatujak district generated about 1.22 million tons or 4 percent of the total waste (Waste Generation 2005-2010, 01/05/12).

[2] http://www.pcd.go.th/info_serv/waste_wastethai48_53.html, 01/05/12
[3] http://www.pcd.go.th/info_serv/waste_wastethai48_53.html, 01/05/12

2.4.3.2 Municipal solid waste composition

One of the most important steps in MSW management is quantifying and qualifying the different types of MSW being generated. It is necessary to have a system of basic information about collection, separation, and analysis of MSW. The solid waste composition in all districts in Bangkok is homogeneous. It is highly biodegradable; the organic waste is the largest portion. Food waste, plastic, paper, rubber, foam, glass, metal, stone, and clothes are the common MSW components. The physical composition of MSW varies according to economic conditions, social activities, consumer patterns, lifestyle, and seasons. The composition of MSW in 2009 was dominated by food waste (44 percent), followed by plastic (22 percent) and paper (12 percent) (Strategy and Evaluation Department: Bangkok Environment, 11/15/11).

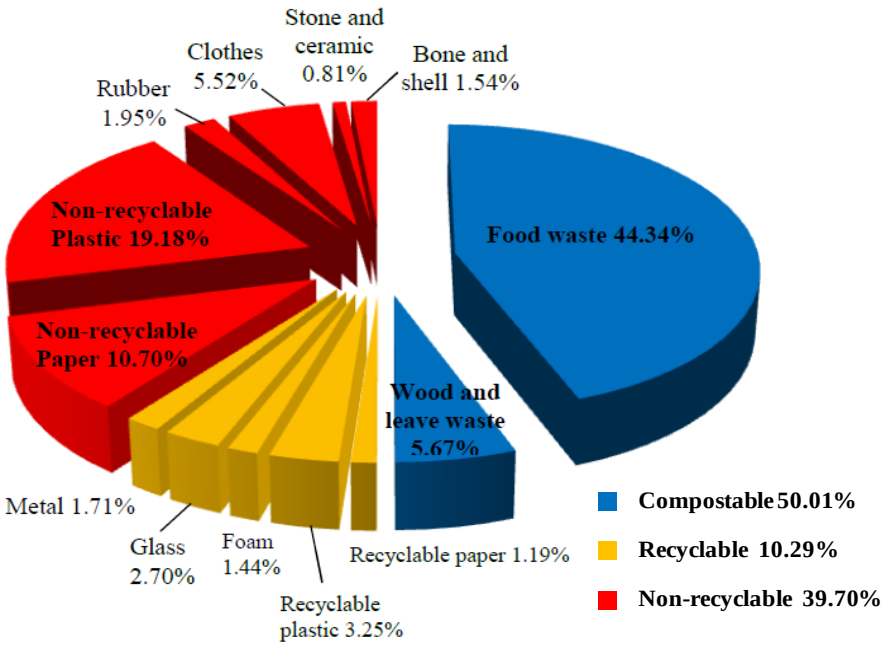

Figure3: Municipal solid waste composition

The average moisture content of MSW in Bangkok is around 40-60 percent, with little difference between dry and wet seasons. The heating value is in the range of 5,163 to 6,121 kilojoules per kilogram (Strategy and Evaluation Department: Bangkok Environment, 11/15/11).

2.4.4 Waste management system

2.4.4.1 Waste collection

An MSW collection system consists of household waste bins, waste collecting equipped trucks, and workers. The amount of solid waste collected by a total of 2,180 trucks is approximately 8,500-9,300 tons per day. BMA collects waste in two ways: directly from households and from community dumpsters. Due to waste collection services being unavailable in some areas, open dumping and burning are still used by some Bangkok residents to dispose of MSW (Public Cleansing Department, Bangkok Metropolitan Administration, 2005; Strategy and Evaluation Department: Bangkok Environment, 11/15/11).

2.4.4.2 Waste transportation

After waste is collected, it is transferred to the stations and is separated by type. After that, it is transported to designated disposal sites by contracted private transporters. General waste accounts for 99.80 percent of total waste and is disposed of by sanitary landfill and composting methods; infectious waste accounts for 0.19 percent and is disposed of by incineration; and hazardous waste accounts for 0.01 percent and is disposed of in a secured landfill. BMA hires private companies to collect and transport around 3,300 tons per day of waste from the On Nuch station, where it is compacted before transferring, to the Latkrabang landfill, and around 5,200 tons per day from the

Nong Kham and Tha Rang stations to the Kampangsan landfill (Department of Environment, Bangkok Metropolitan Administration, 2005; Pollution Control Department, 2009; CDM: A Mechanism to Promote Solid Waste Management Efficiency and GHG Reduction in Thailand, 11/14/11).

2.4.4.3 Waste disposal

Four methods of waste disposal are used in Bangkok, namely landfill, composting, incineration, and open dumping.

Landfill

Sanitary landfill is considered the cheapest method of waste disposal in Bangkok, as 97 percent of the solid waste is disposed of by this method. It occupies vast valuable space, creates a nuisance, and results in the production of methane gas and leachate from waste decomposition (Mazzanti, Massimiliano, and Anna Montini, 2009; Environmental Practices of Yard Waste Management in Bangkok, 11/14/11). Bangkok's two sanitary landfills are located far from the sources of waste, resulting in increasing transfer costs and additional investment in infrastructure. Presently, there is a capacity crisis at both landfill sites and this is becoming more serious because of the rapid growth of population, economic development, and utilization of the facilities.

Composting

MSW composition trends in Bangkok reveal that the composition of solid waste is largely organic waste, which is suitable for composting, due to its high moisture content (40-60 percent). About 60 percent of Bangkok MSW contains organic matter, which can be used to produce natural fertilizer (Municipal Solid Waste Management in Thailand, 11/14/11). Currently, two approaches are being used in the composting of MSW: the typical window system (piling on the ground); and utilization of mechanical equipment to facilitate the

composting process, such as the rotating drum, which is being used at the Nong Kham station. However, composting activities only account for about 3 percent of waste management in Bangkok because of the complexity of the process.

Incineration

Incineration is used for large municipalities and tourist municipality areas because sanitary landfill is not enough for waste disposal. The released heat from combustible processes can be recovered to provide a source of energy, which can be sold in the form of steam, electricity, or both (cogeneration). With the high moisture content of MSW in Bangkok, however, it has a low calorific value. Pretreatment of waste should be considered. However, incineration can cause air pollution by, for example, producing noxious gaseous pollutants (The Evolution of Solid Waste Management in Bangkok: Implications for the Future, 11/14/11).

Open waste burning and dumping

Open waste burning and dumping have been used for waste disposal for many years. Although these methods are easy and can be done at a low cost, they should not be allowed, because they are unsightly, unhygienic, and potentially disastrous to the environment. In some areas of Bangkok, people still manage their waste using these methods.

All in all, the management of the large volume of waste created in big cities, such as Bangkok, is complicated and relatively expensive. In the current situation of MSW management in Bangkok, landfill is the predominant treatment compared with other methods. The main effects of environmental degradation are principally smells from

landfills; groundwater, surface water, and soil contamination from leachate; spreading of diseases by different vectors; uncontrolled release of methane gas from anaerobic decomposition of MSW; and burning and explosion of landfills from methane gas.

2.4.5 Waste management programs

The BMA has initiated many projects in order to reduce the amount of waste and improve the efficiency of the MSW management system. Those projects focus primarily on source reduction, 3Rs, waste treatment, and waste disposal.

2.4.5.1 Projects and activities

Waste Minimization and Separation

This project aims to enhance the attitude and cooperation of people in separating recyclable waste, reducing disposable waste, and reducing the use of resources to the minimum. This project is based on the principle of 3Rs, Reduce – Reuse – Recycle, which aligns with the concept of sustainable development.

MSW in Bangkok has consistently increased every year. Two landfill sites are in crisis, as spaces are all exploited. It is difficult for the BMA to find new land, as people are unlikely to allow landfills in their communities. This is the main reason that this project was initiated. In 1998, this project was launched with the objectives to reduce the amount of waste and to enhance the attitude and cooperation of people in separating recyclable waste before they dispose of it. The project was aimed at 14 target groups: BMA schools, private schools, colleges and higher education institutes, department stores, banks, hotels, minimarts, markets, hospitals, temples and religious places,

communities, housing estates, and high rise buildings (Department of Environment, Bangkok Metropolitan Administration, 2005).

For the time being, one third of the total solid waste that the BMA has to manage each day has the potential to be recycled. Waste is separated at three different stages of the collection process: at source, prior to collection; by staff at waste trucks; and by scavengers at the dumpsites. In Bangkok, about 5 percent of the collected waste is recovered at source, while the quantity of materials gathered by staff varies between 1 and 6 tons per day and the amount of materials recovered by the scavengers at the dumpsites varies between 50 and 150 kilograms per person per day (The Evolution of Solid Waste Management in Bangkok: Implications for the Future, 11/14/11).

Waste Reduction at 10 Percent Annually

With an aim to reduce waste generation at 10 percent a year, BMA encourages people to segregate waste of different kinds for appropriate handling. BMA also gives people inducements to sell their recyclable waste, by providing waste segregation staff to buy their sorted recyclable waste and offer collection services.

Capacity Building for Public Cleansing Staff Project

To improve the efficiency of the waste management system, BMA staff members are required to be prepared, encouraged, and trained to support the system. The project aims to ensure that all staff members meet the requirements. They are educated with knowhow and new technologies in waste management, which focus on both system operation and public participation. The operational result of this project was that 375 cleansing staff members were trained.

BMA's Declaration of Cooperation on Alleviating Global Warming Problems

Besides those projects, the BMA's Declaration of Cooperation on Alleviating Global Warming Problems also mitigates impacts that cause global warming. One of the five strategies of this declaration is "Improve Solid Waste Management and Wastewater Treatment Efficiency 2007 – 2012".

Increased efficiencies in solid waste and wastewater management will lead to reductions in methane emissions. Solid waste contributes to GHGs emissions through the release of methane during the decomposition process of organic matter equivalent to over 1 million tons of CO_2 a year. The organic waste would release methane while decomposing for approximately 3 years. To reduce the amount of methane, this program encourages Bangkok residents to sort organic waste prior to discarding it. The BMA encourages that the organic portion of solid waste be used to make fertilizer at fertilizer production plants. This activity aims to achieve a 15 percent reduction in solid waste by 2012, which will reduce the amount of waste generated per day to 7,000 tons. However, this objective has not achieved its target because there has been a very small change in the amount of waste reduction and separation (Bangkok Metropolitan Administration Action Plan on Global Warming Mitigation 2007 – 2012, 11/14/11; Pollution Control Department, 2009; Ludwig, Christian, Stefanie Hellweg, and Samuel Stucki, 2003). Figure 4 shows the anticipated amount of methane gas that will be emitted from MSW in Bangkok areas.

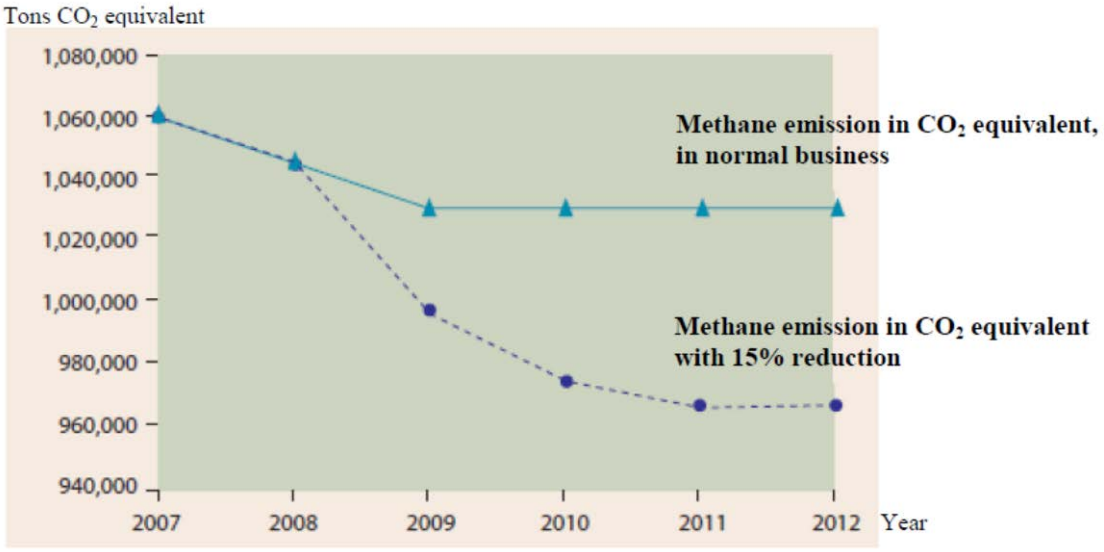

Figure4: Annual GHG emission from municipal solid waste [4]

Besides these projects, the amendment of the solid waste collection fee from 40 to 20 baht of waste that does not exceed 20 liters a month plays a crucial role as it is a way to encourage the people of Bangkok to be mindful of their consumption and solid waste separation for ease of collection, recycling, and disposal. In its first few years, this program met its target of reducing waste by 10% annually. Nonetheless, since 2007 waste generation has increased again.

2.4.5.2 Laws and regulations

Although the laws and regulations of the Bangkok Municipality can be legally enforced on violators, in practice they are very weak. BMA has introduced a separate

[4] Retrieved data from http://203.155.220.239/subsite/index.php?strOrgID=001054&strSection=news_detail&intListID=37723, 11/14/11

collection system for segregation of general waste, recyclable waste, and hazardous waste to some areas in Bangkok. However, the system has not been fully entrenched.

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The Public Health Act 1992

This Act controls both waste and waste transporters/disposers. The Act also establishes criteria to control causes of public nuisance, such as odor, light, radiation, sound, heat, hazardous substances, vibration, dust, and poisonous tar/ash to protect humans and the environment. Whoever fails to comply with this Act is liable to a fine, which ranges from less than 1,000 baht to 100,000 baht, or to imprisonment for a term of 1 month to 1 year, or both.

BMA announced an ordinance on solid waste and changed the night soil collection fee based on this Act by amending the general waste collection fees for buildings having daily waste of less than 20 liters from 40 to 20 baht a month. This amendment has been published in the government gazette and has been enforced since March 2005 (Department of Environment, Bangkok Metropolitan Administration, 2005).

The Public Cleansing Act 1992

This Act prohibits public disposal of solid waste and public cleansing in general. A fine for those who violate or fail to comply with this Act ranges from less than 500 baht to 10,000 baht (Pollution Control Department: Acts and Regulations Related to PCD Roles, 11/14/11).

The National Municipal Solid Waste Management Plan 1997

This plan was developed by the National Economic and Social Development Board to enforce MSW management for the entire country. The two primary points of the plan are encouraging provincial authorities to seek appropriate plots to serve as long-term sites for MSW landfill disposal and to designate these appropriate areas in measures such as urban plans. This will establish MSW management that covers processes of collection, transportation, and hygienic disposal (Design and Construction of Engineered MSW Landfills in Thailand, 11/14/11).

Furthermore, the present laws and regulations need further amendments in terms of household waste recycling including:

Furthermore, the present laws and regulations need further amendments in terms of household waste recycling, including:

- Amend and clarify the regulation of waste management, including the direction, separation, collection, storage, transportation, and disposal of the waste to be used effectively in real situations.
- Enforce the separation of hazardous and infectious waste from municipal wastes, and push to establish treatment centers.
- Establish laws, regulations, orders, or standards with regard to waste sorting prior to disposal.

- Establish solid waste disposal site pollution control standards.

Establish an active environmental protection policy.

2.5 Current situation of recycling program in Thailand

Over recent decades the Thai government has made a concerted effort to improve the nation's waste management. Since 1992, Thailand has had a plan to develop renewable energy and reduce energy dependency. Policies that offer incentives to both local government and private industry have helped the country's recycling rate increase to 26 percent in 2010 (Waste Generation 2005-2010, 01/05/12). However, Thailand is facing severe problems in the sphere of MSW management. In 2010, the volume of waste being generated in Thailand reached about 15.16 million tons. Of this, approximately 3.2 million tons or 21 percent is MSW from Bangkok (Waste Generation 2005-2010, 01/05/12; Recycling & Renewable Energy in Thailand, 02/05/12; Thai Style Recycling, 02/05/12).

There has been a gradual improvement in waste disposal practices from open dumping to sanitary landfilling. Recycling has become one of the most common methods of MSW management in Thailand.

Nevertheless, the increasing amount of solid waste from cities is a significant problem. For many years, the local government has conducted and supported many environmental projects towards community-based solid waste management. However, local residents of big cities in Thailand still suffer from the increase of solid waste and the lack of proper disposal methods (Green antique shop project 2011, 02/06/12).

The recycling industry in Thailand is expanding rapidly. According to the survey of the Pollution Control Department conducted in 2008, there were 10,200 private

recycling shops, of which 3,060 shops were in Bangkok and its vicinity. Today, the market value of this industry is about 40,000 million baht (Waste - a source of income, 02/03/12). The recycling industry has so much room to grow. It helps to prolong the lifespan of landfills and reduce the need for costly incineration and slows down natural resource depletion from resource-intensive industries (Wongpanit Interview, 02/03/12).

2.5.1 Types of recycling programs

The recycling rate in Thailand is progressively increasing due to efforts from both private companies and government authorities. However, there is no formal recycling scheme in Thailand. Types of recycling programs are categorized into the private sector or local authority recycling programs (Recycling & Renewable Energy in Thailand, 02/05/12).

Recycling program sizes range from, for example, small programs in elementary schools, projects at community level, small recycling shops (both registered and unregistered), and recycling factories, to large businesses that have franchises nationwide. Some of these activities or programs are incentive-based and aim to raise public awareness of the value of recyclable waste and to stimulate the people into participation (Thai Style Recycling, 02/05/12).

Economic, social, and environmental benefits should be taken into consideration when developing sustainable recycling programs. The attractive point of such recycling programs is the potential opportunity for waste reduction, the recovery of a significant amount of materials, and reduction of energy required, which indirectly reduces the demand for fossil fuels and reduces GHGs emissions. The success of recycling mainly depends on the active contribution, close cooperation, and mutual support of

communities, municipalities, and the private sector. However, effective legislation, education, and awareness raising campaigns are prerequisites to ensure more widespread and successful recycling activities in the country.

2.5.2 Key players and performance

The role of waste dealing business in Thailand already exists for decades. Before waste dealing job was generally considered as a very dirty and low status work. However, in the last decade recycling industry has grown continuously. Correspondingly, number of players in the market has increased considerably. Nowadays, recycling industry is a large diverse network of public sector institutions (local governments, communities, schools, and universities) and private companies. There are two major types of players in Thailand recycling business. One is private recyclers, which are for profit businesses. The other one is, local level recycling programs. The programs are usually initiated by local authorities, communities, institutions, or companies; these players considered not for profit group. Within these two types of players, there are two groups of people who engage themselves in waste recycling activities. These two groups of people are discarded waste sellers/buyers and waste transforming manufacturers.

2.5.2.1 Discarded waste buyers

Discarded waste buyers are both for profit and not for profit recyclers. Discarded waste buyers can range from very small shops to very large recycling businesses. Discarded waste buyers consist of the following groups of people (Trend of recycling in Thailand, 02/06/12):

- Peddlers: there are approximately 16,000 peddlers in Thailand, who collect and purchase leftover and discarded materials from households and sell them to the first middlemen.
- First middlemen: there are about 2,000 first middlemen in the country who separate leftover and discarded materials bought from peddlers and sell them to the second middlemen.
- Second middlemen: there are roughly 250 second middlemen who gather leftover and discarded materials, which have been separated based on their quality, and sell them to waste transforming manufacturers through agents.
- Agents: act as brokers for waste transforming factories by distributing and passing information from waste transforming factories to the second middlemen, but do not have to deliver the materials themselves.

Focusing specifically in the Bangkok Metropolitan Area, there are 638 registered recycling shops including first middlemen, second middlemen, and agents. These 638 shops buy about 2,000 tons of recyclable waste per day. However, there are many unregistered shops which deal with a considerable amount of waste (Green antique shop project 2011, 02/06/12).

The biggest agency and recycling company, in Thailand is Wongpanit. Wongpanit Co., Ltd. was established in 1974 in Phitsanulok province. Currently, the company has 801 branches spread throughout the country and in Laos, the Philippines, Malaysia, Vietnam, Myanmar, Romania, and the United States with a total capacity of 115,000 tons per month. From all recycling stations, Wongpanit buys more than 1,400 kinds of

recyclable waste, of which 60 percent is exported to India, China, Bangladesh, and Vietnam, and the other 40 percent is sold to domestic customers (WONGPANIT, 03/27/12).

For the BRP, the program includes peddlers, first middlemen, and second middlemen. The BMA acts as a peddler by collecting sorted recyclable waste from households. The BMA is also the first and second middleman, as the program accepts waste from other peddlers and then sells the collected/bought recyclable waste to the second middlemen or directly to agents.

2.5.2.2 Waste transforming manufacturers

There are 830 registered waste transforming manufacturers in Thailand, who can be divided based on the types of leftover and discarded materials they process, which are paper, glass, plastic, aluminum, copper, brass, and foam.

In terms of foreign investment, many countries have been interested in investing in the recycling business in Thailand. For example, Panasonic, a Japanese multinational consumer electronics corporation, is willing to invest 400 million yen in a recycling facility in Thailand, but only after the country legislates home-appliance recycling (New Panasonic investment hinges on Thai recycling law, 03/26/12).

Thailand has been making steps towards drafting legislation on waste electrical and electronics equipment (WEEE) for the past eight years using the EU WEEE legislation as a guideline. In 2007, the Thai WEEE Strategy was approved, setting WEEE collection and recovery rates of 50 percent. The Thai WEEE Strategy underwent further amendments by the Finance Ministry, mainly to provide policies and frameworks for

public-finance measures and other tools involving environmental management. It is also used in determining product fee rates for regulated products. The new laws are expected to take effect in 2015 (New Panasonic investment hinges on Thai recycling law, 03/26/12).

2.5.3 Future trends of the recycling business in Thailand

The market trend for waste recycling is on the rise since waste transforming factories in Thailand are expanding to meet the increasing demand for raw materials. In addition, recycled materials are less expensive than virgin materials. Various companies pay more attention to the increasing values of their wastes, while the people are becoming more environmentally conscious and starting to recognize the importance of recycled products. In addition, there are also factors that promote and enlarge the recycling market.

Internal factors allow a bright future for the recycling market, including commercial competition, and economic degeneration, which increase the production cost. Business owners therefore need to reduce their cost of production by making the best out of their resources through the process of recycling. One external factor that influences the recycling trend is the laissez-faire economy, which is anticipated to lead to the improvement of product quality. Being able to produce standardized and qualified products with lesser production costs will be an advantage to the country. Business owners, therefore, become more alert and concerned about improving their production processes, which in turn influences the trend of the recycling market.

In conclusion, there is a promising trend for the recycling industry in Thailand. Waste recycling rates within the premises of the BMA and other communities throughout

the country are settled at more than 15 percent of the total waste generated (AUTHOR 2012). These measures are likely to make waste recycling move towards a fuller and more practical recycling program, leading to the expansion of waste recycling market in the future.

3. SPSS ANALYSIS

3.1 Target market for the Bangkok Recycling Program

In the survey, there are 2 groups of sample. The first group is people whose age is between 7-15 years old (children group). The second group is people who are older than 15 years old (adult group). Most of the analyses in this report will be based on data collected from the second group. However, for the first group, the author wants to see the perception of young people towards sorting waste, the importance of recycling, incentive-based recycling program, and who should be responsible for waste concerns. Also, the author wants to know whether this group of people has an influence on the amount of household waste generated; and can they be a potential factor that will encourage other members in their family to do waste sorting and join incentive-based recycling program.

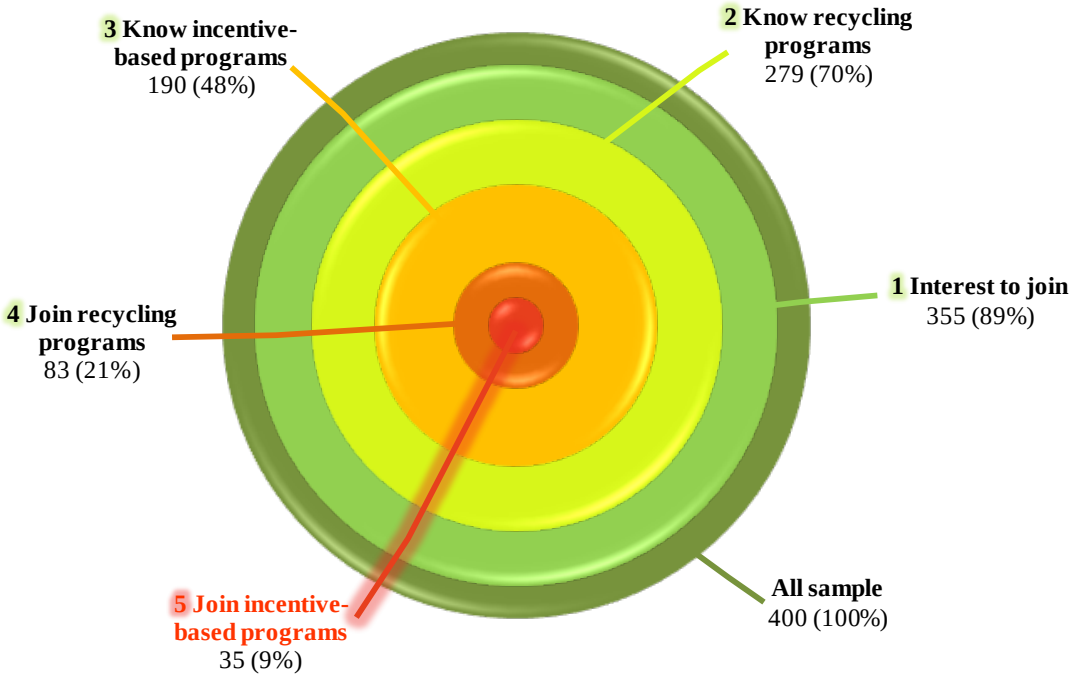

Figure5: Target program members

From the analysis of target recyclers in Figure5, there are 5 groups of recyclers that have potential to join the recycling program.

Incentive-based recycling program members

The group with the most potential is incentive-based program members. As 35 people (9 percent) of all samples (400) are willing to join the program, this is the first group that the BMA should capture. The people in this group already know the program and familiar with how the program works. Thus this group of people is most likely to join the program.

Recycling program members

This is the second group that the BMA should focus on, as there is 21 percent of total samples. The BMA should attract this group of people to join the BRP, by providing information and encourage them by using incentive scheme.

Know incentive-based recycling programs

This is a big group of people, represents 48 percent of total samples. They know the incentive-based program. To attract this group of people to join the program, it is important to employ a well planned strategy by showing them what benefits they will get if they join the BRP.

Know waste recycling programs

This group of people knows the concept of recycling programs, 279 respondents (70 percent). The BMA should attract this group of people by providing information about incentive-based recycling programs and what they will get from the programs if they are members.

Interested in joining the incentive-based recycling program

This is a very big group of people. There are 355 respondents (89 percent), who want to participate in the incentive-based recycling program. To pull their attraction and make them to be part of the program is essential. Providing information about benefits of the program that the members will get and also the incentives the program provides are a good way to attract this group of people.

3.2 Target recycler profile

Based on the survey of 800 samples in Jatujak District area in Bangkok, for the first group sample, the SPSS analysis shows that male and female students who currently study in grade 4-9 know that some types of waste can be recycled. They sort waste at school and at home. There are both incentive-based and regular recycling programs at schools. In their opinion, they think that everyone should be responsible for waste management in terms of waste reduction at source. And they are willing to join the incentive-based recycling program.

Gender	Male and female
Age	7 – 15 years old
Occupation	Students (grade 7-9)
Waste that usually see at school	Plastic bottles and paper
Perception on waste	Waste has values and can be recycled
Waste management at school	Recycling programs - waste sorting
Recycling programs at school provide incentives	Yes, certificate and cash (recycle bank)
Waste management at home	Sort recyclable waste before disposal
Perception on waste sorting	Waste sorting can reduce waste generation
Responsible person on waste management at home	Everyone
Interest in incentive-based recycling program	Interest

Table4: Group 1 customer profile

For the second group sample, the SPSS analysis shows that the most potential target customers of incentive-based recycling programs in Thailand are male and female in the range of age 26 to 40 years old. Majority of recyclers are people who work for private companies with income about 10,001 – 20,000 Baht per month. They dispose of about 1 – 3 kilograms of waste everyday in public dumpsters. Amount of recyclable waste is approximately 11 – 20 percent of daily disposal amount. The recyclable waste materials are plastic, paper, aluminum cans, metal, and glass. Waste collection fee per month is 20 Baht. For those who know the incentive-based recycling program, they gain information from television. The majority of people want cash as the project incentive and to use the incentive at convenient stores. In terms of waste management system of the program, they want more trash bins. The additional cost for the program services should be about 10 Baht.

Gender	Male and female
Age	26 – 40 years old
Education	High school and bachelor's
Occupation	Private company officers
Income	10,001 – 20,000 Baht
Family members	4
Waste disposal method	Put in public dumpsters
Waste disposal frequency	Everyday
Waste disposal quantity per time	1 – 3 kilograms
Amount of recyclable waste per disposal	11 – 20 percent
Types of recyclable waste (most to least)	Plastic, paper, aluminum can, metal, glass
Disposal fee	20 Baht per month
Know incentive-based recycling program from	Television
Incentive from the program	Cash
Place to use incentive	Convenient stores
Additional fee for the program	10 Baht
Factor that affect their decision to join the program the most	Need trash bins for recyclable waste

Table5: Group 2 customer profile

3.3 Key features of respondents

This part shows important results of the SPSS analysis based on data collected from the second sample group. The results show, for example, how the respondents deal with their household waste; the amount of waste and recyclable waste that was generated; experience in recycling programs; interest in joining in incentive-based recycling program; and how the respondents think towards the BRP.

3.3.1 General information about the respondents

Classification		Composition		Classification		Composition	
		Number of Respondents	%			Number of Respondents	%
Total		400	100	Occupation	Student	39	9.8
Sex	Male	194	48.5		Business owner	35	8.8
	Female	206	51.5		Government officer/ state enterprise	110	27.5
Age	16 to 18	33	8.3		Company officer	141	35.3
	19 to 25	43	10.5		Work for money	31	7.8
	26 to 30	54	13.5		Housewife	29	7.3
	31 to 35	64	16.0		Retired	6	1.5
	36 to 40	55	13.8		Unemployed	9	2.3
	41 to 45	34	8.5	Monthly income	< 5,000 B	29	7.3
	46 to 50	43	10.8		5,001 – 10,000 B	58	14.5
	51 to 55	29	7.3		10,001 – 20,000 B	120	30.0
	56 to 60	19	4.8		20,001 – 30,000 B	69	17.3
	> 60	27	6.8		30,001 – 50,000 t	68	17.0
Education	Primary school	12	3.0		> 50,000 B	56	14.0
	Secondary school	8	2.0	Family members	1	17	4.3
					2	60	15.0
	High school	44	11.0		3	80	20.0
					4	107	26.8
	Vocational school	29	7.3		5	73	18.3
					6	33	8.3
	Bachelor’s degree	217	54.3		7	12	3.0
					8	5	1.3
	Master’s degree	87	21.8		9	7	1.8
					10	4	1.0
	Doctoral degree	3	0.8		11	0	0.0
					12	2	0.5

Table6: Key features of respondents

3.4 SPSS results analyzed from 400 samples (the second group)

3.4.1 Household waste management

3.4.1.1 Household waste disposal method

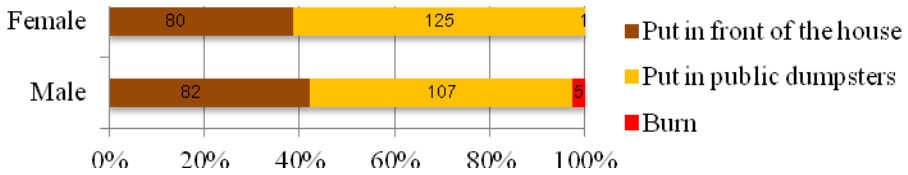

Figure6: Disposal method by gender

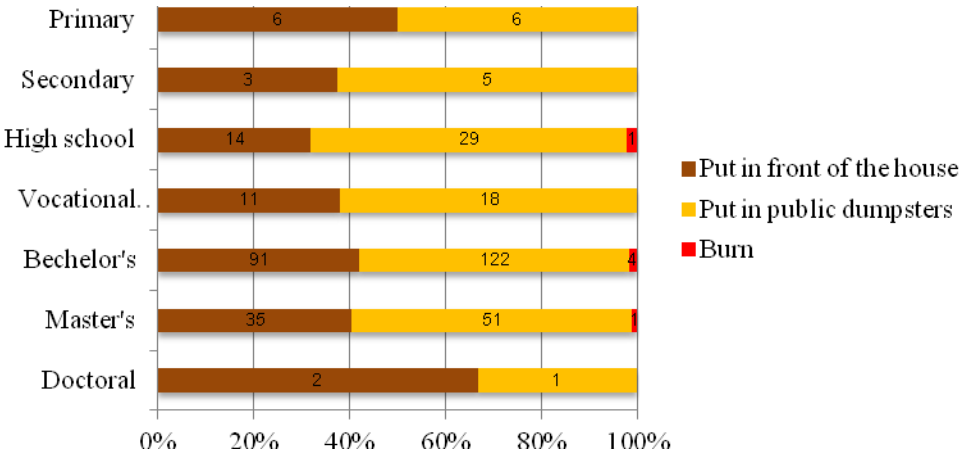

Figure7: Disposal method by education level

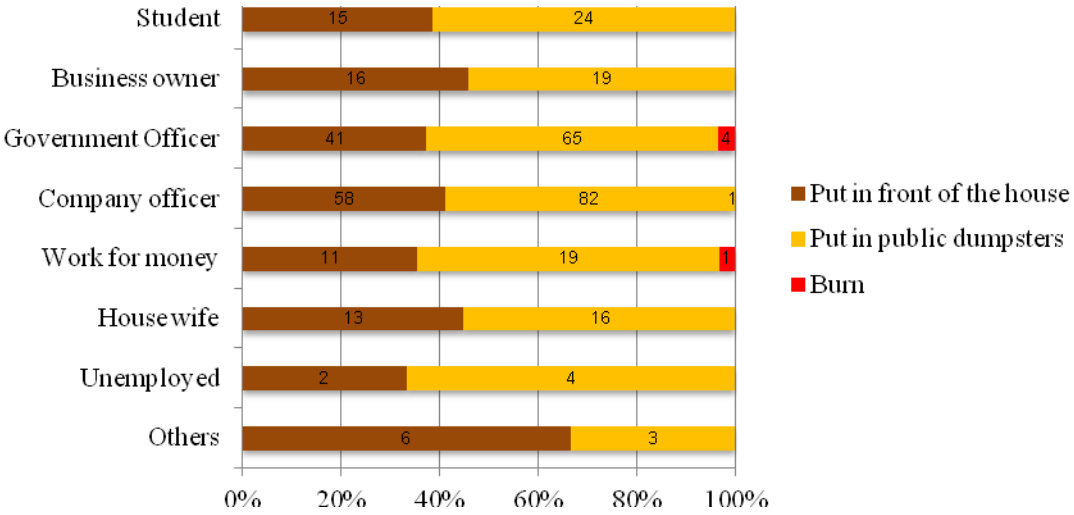

Figure8: Disposal method by occupation

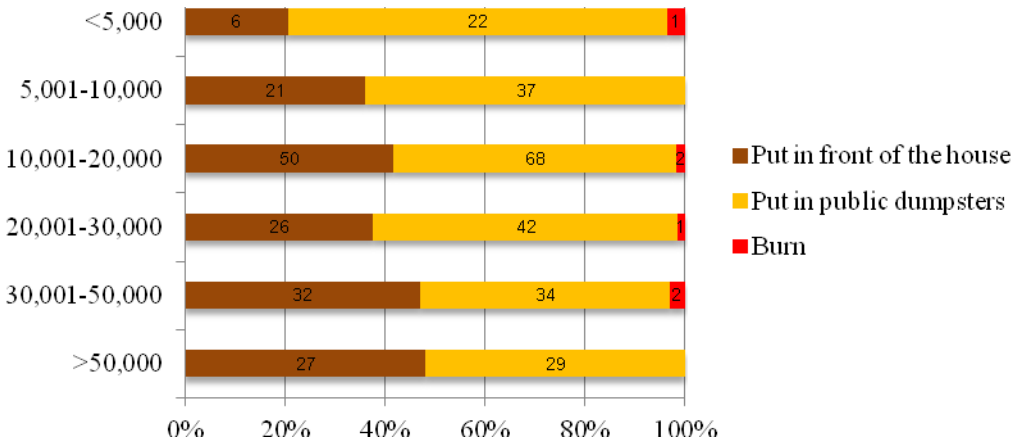

Figure9: Disposal method by monthly income

From the survey, question of household waste disposal methods, 41 percent of the respondents put their waste in front of the house, 58 percent put in public dumpsters, and 1 percent burns their waste.

From all respondents, half of the primary education level respondents manage their waste by putting in front of the house, and the rest put their waste in public dumpsters. Focused mainly on those who burn the waste, there are 6 people who said that waste burning is their management method, 1 female and 5 male. In terms of education, 4 of them hold a bachelor's degree, 1 master's degree, and 1 has high school education level. Among these people, they are government officers, a company officer, and a worker. Interestingly, out of the 6 people, only one person who has monthly income less than 5,000 Baht, the rest earn 10,001 to 50,000 Baht.

3.4.1.2 Household waste disposal frequency

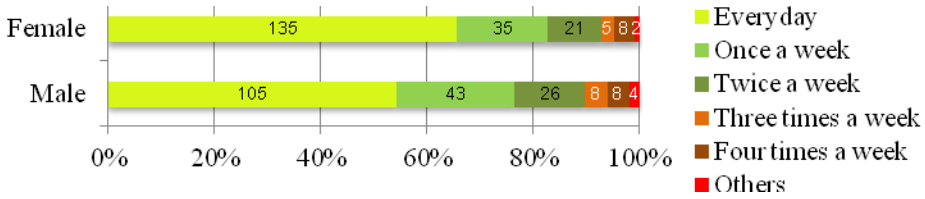

Figure10: Waste disposal frequency by gender

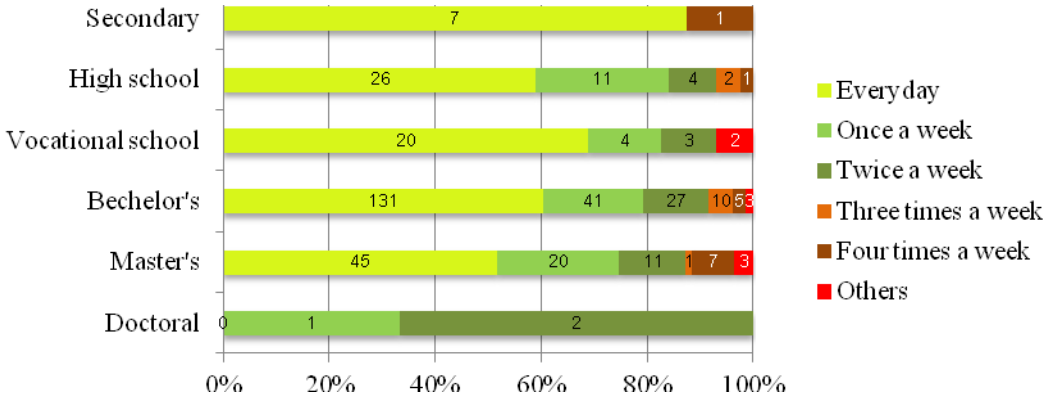

Figure11: Waste disposal frequency by education level

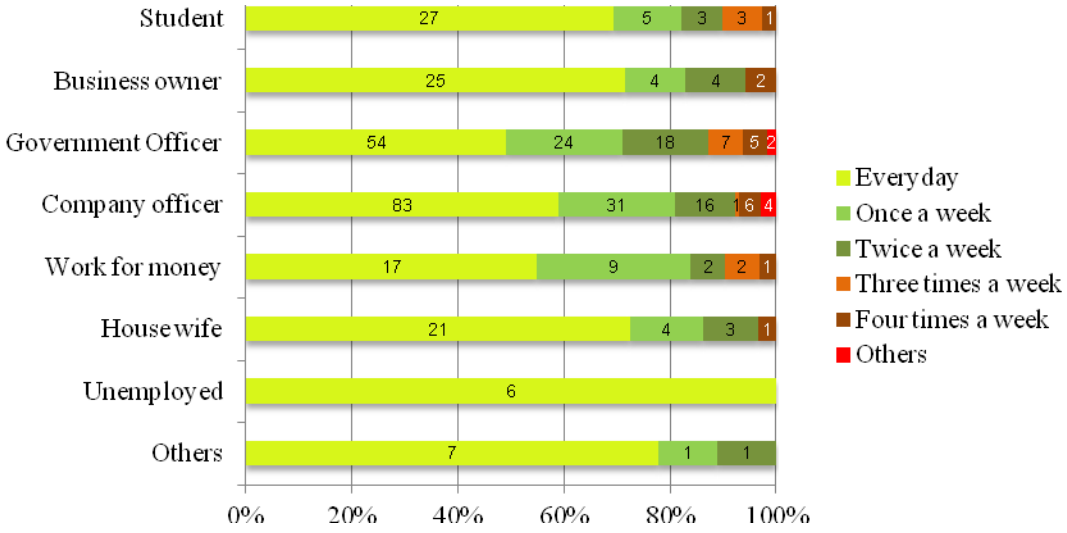

Figure12: Waste disposal frequency by occupation

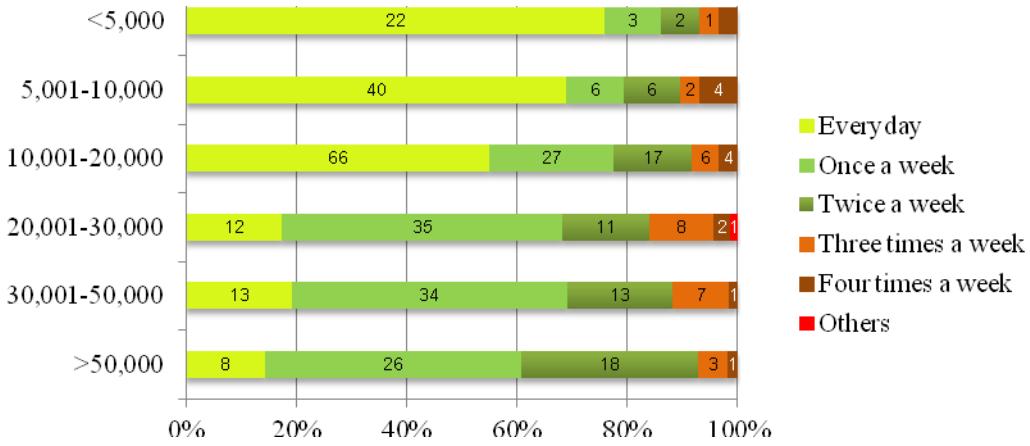

Figure13: Waste disposal frequency by monthly income

From the total 400 samples, 240 respondents (60 percent) dispose of their waste every day. By gender, 66 percent of female and 54 percent of male respondents said that they dispose of household waste every day. For education level and occupation, in the same way as gender, the respondents dispose their waste daily.

However, considering monthly income perspective, most of the respondents who earn 20,001 – 30,000 Baht (51 percent), 30,001 – 50,000 Baht (50 percent), and > 50,000 Baht (46 percent) dispose of their waste once a week.

3.4.1.3 Amount of household waste generated per disposal

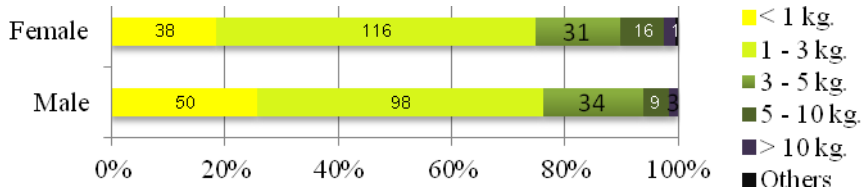

Figure14: Amount of waste generated per disposal by gender

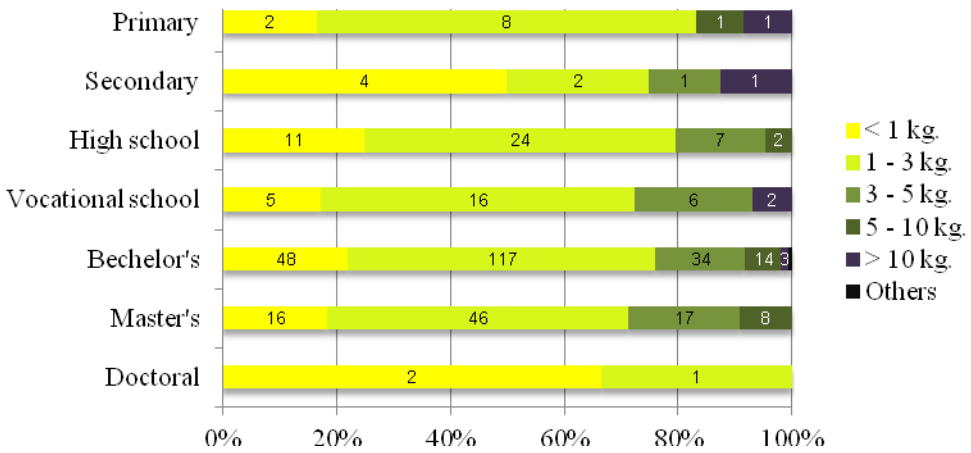

Figure15: Amount of waste generated per disposal by education level

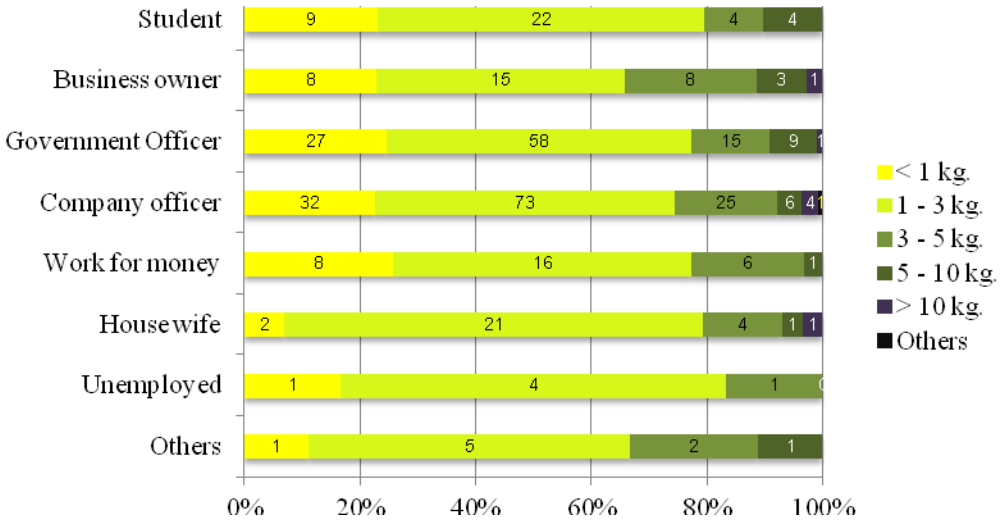

Figure16: Amount of waste generated per disposal by occupation

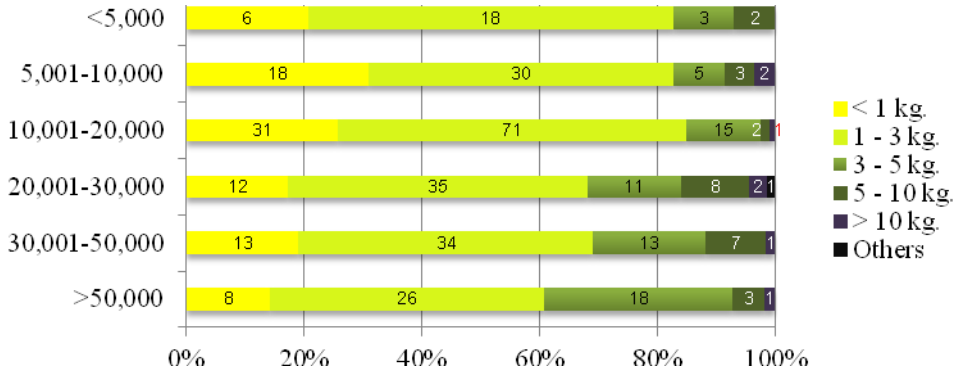

Figure17: Amount of waste generated per disposal by monthly income

On the question of amount of waste generated per disposal, 214 respondents In terms of education level, 50 percent of respondents who had secondary education and 67 percent of those who had doctoral degree generates waste less than 1 kilogram per disposal.

When consider occupation and monthly income, more than half of the respondents dispose about 1 – 3 kilograms of household waste per time.

3.4.1.4 Amount of recyclable waste generated per disposal

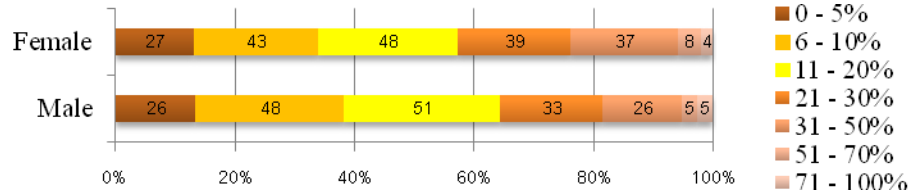

Figure18: Amount of recyclable waste generated per disposal by gender

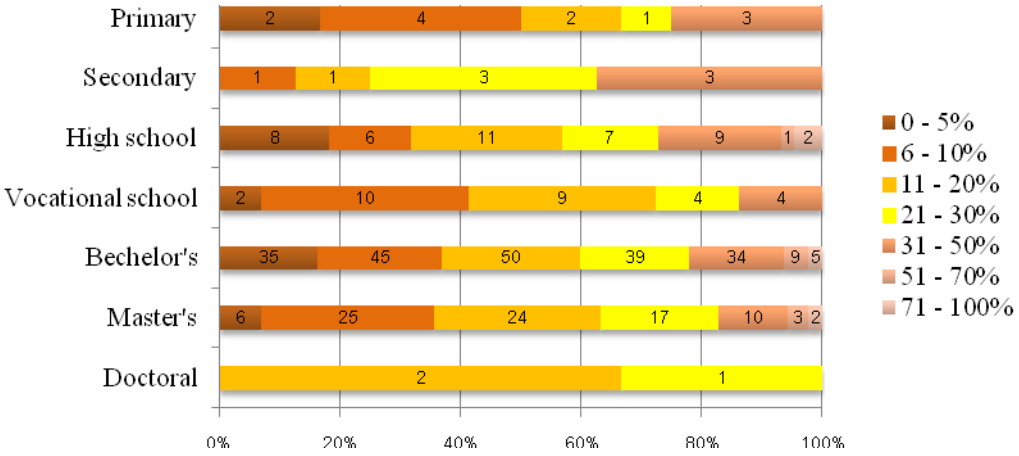

Figure19: Amount of recyclable waste generated per disposal by education level

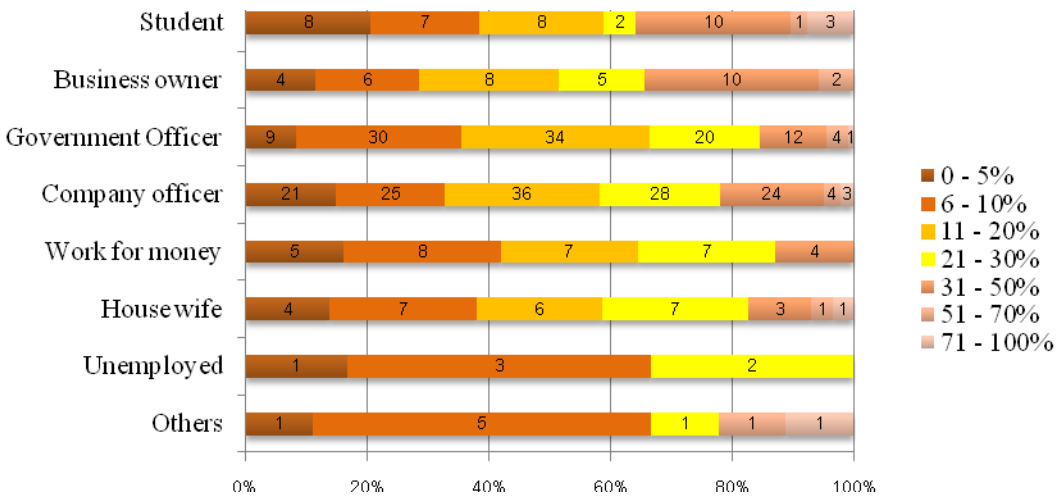

Figure20: Amount of recyclable waste generated per disposal by occupation

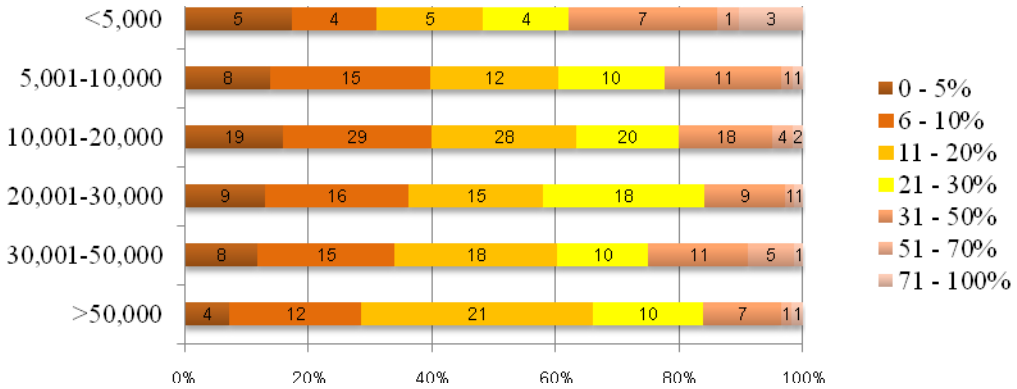

Figure21: Amount of recyclable waste generated per disposal by monthly income

In terms of the amount of recyclable waste generated each time of disposal, it can be categorized into two groups: 6 – 10 percent and 11 – 20 percent of total household waste generated.

3.4.1.5 Types of recyclable waste and amount generated per disposal

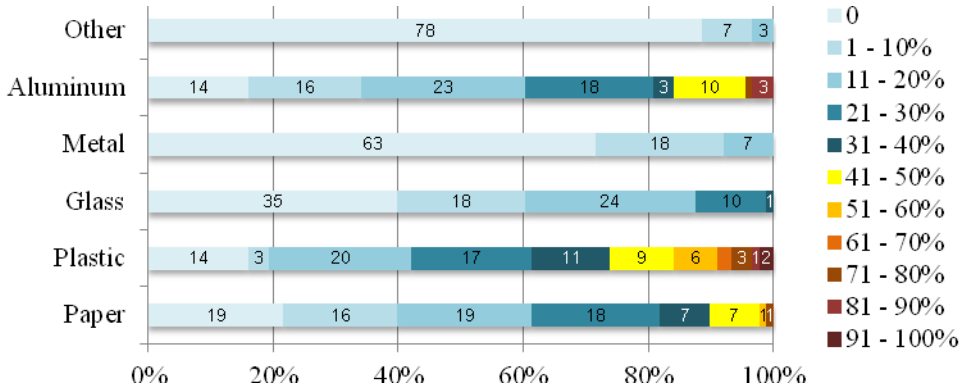

Figure22: Amount and types of recyclable waste generated compared to the amount of total household waste (household waste weight of < 1 kilogram)

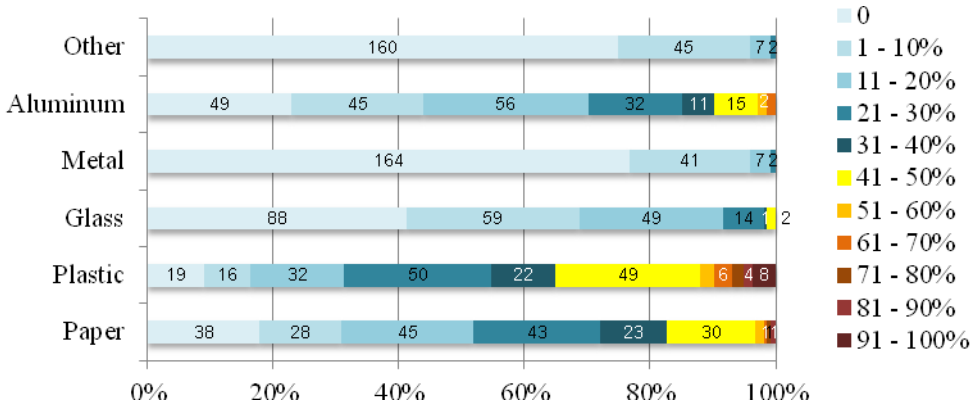

Figure23: Amount and types of recyclable waste generated compared to the amount of total household waste (household waste weight of 1 - 3 kilogram)

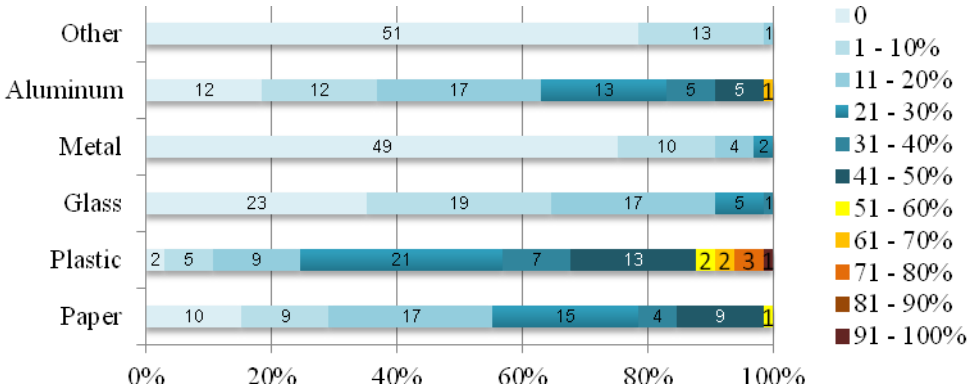

Figure24: Amount and types of recyclable waste generated compared to the amount of total household waste (household waste weight of 3 - 5 kilogram)

Results from SPSS show that from each disposal, the amount of recyclable paper is about 11 – 30 percent; plastic 21 – 30 percent, glass 1 – 20 percent, and aluminum can 11 – 20 percent.

3.4.1.6 Household waste collection service fee

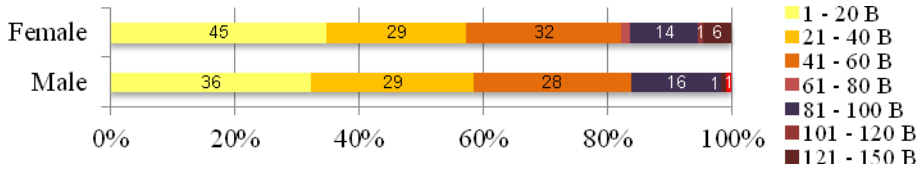

Figure25: Household waste collection service fee by gender

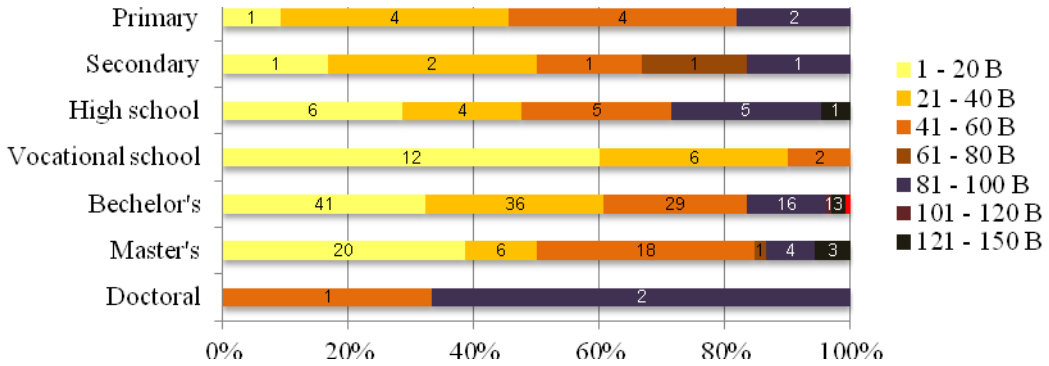

Figure26: Household waste collection service fee by education level

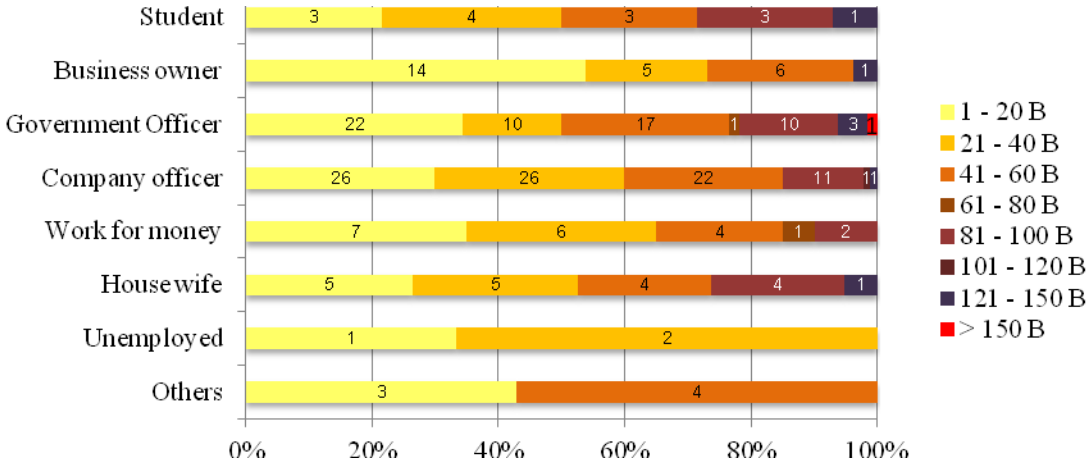

Figure27: Household waste collection service fee by occupation

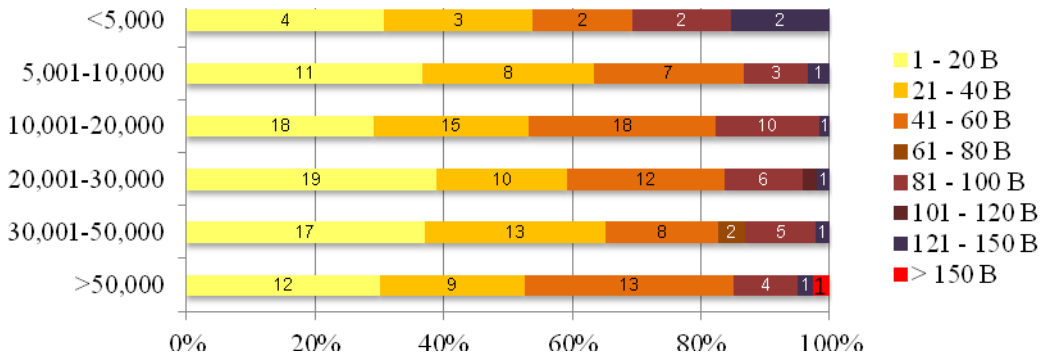

Figure28: Household waste collection service fee by monthly income

From all respondents, the amount that they have to pay for household waste collection service fee is 1 – 20 Baht (34 percent), 21 – 40 Baht (24 percent), 41 – 60 Baht (25 percent), and more than 60 Baht (17 percent). From the results, it can be defined that those who have high level of education and higher monthly income tend to pay more waste collection fee.

3.4.1.7 Sorting recyclable waste experience and disposal method

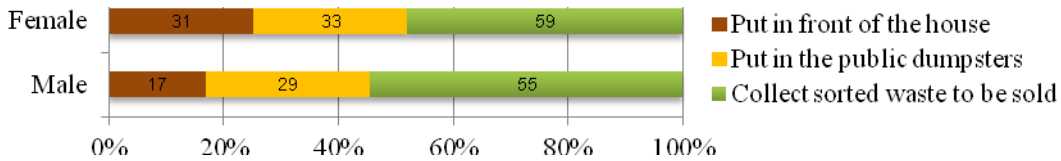

Figure29: Sorted recyclable waste experience and disposal method by gender

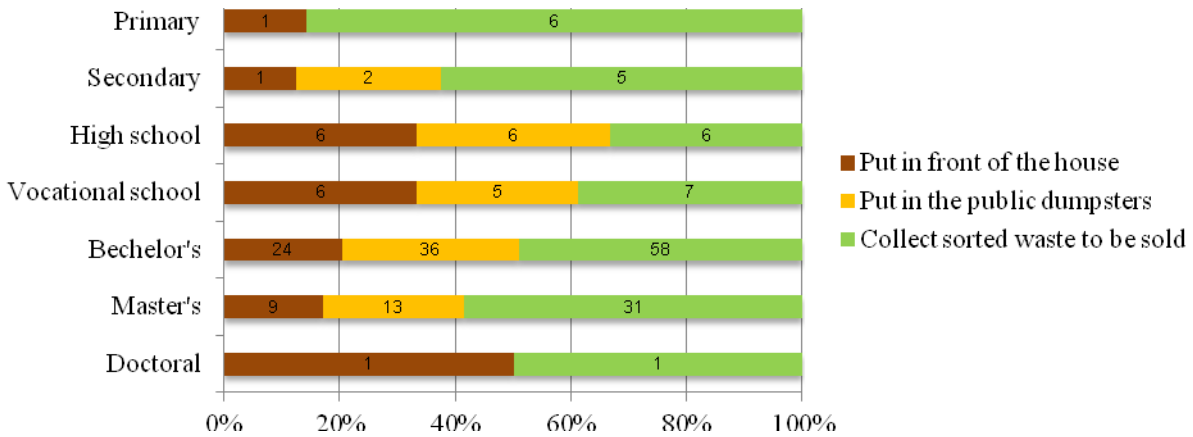

Figure30: Sorting recyclable waste experience and disposal method by education level

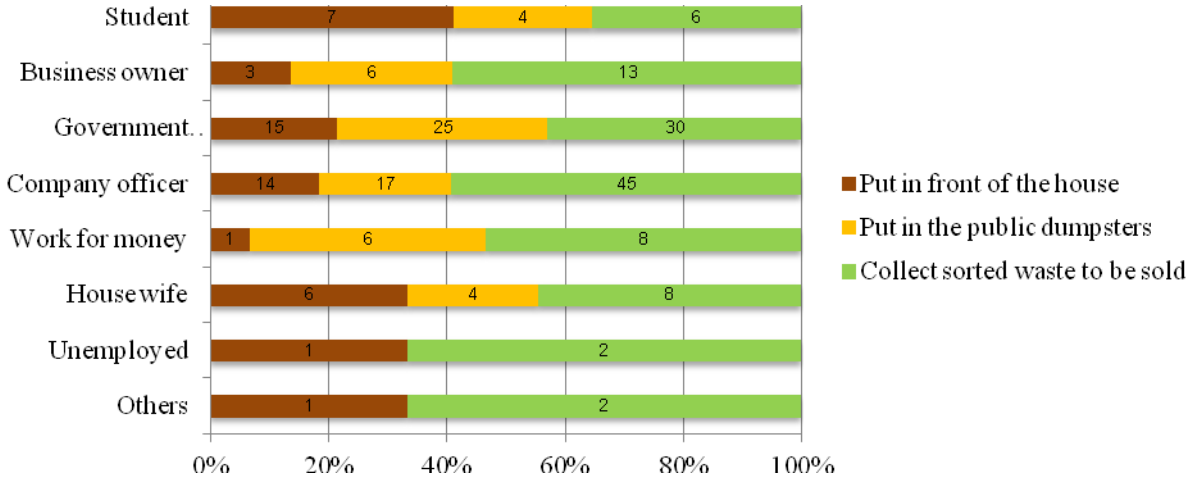

Figure31: Sorting recyclable waste experience and disposal method by occupation

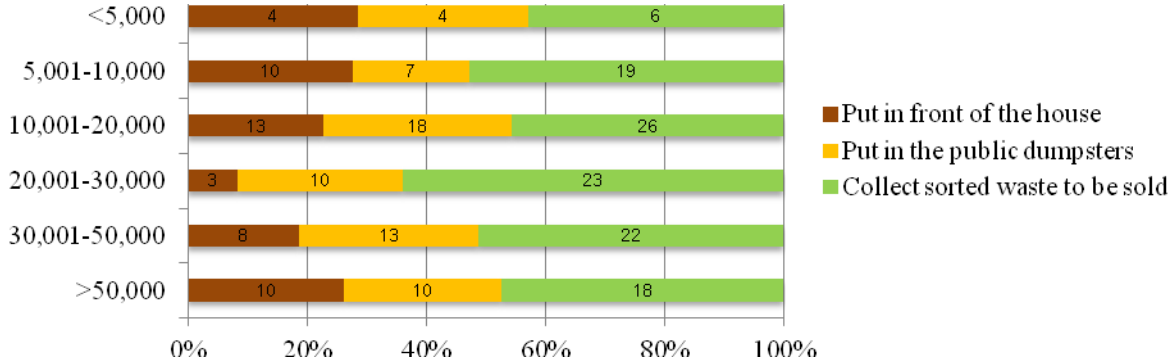

Figure32: Sorting recyclable waste experience and disposal method by monthly income

When asked question about recyclable waste sorting experience and disposal methods, more than half (51 percent) of the respondents who do recyclable waste sorting manage their waste by collect and sell to peddlers. About 28 percent put sorted recyclable waste in public dumpsters, and the rest of the respondents put waste in front of the house.

3.4.2 Household waste recycling program

3.4.2.1 Household waste recycling program experience

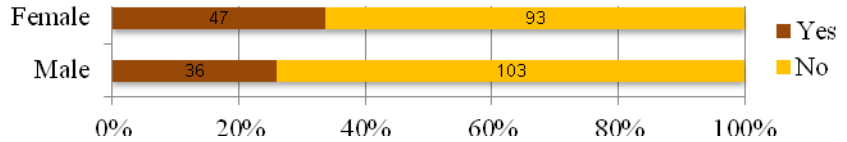

Figure33: Household waste recycling program experience by gender

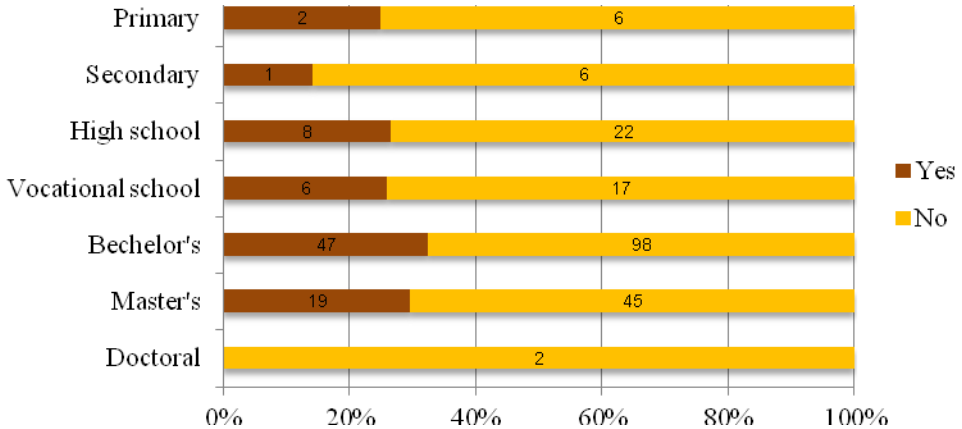

Figure34: Household waste recycling program experience by education level

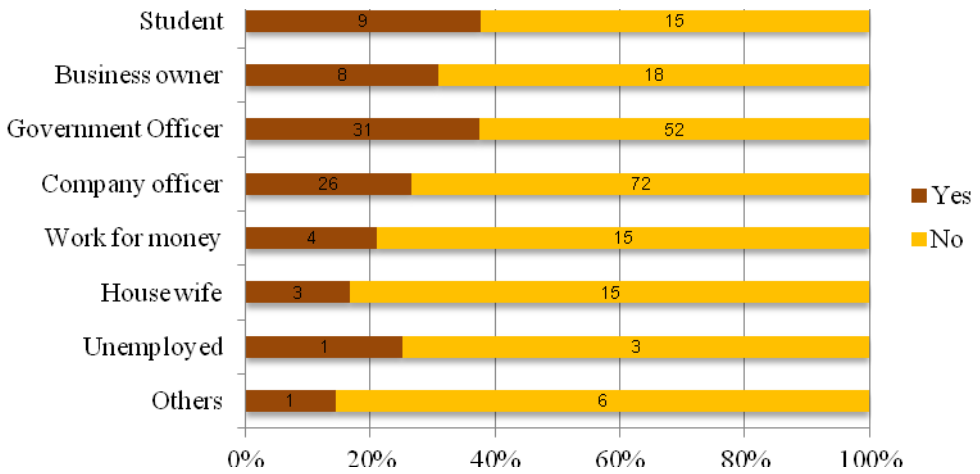

Figure35: Household waste recycling program experience by occupation

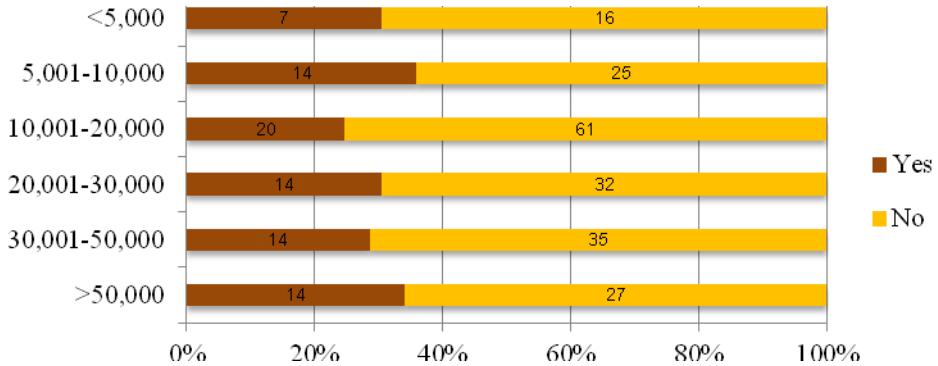

Figure36: Household waste recycling program experience by monthly income

When asked questions about experience in household waste recycling programs, only 83 (30 percent) respondents are members of the programs. When looking into education level, the respondents who earned bachelor's degree have experience about recycling program the most, 47 people (32 percent). In occupation perspective, those who are students, government officer, and private company officers have more experience in household waste recycling program, 38 percent, 37 percent, and 31 percent, respectively.

3.4.3 Incentive-based recycling program

3.4.3.1 Incentive-based household waste recycling program experience

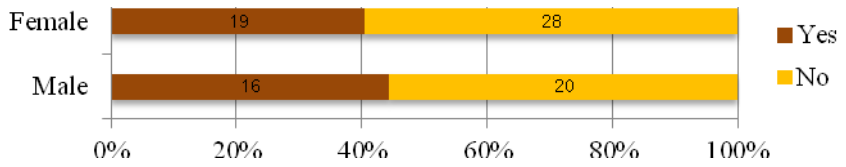

Figure37: Incentive-based recycling program experience by gender

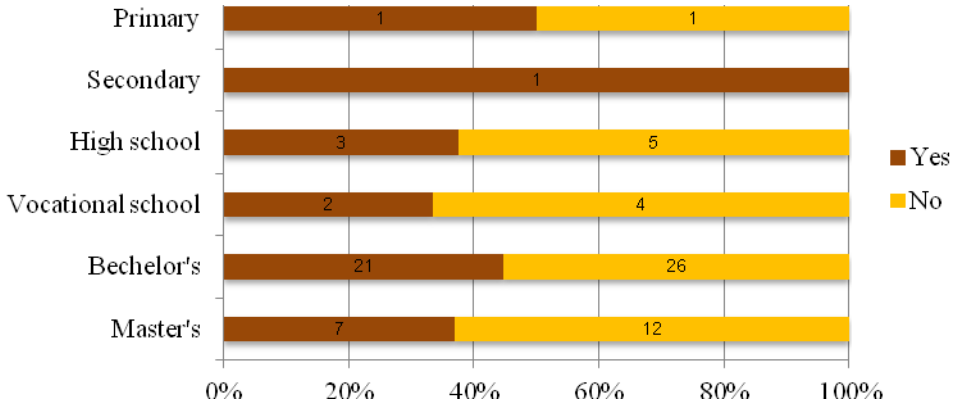

Figure38: Incentive-based recycling program experience by education level

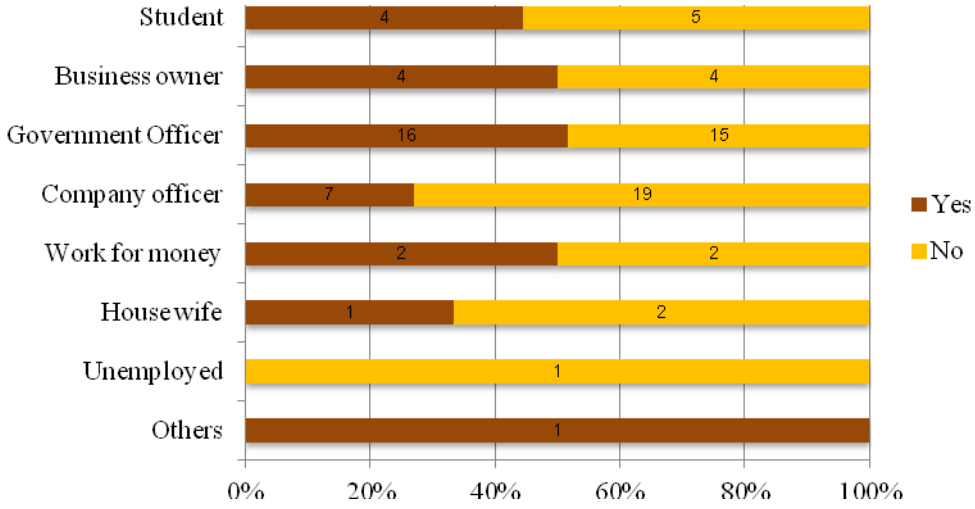

Figure39: Incentive-based recycling program experience by occupation

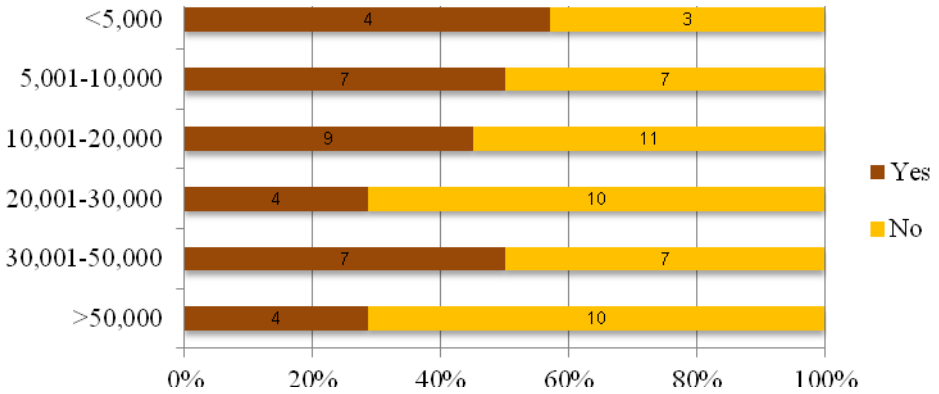

Figure40: Incentive-based recycling program experience by monthly income

When asked of incentive-based recycling program experience, only 35 respondents are member of incentive-based program, of which 21 respondents (60 percent) are bachelor's degree people. From the amount of people who are a program member, the majority of this group of people are government officers (16 people, 46 percent), and private company officers (7 people, 20 percent). When concern monthly income, majority of the experienced respondents earn 10,001 – 20,000 Bath (9 people, 26 percent), 5,001 – 10,000 Baht (7 people, 20 percent), and 30,001 – 50,000 Baht (7 people, 20 percent).

3.4.3.2 Incentives/benefits gained from household waste recycling programs

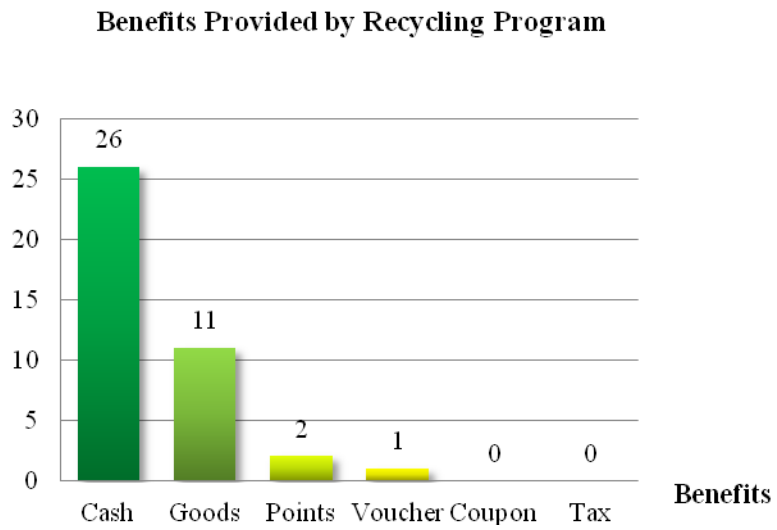

Figure41: Incentives/benefits gained from household waste recycling programs

From 35 respondents who have experience in incentive-based recycling programs, the results show that the programs provide more than one types of incentives. The incentives are cash, goods, points, and vouchers.

3.4.3.3 Know the incentive-based recycling program

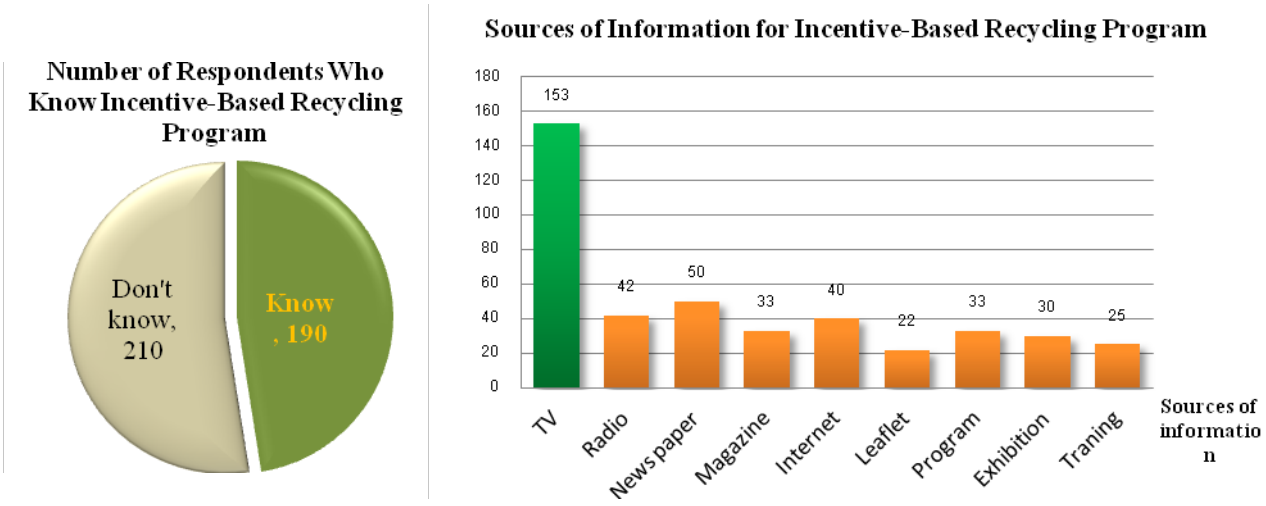

Figure42: Number of respondents who know incentive-based recycling program and sources of program information

Gender	#	%
Female	82	54%
Male	71	46%
Education level		
Bachelor's	83	54%
Master's	26	17%
High school	21	14%
Vocational	15	10%
Occupation		
Company officer	52	34%
Government officer	45	29%
Monthly income		
10,001-20,000	41	27%
20,001-30,000	28	18%
30,000-50,000	28	18%
5,001-10,000	25	16%

Table7: Key figures of number of respondents who know gain information from television

From the total samples, 190 respondents know incentive-based recycling programs. This group of people gains the program information from many sources. People gain information from television the most, follow by newspaper, radio, internet, magazines, recycling programs, exhibitions, training, and leaflets.

3.4.3.4 Number of people who are interested in joining the incentive-based recycling program and types of incentives to be provided by the program

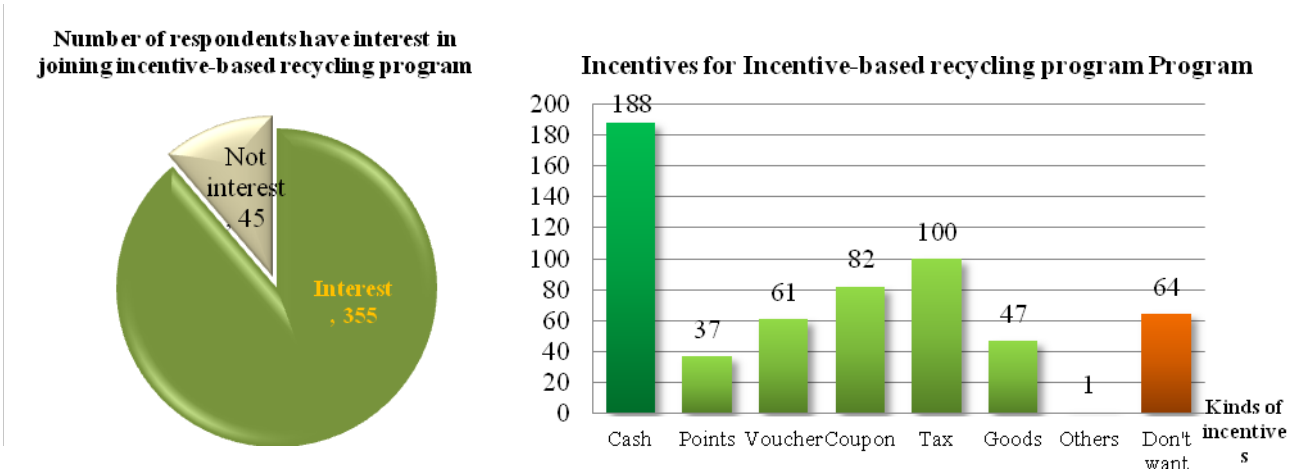

Figure43: Number of respondents who are interested in incentive-based recycling program and types of incentives people want from the program

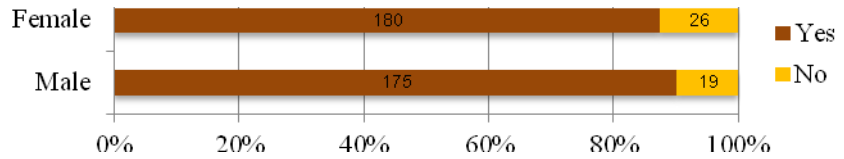

Figure44: Number of respondents who are interested in incentive-based recycling program by gender

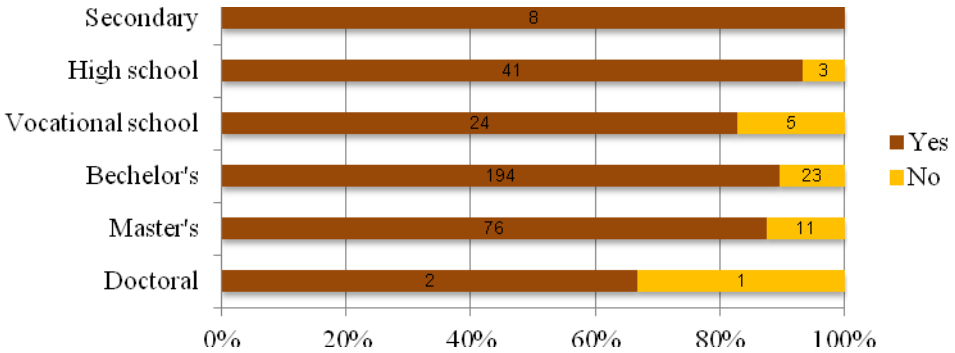

Figure45: Number of respondents who are interested in incentive-based recycling program by education level

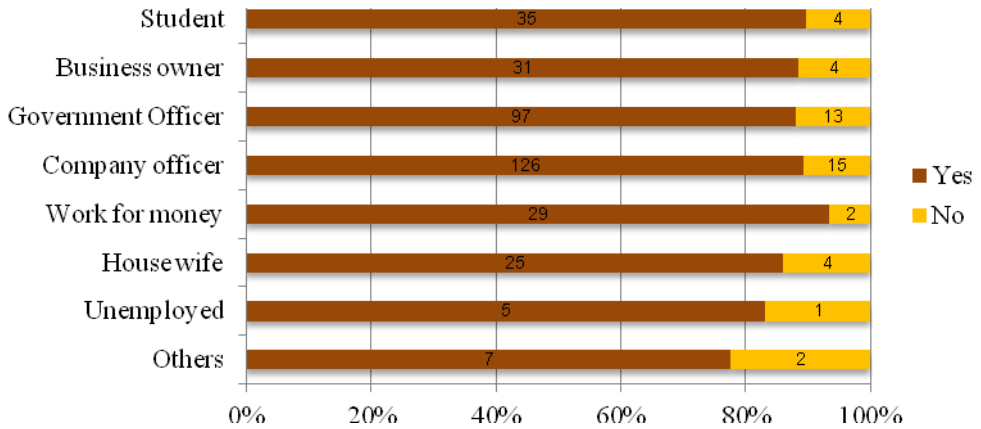

Figure46: Number of respondents who are interested in incentive-based recycling program by occupation level

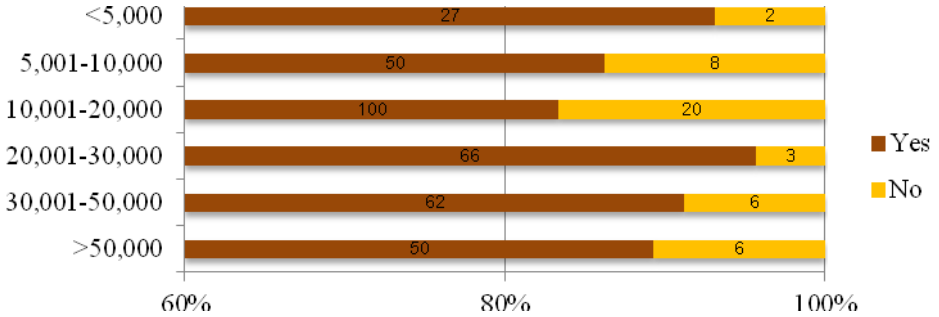

Figure47: Number of respondents who are interested in incentive-based recycling program by monthly income

There are 355 (89 percent) respondents who want to join the incentive-based recycling program. Of this number, they want different kinds of incentives to be provided. The majority wants the incentives to be cash, follow by tax deduction, coupons, vouchers, and points. One person of the respondents wants the incentive to be a kind of donation. Sixty-four respondents do not want any incentives from joining the program.

3.4.3.5 Incentive-based recycling program business partners or organizations to be

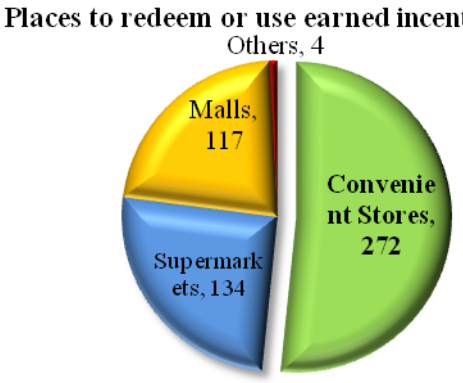

Figure48: Incentive-based recycling program business partners or organizations

When asked about where to redeem or use the incentives, the respondents want to use the incentives at convenient stores, follow by supermarkets, malls. Some respondents defined that they want to use incentives at temples and banks.

3.4.3.6 Additional fee for monthly services provided by the program

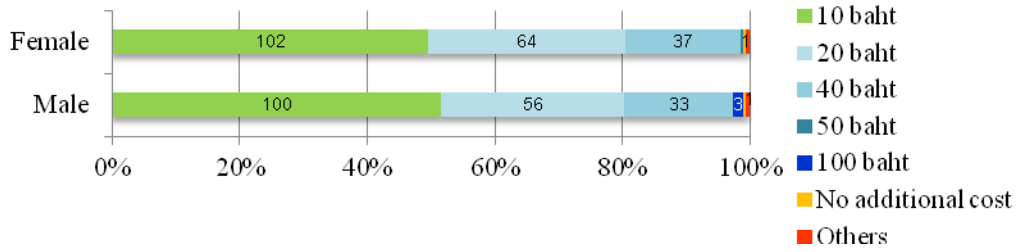

Figure49: Additional fee for monthly services provided by the program by gender

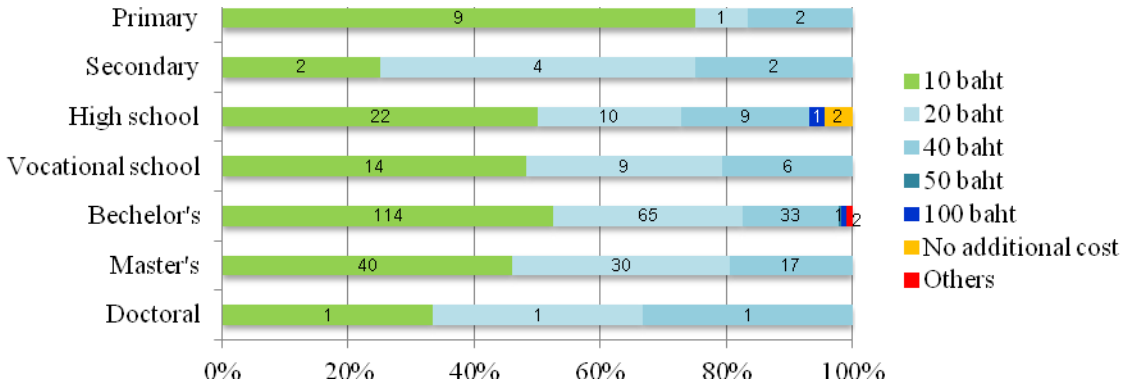

Figure50: Additional fee for monthly services provided by the program by education level

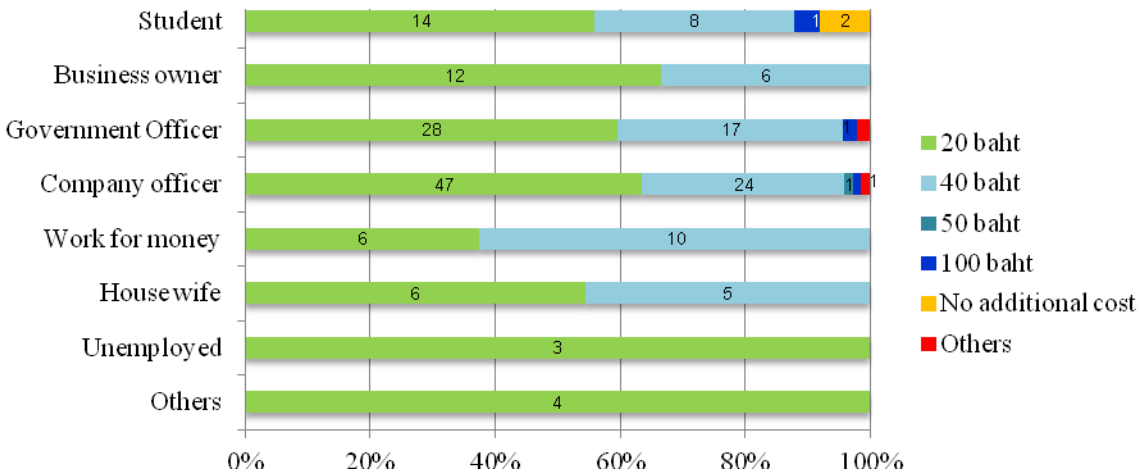

Figure51: Additional fee for monthly services provided by the program by occupation

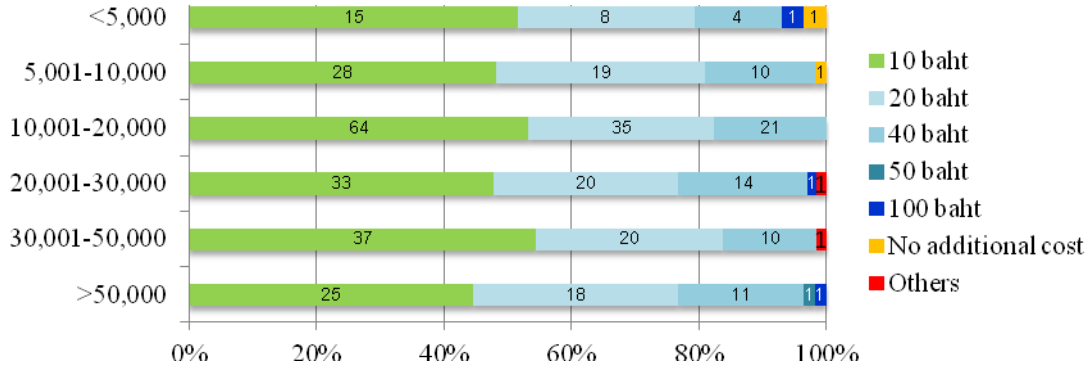

Figure52: Additional fee for monthly services provided by the program by monthly income

In terms of additional fee for monthly waste management services, 202 respondents (51 percent) of the total samples want to pay 10 Baht, 120 respondents (30 percent) of the total samples want to pay 20 Baht. Only 2 respondents do not want to pay additional fee. The results also show that for those people who have jobs and have higher income, they want to pay higher additional fee.

3.4.4 Attitude towards incentive-based recycling programs

3.4.4.1 Concerned factors towards incentive-based recycling programs

Concerned Factors Towards Incentive-Based Recycling Programs	Not important		Not quite important		Important		Quite Important		Most Important	
	#	%	#	%	#	%	#	%	#	%
Complexity of sorting waste	55	14%	68	17%	143	**36%**	61	15%	73	18%
Time to do waste sorting	68	17%	71	18%	128	**32%**	69	17%	64	16%
Insufficient trash bins	33	8%	53	13%	101	**25%**	89	**22%**	124	**31%**
Possibility of program implementation	22	6%	66	17%	119	**30%**	101	**25%**	92	**23%**
Worthwhile of incentives	65	16%	73	18%	121	**30%**	71	18%	70	18%

Table8: Concerned factors towards incentive-based recycling programs

When asked question of factors that affect the decision of joining the incentive-based recycling program, the respondents think that sufficient trash bins should be available in relation to types of recyclable waste. Another important concern is possibility of the program implementation. Complexity of sorting waste, time to sort, and worthwhile of incentives do not affect their decision of joining the program.

3.4.4.2 Opinions towards the incentive-based recycling program

Opinion Towards Incentive-Based Recycling Programs	Totally Disagree		Disagree		Okay		Agree		Totally Agree	
	#	%	#	%	#	%	#	%	#	%
Members will get incentives/benefits from the program	33	8%	32	8%	104	**26%**	94	**24%**	137	**34%**
The program can reduce amount of household waste generation	5	1%	4	1%	47	12%	93	**23%**	250	**63%**
The program can increase the efficiency of waste management system	3	1%	7	2%	44	11%	97	**24%**	249	**62%**
The program can alleviate waste management problems in long-term	3	1%	5	1%	75	19%	84	**21%**	232	**58%**
The program can be implemented in other communities/cities in Thailand	9	2%	17	4%	65	16%	103	**26%**	206	**52%**

Table9: Opinions towards the incentive-based recycling program

In terms of opinions of the respondents towards incentive-based recycling program, more than half of the respondents agree that being part of the program will get benefits; the program can reduce amount of household waste generation; the program will increase efficiency of waste management system; the program can improve household waste management in long-term; and the program can be applied to implement in other areas in Thailand. To focus specifically on amount of waste generation, 250 (63 percent) respondents totally agree that the program will reduce amount of waste; and 249 (62 percent) respondents totally agree that there will be more efficiency in the waste management system.

In conclusion, the results received in the survey were based upon data provided mainly by the second group sample. The number of returns from doing the survey allows a good general overview of the current waste situation in Bangkok and also trends of household waste recycling programs.

Results from the first group of sample are:

- People have waste sorting experience at school or home
- They perceive that waste is valuable
- They perceive that sorting waste is a way to reduce waste generation
- They think that everyone should be responsible for reducing household waste generation
- Almost 90 percent of this group interests in participating the incentive-based recycling program

Results received from the second group of sample are:

- Only about half of the people pay waste management service fee
- Only about half of the people sort recyclable waste at home
- People know about waste sorting and recycling
- From household waste disposal per time, there is a considering amount of recyclable waste
- Only about 30 percent of the total samples have experience in recycling program
- Almost 90 percent of the people want to join incentive-based recycling programs
- People are willing to pay additional waste management fee if the intensive-based program is executed

- Concerns of the program are a sufficient amount of trash bins and possibility of the program implementation
- People think positively towards the incentive-based recycling program, as it will benefit program members, reduce amount of waste generation, increase the efficiency of solid waste management system, alleviate waste related concerns in long-term, and can applied in other cities.

Finally, the objectives of this research are answered by the results got from the SPSS analysis, which are explained in the table below.

Objectives	Survey Results
To appraise the response of Bangkok residents towards the incentive-based recycling program to reduce waste generation.	The residents have positive responses to the incentive-based recycling program - They want to participate in the program - They think that the program can reduce household waste generation
To study the possibility of implementing Bangkok Recycling Program in a sustainable way in the Bangkok Metropolitan Area.	The results give a positive answer to this objective in terms of public participation. And the respondents also think that the program will increase efficiency of solid waste management system.
To study whether Bangkok Recycling Program is able to alleviate solid waste issues in Bangkok and helps the City meets the triple bottom line	The results show that there is a substantial amount of recyclable waste to feed into the program. - Waste generation will decrease - More recyclable materials to be recycled - Use less virgin materials - Less energy used and less pollution emitted Eventually, the program is socially, economically, and environmentally beneficial to the City.

Table10: Correlation between research objectives and survey results

4. BANGKOK RECYCLING PROGRAM

BENEFITS AND CONCERNS

4.1 Benefits from Bangkok Recycling Program

The recycling trend is offering immense potential to enhance resource management and reduce waste disposal pressures. Benefits of recycling are found at every stage of the life cycle of a consumer product, from extracting of raw materials through use, and final disposal. Additionally, higher efficiency in recycling that comes with technological improvements has made recycling a progressively more popular alternative to waste disposal. Many government agencies, businesses, organizations, communities, and households also institute recycling programs.

According to the survey, the respondents know that recycling plays an important role in managing household waste. They realize that recycling is not just a waste management strategy. On the contrary, recycling cover a broad range of benefits that lead to sustainable waste management, including environmental, social, and economic benefits.

4.1.1 Environmental benefits

Prolongs the lifespan of landfills

Recycling diverts a considerable amount of waste away from landfills, thus landfills have more space for other kinds of waste. This can partly solve a problem of scarce land areas or finding areas to construct new landfills.

Reduces pollution released to the atmosphere and water

- Recycling reduces amount of methane by diverting organic wastes from landfills, thereby reducing the methane released when these materials decompose.
- Recycling reduces emissions from incinerators: it allows some materials to be diverted from incinerators.
- Recycling reduces emissions from energy consumption: manufacturing goods from recycled materials typically requires less energy than producing goods from virgin materials, which require energy to extract, process, transport, and manufacture products. When energy demand decreases, fewer fossil fuels are burned and less carbon dioxide is emitted to the atmosphere.
- Recycling reduces possibility of dangerous substances coming from the solid waste deposited in landfills, which contaminate underground water supply.
- Recycling gives a net reduction of 8 major categories of water pollutants being release to water resources (Recycling for the next generation, 03/26/12).
- Recycling prevents pollution by increasing the potential amount of carbon that is absorbed by trees. Recycling of paper products reduces the number of trees that are cut down. With more trees standing, more carbon is absorbed from the air.

<u>Slows down natural resource depletion</u>

- Recycling conserves natural resources for the next generations, for example every ton of paper that is recycled saves 17 trees; or every single aluminum can saves 6 ounces of gasoline (A recycling revolution 03/25/12)
- Recycling saves energy: energy savings from using recycled material as supply in manufacturing process require less fossil fuel compare to using virgin materials
- Recycling reduces ecosystem impacts as a whole; ecosystems provide support for

human wellbeing that is mostly not counted in current prices for materials and services.

- By supplying industry with recycled materials, recycling also preserves biodiversity by slowing the destruction of forests, wetlands, rivers and other places essential to wildlife. As well, other detrimental impacts that have happened, such as soil erosion associated with logging and mining are lessened.

4.1.2 Social benefits

Creates jobs

Recycling creates jobs in the full spectrum of the labor market from low and semi-skilled jobs to highly skilled jobs

Creates higher living standards

Higher income from selling recyclable materials can contribute to raising living standards of the communities

Health

Recycling reduces health risks resulting from virgin material production. Many pollutants released by the extraction and processing of raw materials are known to be carcinogenic (Recycling for the future, 03/25/12).

Build community

In almost all communities, there is a growing concern for recycling and the environment. People are working together in recycling programs, lobbies, and free recycle organizations

Recognition

Many communities have recognition and awards programs for communities, groups, or companies that recycle to an amount of recyclable waste. Recycling is part of Corporate Social Responsibility (CSR) that improves public image, reach new markets, and improve employee morale

4.1.3 Economic benefits

Financial income

- Recycling generates more income to communities for their recyclable materials
- Recycling can be a significant sector of the national economy
- Recycling creates new businesses that haul, process and broker recovered materials, as well as companies that manufacture and distribute products made with these recycled materials

Energy savings

- Recycling can translate into a huge reduction in our energy costs. The steps in supplying recycled materials to industry, including collection, processing and transportation, typically use less energy than the steps in supplying virgin materials to industry, including extraction, refining, and transportation

Tax credits

- The government offers tax credits for companies or manufacturing businesses that use recycled materials

Waste disposal costs

- Reducing waste stream through recycling leads to lower waste removal costs

- Recycling programs can give recyclers avoid waste collection and disposal costs that is expected to rise over time

4.2 Concerns and implications

Environmental degradation has occurred, resulting in rising amount of waste generated and a rise in cost of operating solid waste management system. To have a sustainable incentive-based recycling program, based on the primary and secondary study of this research, there are 5 concerns that have to be stressed.

4.2.1 Financial support

There is lack of financial support from the government to run the recycling program at local level, leads to inefficient waste management system. In terms of Bangkok Recycling Program, the BMA should:

- Transparently allocate funds that cover the costs of waste collection, transportation, disposal, and other services to the responsible parties
- Compensate and subsidize to the people who suffered either from health, social, or environmental impacts

4.2.2 Laws and regulations

Current laws and regulations do not enforce measures on waste separation. There is lack of capacity to enforce laws for the entire system of solid waste management. However, there are laws that allow the opportunity for local authorities to issue regulations in the form of municipal laws. They do not cover activities relating to waste management and recycling. Thus, there should be:

- An amendment of outdated laws, to effectively enforce on any violations relating to municipal solid waste
- A law that concerns on pollution (odor, leachate, noise) from recycling shops or stations
- A law that concerns packaging and containers so as to tell manufacturers and vendors responsible for containers' deposit.
- A coordinated approach to the enforcement of laws and standards among regulatory agencies, to avoid duplication, overlapping, and inconsistency in government policy regarding waste management

4.2.3 Data, information, knowledge

Lack of information is the main problem that hinders waste recycling. Data on waste generation, collection, and disposal is not collected in the same standard. In addition to that there is no accurate data for recycling programs and recycling shops. Thus, related stakeholders should collaborate and create a recycling association to:

- Promote the establishment of a waste managing technology development information center to serve as an agency responsible for disseminating and exchanging technical information, recycling technology, waste generation, and recycled waste quantity.
- Promote research on household waste management and recycling technology to urge and motivate relating agencies to develop environmental friendly technologies on waste recycling industry.

- Create collaboration in promoting household waste management and recycling knowledge by encouraging collaboration among the public and private sectors, and educational institutions, which can lead to a systematic cooperative network.

4.2.4 Expertise and technology

Currently, in Thailand there is lack of expert agencies that provide services on discarded material component or qualification analysis, which can provide guidance on how waste can be recycled. There also have been only some amount of research on waste recycling carried out within the country due to lack of monetary support, modern technology, researchers, and technical personnel, and research and developmental institutions. Therefore,

- The government should allocate funds for waste recycling technology development including vehicles, equipment, and other needed materials, particularly for small and medium scale projects.
- The government should support and promote research to develop and improve recycling technologies.

4.2.5 Consumers

Public awareness of natural resources and environmental issues was very low until 1995. Afterwards, it is fast increasing due to an improved basic education, more grassroots movements, and a comprehensive coverage provided in the news by the media. However, in terms of waste reduction at source, there is lack of continual campaigns and

economic mechanisms to encourage the people to separate to separate wastes (Barr, 2002; McDougall, Forbes R., and Peter R. White, 2001). The related parties should:

- Carry out continual campaigns for recycling technologies
- Create a campaign to encourage people to reduce, reuse, recycle, and segregate waste
- Create tangible awareness among consumers through education; such as include curriculum on environmental friendly consumer behaviors into programs at schools and educational institutions
- Use incentives to motivate people to recycle waste and use more products that made from recycled materials.

4.3 Concerns on the Bangkok Recycling Program from the respondents

Other than factors on the questionnaire, the respondents also stressed one important concern which is very important to consider if the BRP is going to be implemented. The comment was that human health and hygiene is one of the success factors of the program. The BMA and responsible parties should ensure that they will provide a clean waste collection and collect waste according to the service schedules. Because there is a chance that people would contact the sorted waste and get infected, or waste is a source of diseases that might be spread by vectors like insects or rodents.

To emphasize more on this concern, there is evidence from the Environmental Health Division, the Health Department, the BMA and 50 district offices. These institutions collected data about complaints concerning environmental health nuisance throughout Bangkok. The result showed that 31 percent or 1,242 complaints of total

response agreed that solid waste and its offensive odor was one of the major causes of nuisance.

5. CONCLUSION

Environmental impacts have been considered by many people to be the world's most serious issue. Human-induced activities, caused by urbanization, industrialization, and a growing population, have worsened the environmental condition which may reach a threshold in the near future. The world is running out of natural resources. Fortunately, private and public sectors have devoted more attention to solving this problem by finding alternative sources of energy, substitute materials, and using recycled products.

One of the best ways to extend the lives of natural resources is recycling. Recycling is a highly effective strategy; not only does it reduce the amount of virgin materials in production, but it also reduces waste generation, health risks, and pollution. In developing countries, where waste is a serious concern, opportunities for recycling that have not yet been used are substantial. In a big city like Bangkok, for example, there is a considerable amount of recyclable waste dumped into landfills. Adding an innovative incentive-based recycling program to the municipal waste management system is a potential way to solve a high level of waste generation and to draw communities to participate in the program. The results from surveys show that the respondents want to participate in incentive-based recycling programs. Communities have awareness of waste impacts on the environment and think that waste reduction at source is a way to reduce household waste generation. If the program is executed, there will be a substantial amount of recyclables fed into the recycling market, which in turn will provide benefits to all of the stakeholders in the recycling chain.

Nonetheless, sustainable waste recycling is an activity that needs to be carried out tangibly and continually. Community willingness to join is an essential factor; however, to achieve a successful recycling program, the government needs to provide support, especially in tools, equipment, information, and technologies. Besides, supporting laws and regulations are needed to promote recycling activities as well as a change of people's attitudes towards recycled products and environmental friendly products.

In summary, environmental impacts and sustainable development in developing countries are vital issues that should be emphasized. Finding solutions to tackle the ever-increasing generation of MSW is a must. Bangkok's Recycling Program is a solution that well suits the characteristics of the residents and the City of Bangkok.

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6. RECOMMENDATION FOR FUTURE RESEARCH

This study is a very good starting point for future research into an incentive-based recycling program. More surveys can be sent out to increase the number of respondents in the database to increase the accuracy of the information. Benchmarking against successful programs in other cities would also be helpful. It gives a better understanding of what has or has not worked in other places. Moreover, to accomplish a successful sustainable incentive-based recycling program, a feasibility study of the program is needed. This should take the form of a comprehensive study that contains marketing analysis and financial analysis to see how the program would benefit the members, the city, and the environment.

APPENDIX

Questionnaire: First Group Sample (Children)

Household Waste Sorting and Interest in Participation for Incentive Based Recycling Program

This questionnaire is part of ENVS 669 – 660: MES Capstone Seminar of Ms. Pitchayanin Sukholthaman ID: 47798910, a graduate student in the Master of Environmental Studies Program at the University of Pennsylvania.

The student is collecting information for doing project about study the feasibility and trend of waste sorting for the incentive based household waste recycling program in urban cities of developing countries. The main objectives of this questionnaire are: to assess citizens' behaviors and attitudes towards waste sorting, recycling, and incentive based recycling programs. All collected data will be kept confidential and will use only for this project. Thank you for your cooperation and sacrifice.

Please check ✓ on the box that you prefer or agree

Part 1: General information of respondents

1. Sex
   - ☐ Male
   - ☐ Female

Part 2: Waste sorting and waste management at schools

2. Types of waste that you usually see at school (More than 1 answer is possible)
   - ☐ Paper
   - ☐ Water bottle
   - ☐ Milk carton
   - ☐ Beverage can
3. Some types of waste are valuable and can be recycled
   - ☐ Yes
   - ☐ No
4. Your school has waste sorting programs
   - ☐ Yes
   - ☐ No (go to question7)
5. You get incentives from the program
   - ☐ Yes
   - ☐ No

6. The incentives that you get from the program are (more than 1 answer is possible)
   - ☐ Cash
   - ☐ Points
   - ☐ Contest for rewards
   - ☐ Certificate

Part 3: Waste sorting at home and interest in participation for incentive based recycling program

7. You or your family sorts recyclable waste before disposal
   - ☐ Yes
   - ☐ No
8. Sorting waste is a way that reduces household waste
   - ☐ Yes
   - ☐ No
9. Who should be part of reducing household waste? (more than 1 answer is possible)
   - ☐ Waste pickup companies/waste pickers
   - ☐ Parents/guardian
   - ☐ Yourself
   - ☐ Everyone
10. If there is an incentive based household waste recycling program, would you like to participate?
    - ☐ Yes
    - ☐ No

Questionnaire: Second Group Sample (Adult)

Household Waste Sorting and Interest in Participation for Incentive Based Recycling Program

This questionnaire is part of ENVS 669 – 660: MES Capstone Seminar of Ms. Pitchayanin Sukholthaman ID: 47798910, a graduate student in the Master of Environmental Studies Program at the University of Pennsylvania.

The student is collecting information for doing project about study the feasibility and trend of waste sorting for the incentive based household waste recycling program in urban cities of developing countries. The main objectives of this questionnaire are: to assess citizens' behaviors and attitudes towards waste sorting, recycling, and incentive based recycling programs. All collected data will be kept confidential and will use only for this project. Thank you for your cooperation and sacrifice.

Please check ✓ on the box that you prefer or agree

Part 1: General information of respondents

1. Sex

☐ Male ☐ Female

2. Age

☐ 16 -18 years old ☐ 19 - 25 years old ☐ 26 - 30 years old
☐ 31 - 35 years old ☐ 36 - 40 years old ☐ 41 - 45 years old
☐ 46 - 50 years old ☐ 51 - 55 years old ☐ 56 - 60 years old
☐ > 60 years old

3. Education

☐ Primary School ☐ Secondary School ☐ High School
☐ Vocational School ☐ Bachelor's degree ☐ Master's degree
☐ Doctoral degree

4. Occupation

☐ Student ☐ Business owner ☐ Government officerl/State enterprise
☐ Company officer ☐ Work for money ☐ Housewife
☐ Retired ☐ Unemployed
☐ Others (Please specify) _____

5. Monthly income

☐ < 5,000 baht ☐ 5,001 - 10,000 baht ☐ 10,001 -20,000 baht
☐ 20,001 – 30,000 baht ☐ 30,001 – 50,000 baht ☐ > 50,000 baht

6. How many people live in your house? _____ persons,
Member(s) whose age less than 16 years old _____ persons

Part 2: Waste sorting and waste recycling programs

7. How do you dispose of waste at home?
☐ Put garbage bags in front of the house, to be collected
☐ Put garbage bags at a community dumpster, to be collected
☐ Burn
☐ Throw into a river/a canal/roadside
☐ Others (Please specify) _____

8. How often do you dispose of waste per week?
☐ Everyday ☐ Twice a week ☐ Three times a week
☐ Four times a week ☐ Five times a week ☐ Others (Please specify) _____

9. How much waste is generated each time of disposal? **Approximate volume**
☐ < 1 kilogram ☐ 1 - 3 kilogram ☐ 3 - 5 kilogram
☐ 5 - 10 kilogram ☐ > 10 kilogram ☐ Others (Please specify) _____

10. For each time that you dispose of waste, how much recyclable waste is generated?
Approximate volume _____ percent

11. From the amount of recyclable waste generated in question 10, please put an **approximate volume** of each type of recyclable waste in the table below

Please put an approximate amount of each type recyclable waste	%
a) Paper	
b) Plastic	
c) Glass	
d) Metal	
e) Beverage/food can	
f) Others	
	100

12. Do you have to pay for waste collection?
☐ Yes, _____ baht per month ☐ No

13. Do you sort recyclable waste before disposal or not?
☐ Yes ☐ No *(go to question 15)*

14. How do you do with sorted recyclable waste?
☐ Put garbage bags in front of the house, to be collected
☐ Put garbage bags at a community dumpster, to be collected
☐ Keep the waste to sell to waste buyers
☐ Others (Please specify) _____

15. Do you know any waste recycling programs?
☐ Yes ☐ No *(go to part 3)*

16. Have you ever participated any waste recycling programs?
☐ Yes ☐ No *(go to part 3)*

17. Have you ever received any incentives from participating in the recycling program?
☐ Yes ☐ No *(go to part 3)*

18. What are the incentives that you received from participating in the recycling program? (More than 1 answer is possible)
☐ Cash ☐ Points ☐ Vouchers
☐ Discount coupons ☐ Tax deduction ☐ Goods
☐ Others (Please specify) _____

Part 3: Interest in participating in the incentive based recycling program

19. Do you know any incentive based recycling program or not?
☐ Yes ☐ No *(go to question 21)*

20. How do you know the program? (More than 1 answer is possible)
☐ Television ☐ Radio ☐ Newspaper
☐ Magazine ☐ Internet ☐ Leaflet
☐ Poster ☐ Exhibition/Conference ☐ Training
☐ Others (Please specify) _____

21. If there is an incentive based recycling program, would you like to participate?
☐ Yes ☐ No

22. If there is an incentive based recycling program, which incentives you think the program should reward? (More than 1 answer is possible)
☐ Cash ☐ Points ☐ Vouchers
☐ Discount coupons ☐ Tax deduction ☐ Goods
☐ Others (Please specify) _____

23. If there is an incentive based recycling program, which businesses/organizations you think the program should partner with? (More than 1 answer is possible)
☐ Convenient stores ☐ Supermarkets ☐ Department stores
☐ Charity organizations ☐ Others (Please specify) _____

24. If there is an incentive based recycling program, how much extra would you like to pay on your monthly waste collection bill?

☐ 20 baht ☐ 40 baht ☐ Not willing to pay extra

☐ Others (Please specify) _____

25. For each factor, how does it make you interest or not interest in the program?

(1-Most important, 5-Least important)	Importance				
	1	2	3	4	5
Sorting waste is complicated					
Do not have time to sort waste					
Do not have bins for each type of recyclable waste					
Concern about reliability of the program					
Concern about worthiness of incentives					
Others (Please specify) _____					

26. Do you agree with the following sentences or not?

(1-Completely agree, 5-Absolutely disagree)	Agreeableness				
	1	2	3	4	5
Members of the BRP will get benefits from joining the program					
The BRP can reduce amount of household waste generation					
The BRP can increase the efficiency of waste management system					
The BRP can alleviate waste management problems in long-term					
The BRP can be implemented in other communities/cities in Thailand					
Others (Please specify) _____					

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