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Source Separation Scheme in Three Thai Cities

Comparison of achievements

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Abstract

Conventional MSWM in the Southern urban cities is gradually moving upward the hierarchy of solid waste management as their disposal capacity diminishes and it becomes dauntingly difficult to locate new disposal site. In Thailand, many municipalities have initiated a source separation scheme as part of their waste management strategy to promote waste reduction. However, the success of the intervention depends on various factors, some internal and others external. This study has compared the schemes in three Thai municipalities, Chiang Mai City Municipality (CMCM), Phitsanulok City Municipality (PCM), and Rayong City Municipality (RCM) to understand the drivers and barriers in the promotion of source separation. It further examines the municipal solid waste systems - and the source separation campaigns in the three cases and evaluates the program outcomes in terms of waste to ladfill and level of household participation in source separation in both traditional (customary) and organized modes. The results show the obvious roles of (a) external aid from waste policy specialists, (b) visible infrastructure provided to support material separated, and (c) the level of cooperation between the public and private recycling sector in the source separation program. The case where these elements are present, such as RCM, tends to perform better, gaining more cooperation from households. However, some challenges remain including discovering waste technology that is more appropriate but less cost-intensive, dealing with household hazardous waste separation, and overcoming Thai unconsolidated socio-political environment.

Executive Summary

Along with the world's rapidly spreading consumerism, municipal solid waste (MSW) is one of the major environmental issues restraining the mission toward sustainable development in both developed and less developed countries. In addition, in the less developed countries, waste collection is not effective and disposal methods such as landfills are not done in the appropriate way which subsequently gives negative effects to the environment and human health. The situation is caused by, among other things, national economic constraints, the lack of technological know-how, and the lack of environmental awareness among citizens and authorities. Under such circumstances, the need to plan and implement the MSWM in a more favourable way has begun to come to the light. This is no exception in the case of many cities in Thailand.

One of the popular MSWM policies in the municipalities is to carry out waste reduction schemes to reduce the amount of waste going to municipal landfills. Reuse and recycling seems to be the most preferable methods when considering waste composition and financial difficulty because energy recovery methods, e.g. incineration have high cost of operation and maintenance.

Recently several programs and projects have been drawn toward 'people-centred approaches'. They aim to promote behaviour change among households to separate the reusable and the recyclables at source – known as source separation. Yet, the policy effectiveness diverges from case to case. Thus, this research intends to discover underlying factors explaining the diversity by comparing source separation programs in 3 different municipalities – Chiang Mai City, Phitsanulok City and Rayong City.

MSWM systems in the three cities are different both in terms of the infrastructure and arrangements. Chiang Mai City Municipality (CMCM) collecting waste everyday and all is transferred to municipal landfill. However the effectiveness of the collection is know to be very poor. At the moment more than 70% of the collection and treatment tasks are taken over by a private waste management company. On the other hand, Phitsanulok City Municipality (PCM) has systematic waste collection. Householders are to bring the garbage bins outside their house at specific time and day. The waste collected will be pre-treated using mechanical-biological technology before going through the process of compacting and disposing in sanitary landfill. Their waste management system is assisted by German Technical Cooperation Agency (GTZ). Rayong City Municipality (RCM) also has systematic waste collection; organic wastes are collected everyday and every other day for rest wastes. Whole organic waste sorted by household will be fed to the composting plant and rest waste will end up at the disposal destination. The composting plant is the pilot project, which the system from source separating point had been assisted by Development for Environment and Energy Foundation – an NGO.

In all three cases, source separation campaigns are parts of their MSWM systems. The municipality is responsible in communicating with the community and raising awareness among household by giving information and education about source separation. In the case of Phitsanulok City, the municipality has given the management of source separation activities to the community and only assists when needed, in other words, implementing communitybased solid waste management. Mostly the campaigns are focused on recyclable materials since it is easier to start persuading from wastes that have economic value; organic waste and hazardous waste are also encouraged to be separated. Private recycling business sector is an important partner who picks up the recyclable materials from the campaign to process into the secondary materials. Regarding organic waste, the municipalities launch composting campaigns, though at different scales. CMCM and PCM have home composting campaigns, while RCM builds and operates composting plant for electricity project with a support of the Ministry of Energy. Household hazardous waste campaigns are running by drop-off system.

The outcome of source separation can be, first, measured by the reduction of waste to landfill. When comparing waste reduction from 1994-2004, amount of waste to landfill in the case of Chiang Mai City had increased, while the other two cases show declining trends. Especially in the case of Phitsanulok City, the quantity of waste had dropped sharply in 1996 and stayed quite stable which may imply that the present source separation was acting in its full extent under the limit of current situation.

Secondly, and probably more importantly, the programs result can be assess by knowing how much households are practicing source separation. From the survey, this study finds RCM is more successful in encouraging households to participate in its source separation programs, following by PCM and CMCM.

The result can by explained by the fact that the municipality with better supporting infrastructure tends to receive cooperation from householders than ones without. The case in point is the composting plant for electricity in Rayong. The absence of organic waste infrastructure might explain lower rates of organic waste separation in Phitsanulok and Chiang Mai, although PCM is still in a better position as it can cope with the fraction by central sorting and MBT to an extent.

The analysis may also suggest that in the case of Thailand, external expertise from professional organizations, such as GTZ in the case of PCM and the Ministry of Energy and Development of Energy and Environment Foundation (DEE) in the case of RCM, might be important to 'exemplify' the policy which eventually will result in positive behaviour change. CMCM is the only case without such an external support. CMCM's program was started by giving education, launching promotion through several awareness raising campaigns and media channels. Yet the waste management mechanism to comply with the program is not available. This, perhaps, pushes pressure on individuals to make sacrifices for the environment in terms of time and effort, whilst the apparent action from the municipality who is responsible for waste matter is not shown. Thus it is essential for the municipality to be able to present the waste management ability before the program promotion. The other issue is about the socio-political environment of the country which is still quite elite-oriented and the position of civil society is not clearly presented, so probably it is more of the challenge to expect active participation in waste management from grassroot level e.g. community-based waste management in Phitsanulok City. Achievement of environmental policy in Thailand still heavily relies on the decision makers or mayors in this case. The devotion to improve waste situation is out-standing from Rayong and Phitsanulok City Municipality's mayors, partly can be seen from the decision to call for external help to improve the entire waste management system.

Regarding external factors that influences source separation behaviour in Chiang Mai, Phitsanulik and Rayong, the data confirm the role of habit, gender, and space in households. Though these elements are not opened to direct intervention, they might be useful when seeking target group to implement further source separation programs.

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1 Introduction

1.1 Background and Problem Statement

Along with the world's rapidly spreading consumerism, municipal solid waste (MSW) is one of the major environmental issues restraining mission toward sustainable development in both developed and less developed countries. In dealing with the problem, concept of the 'waste hierarchy' as shown in figure 1-1 has been widely recognized and adopted by policy makers. The more environmentally preferable waste handling is on the higher rank of the pyramid.

While the municipal solid waste management (MSWM) in the northern cities are engaging themselves more and more toward the upper part of the waste hierarchy, MSWM in the southern cities are still dangling around disposal method at the bottom of the pyramid. In fact, there is apparent evidence that, in the less developed countries, waste collection is not effective and a disposal method such as landfill are not done in the appropriate way which subsequently gives negative effects to the environment and human health. (UNEP 2008) The situation is caused by, among other things, national economic constraint, the lack of technological know-how, and the lack of environmental awareness among citizens and authorities. What seems to frequently happen afterward is the difficulty to find new vacant space for waste disposal due to the objection from community residing near by the intended site (NIMBY Syndrome). Under such circumstance, the need to plan and implement the MSWM in more favourable way has begun to come to the light. This is no exception in the case of many cities in Thailand.



Figure 1-1 Hierarchy of Solid Waste Management Source: (C&D Equipment 2008)

Thailand's solid waste legislation is mainly based on the Public Health Act (revised in 1992) which aims to promote sanitation and disposal of solid waste in the country. (Muttamara *et al.* 2004) The responsibility to run regulation improvement, project consideration, and consultancy from the central government side relies on Pollution Control Department and

the Department of Environmental Quality Promotion under Ministry of Natural Resources and Environment. (Muttamara *et al.* 2004) The municipalities are the significant agencies that come up with local waste management plans and policies which pursue central framework, and implement those plans and policy to the accomplishment.

The mainstream MSWM policy among policy makers in the municipalities is to carry out waste reduction scheme to lessen waste going to municipal landfill. Reuse and recycling seems to be the most preferable methods when considering waste composition and financial difficulty because energy recovery methods, e.g. incineration have high cost of operation and maintenance.

The recycling concept is nothing new to Thai society as it has been introduced since the early 1990s. As well, the 3R –reduce-reuse-recycle- has been the core principle for the governmental authorities to promote several waste reduction campaigns. Recently several programs and projects have also been drawn toward 'people centred approaches' promoting behaviour change among households to separate the reusable and the recyclables at source – known as source separation. Yet, the policy effectiveness diverges from case to case among municipalities. Thus, this research intends to discover underlying factors explaining such diversity conducting comparative study among 3 different City Municipalities – Chiang Mai City, Phitsanulok City and Rayong City – focusing on source separation program in particular. (Fig 1-2)



Figure 1-2 Part of map of Thailand with star marks pointing out the three selected cities for this research which are Chiang Mai in the north, Phitsanulok in the lower north, and Rayong in the east. Source: Google maps 2008

1.2 Research Objectives

The objectives of this research are:

- To understand MSWM situation in selected cases
- To understand roles of responsible authorities and other sectors in waste reduction scheme, especially source separation for recycling campaigns.
- To evaluate effectiveness of the implemented policies so far.
- To analyze the possible factors that influences the policy outcome.

Expected result from this research is to make some feedbacks and recommendations to both the municipalities, and the central government.

1.3 Hypothesis and Research Questions

The brief hypothesis is that different municipal source separation program can give impact on household behaviour differently. Furthermore, it is also presumed that the whole MSWM as a mechanism supporting separation at source is highly crucial to give positive policy/program feedback from citizens.

Therefore the main research question is:

Why does source separation succeed or fail in Thai municipalities?

The main question is followed by sub-questions, they are;

1) How have the municipalities tried to promote source separation activity?;

2) What are the outcome of the implemented programs (household behaviour and waste amount reduced)?;

- 3) How do the three cases differ from one another?
- 4) What caused such results?, and;
- 5) What would help facilitate the program to a more successful path?

1.4 Scope

At the outset, the analytical unit is a *city* more specifically, a City Municipality. Within that spatial scope, the research is going to focus on the selected *municipalities' source separation program* of solid waste from the *household* sector, whilst including the entire solid waste management system into consideration as well. The analytical time frame is the period between 1994 and 2008, except for the case of Rayong City Municipality

The term 'source separation' in this place means the activity where household residents set aside material for further recovery both by the municipality and private recycling sector. The terms 'separation at source' or 'household recycling' also infer the same concept in this place. As well, 'recycling system' in the municipality covers source separation activity. This research concerns certain household items and materials that are separated frequently, they are: newspaper, magazines, scrap paper, boxboard, food and drink can and containers, used clothes, old batteries, light bulbs, and organic/food waste. These materials are sometimes called 'wastes' in the text, yet it has to be noted that not all the primary consumers who separate the materials regard them as wastes. (Lardinois and Furdy 2007)

Besides, the informal recycling sector in this study signifies only non-governmental recycling system which includes, namely, waste pickers, scavengers, itinerant buyers, junk shop, including related industries. Thus sorting recyclable and organic material on the garbage truck, which is informally done by municipal collectors, is excluded from the concept.

Lastly, the '4Es' model adopted from Defra (2007) and part of external factors that influence the propensity to separate at source collected by Furedy and Lardinois (2007) are the basic organizational framework of this study, as shown in Fig. 1-3. These theories are to be described in Chapter 2 and applied in Chapter 6.



Figure 1-3 Research conceptual framework and methodology (in grey ovals) Source: own figure

1.5 Research Methodology

This study follows a multiple-case-study design. According to Yin (2004) it is appropriate for analyzing a success and a failure. The three cases are chosen due to the highly different images of their solid waste situation. Chiang Mai City is known as the city that has always been facing hideous solid waste problem. On the other hand, Phitsanulok City and Rayong City have quite fine MSWM reputation as they are the good example of local initiative in this field.

Hence it is believed that comparison analysis derived from these three cases will lead to fine answers to the research questions.

Besides, good case studies are usually benefited from having multiple sources of evidences. Other than relevant empirical literature review, other original data collections were also carried out. (also see Fig. 1-3) Questionnaire-based surveys were used to elicit information from more than 1,200 households in the 3 cities. The size of the sample was determined by using Taro Yamane's table, (Appendix 1) which decided that at least 400 samples were needed for each city. Questionnaires, available in appendices, are tailored to be applicable to each selected case's source separation program, particularly in the parts about municipal campaigns. They were distributed by using door-stepping method in April 2008, during the day time (10.00 - 15.00) and small period after evening rush hours (17.00-18.00). The effort to collect samples covering the entire vicinity is assured by the use of city maps. The sampling method was the combination of systematic sampling and quota methods.

There were several answered questionnaires that could not be used. Chiang Mai Cities has 25 invalid forms from 450 forms so 425 were valid. Rayong City has374 remained practical with 36 invalids out of 410 forms. And for the case of Phitsanulok City, in total of 420 forms there were 8 forms found invalid thus 412 forms were appropriate.

Also, before the actual questionnaire survey, 30 sets of the form were handed out in order to find any possible defects in the form as well as to test whether people comprehend the questions correctly.

In addition, key informant interviews were done with 5 senior officers from responsible divisions in the three municipal authorities, 2 officers from Chiang Mai City Municipality, 1 officer from Phitsanulok City Municipality, and 2 officers from Rayong City Municipality. Interviews for related stakeholders such as private recycling company and academic institutions are also conducted, namely Urban Development Institute Foundation, Social Research Institution, and Wongpanit Group. The interview questions are available in (Appendix 2)

The data from household surveys was analyzed using Microsoft Excel to determine grouping of result in percentage, and, where possible, Pearson's Chi-square statistic method in the statistical package for social sciences (SPSS) to find whether the relations among variables are statistically significant to support some qualitative analysis derived from literature review and interviews.

1.6 Scope Limitations

Firstly, the case studies might not be applicable to every municipality in Thailand. They are selected by the reason that the MSW situations and the management are rather extreme.

Secondly, the sampling methodology was not done perfectly due to time and human resource shortage. Hence it cannot be said that these data are representing behaviour of the whole population. Thus, this somewhat certainly affects the data analysis and its liability as well.

The matter of temporal aspect which is only up to April 2008 can be an obstacle to generalize the analysis of Rayong City's case, since the opening of petroleum factory is planned to be in the end of 2008 which will later affect the MSWM situation in the city. In other words, the

analysis of Rayong City's case would not be suitable after the operation of the petroleum factory.

Besides, there was the difficulty in accessing some confidential information as well as some data which is unfortunately not updated.

The last concern is the issue of translation. Most of the secondary data and literatures about the cases are translated from Thai language. Thus, it would be complicated for the non-Thai readers who are interested to explore further according to research references.

1.7 Chapters Introduction

The outline of the paper is as followed:

Chapter 2: Source Separation Scheme – the Theories

Theoretical discussion and empirical studies relating source separation especially its definition and factors which influence household behaviour in the separation at source program in the past are illustrated in this section. Some common Thai-styled source separation campaigns are also mentioned to give general image of waste reduction activities in the country.

Chapter 3: Case of Chiang Mai City

This section includes introduction to Chiang Mai City and its waste situation by far, following by the municipal waste management system with a fairly emphasis on source separation programs by the municipality. The outcome of the implemented source separation is described at the end of the section.

Chapter 4: Case of Phitsanulok City

This section describes the case of Phitsanulok City in the same contents as that of chapter 3.

Chapter 5: Case of Rayong City

This section also describes the case of Rayong City in the same contents as that of chapter 3.

Chapter 6: Analysis and Discussion

Source separation programs' effectiveness from the three cities are compared and translated. Their circumstances considered to affect the outcome according to '4Es' model and the list of external factors are also demonstrated in comparison, and later analyzed. The analysis is finally discussed in the broader scope.

Chapter 7: Recommendations and Conclusion

Points drawn from chapter 6 lead to recommendations to the municipalities. All important lessons learnt from this study are concluded. And there are some future research recommendations at the section ending.

2 Source Separation Scheme: the Theories

2.1 Definition

Adapted from Lardinois and Furedy (2007, 21) and US EPA (1995 in Manomaivibool 2005, 9) the most favourable definition for the term 'source separation' or 'separation at source' in this place is "the practice of setting aside post-consumer materials and household goods at point of generation so that they do not enter mixed waste streams The purposes of separation are recycling, reuse or improved waste management."

Materials that are usually kept aside from mixed waste are:

- Reusable items
- Materials which are usually regarded by the primary consumer as 'waste'
- Organic matter, and
- Toxic and hazardous wastes that are dangerous in the disposal mixed waste.

Examples of reusable items are such as old clothes, furniture and appliances. Newspaper, glass/plastic bottles, boxboard, or drink cans are those categorized in the second group which are considered as waste according to the first consumption. The organic matters are those of food wastes, yard waste or other organic residue. Lastly, hazardous wastes that are normally found in household are biomedical items, pressurized cans, batteries and light bulb.

2.2 Why should separating be done at source?

Manomaivibool (2005) stated the necessity of 'waste separation' for all waste treatment schemes and is suitable for certain material types "Separation of paper, plastic, glass and metals from other wastes and each other is a must for recycling. Incineration also needs pre-treatment and pre-sorting to be able to unleash its energy recoverability with minimum negative impacts. Biological treatment of mixed MSW is only a smelling volume reduction." (Manomaivibool 2005, 9)

Waste can be separated after the mix as proved by the materials recovery facilities or MRFs which is the main method of 'central' sorting conduct by municipalities. The question is why shifting burden to the waste origin?

According to Lardinois and Furedy (2007), intervention to improve source separation results in many benefits. Firstly it reduces amount of waste to be collected and disposed of, leading to the improvement of MSWM at collection and disposal stage. Secondly, source separation improves the quality of materials for reuse or recycling since they are rather clean and hence reduce the cost of recycling process. Thirdly, it counts for efficient treatment and reuse of organic refuse which are frequently unusable due to contamination. Subsequently, source separation facilitates the upward mobility of waste picker by improving access to their resource. And lastly, added by Turner and Thomas (1982) the use of secondary materials input brings about resource efficiency and energy saving in the primary-material-based production.

In developing countries, source separation fosters a free market, independent of the solid waste collection and disposal system. This reduces the need for burdensome regulations and

costly enforcement. Furthermore source separation fosters competition among recycling companies, thereby keeping costs low and quality of services high. (MCMUA 2008)

2.3 Modes of source separation

There are two obvious patterns of source separation practice, one is arranged by the municipalities and the other one is run by society and business sector. Lardinois and Furedy (2007) have defined these modes as follows.

2.3.1 Customary practices

Customary practice is the separation and training that have persisted over many decades. The types of materials separated are determined by needs of charities, trading operations, industries, markets and even by religious observances.

In less developed cities most recycling activities are performed based on small customary source separation, and informal recycling system. Informer recycling activity conducts waste separation at several points by several actors from sources of refuse until the final dumpsite. Among such actors are scavengers or rage pickers who look for saleable materials from communal waste bins, and self-employed wheelers or itinerant buyers who purchase recyclable materials from households (Wilson *et al.* 2006, Medina 2000).

Other than mentioned actors who directly recover the reusable/recyclable material from the mixed wastes, 'middlemen' or 'dealers', 'junk shops' and 'wholesalers' are also involved in informal recycling system as the important 'traders'. Waste pickers usually trade their collected recyclables into money with local junkshops, or sometimes with middlemen who will again sell the materials to junkshops. Then junkshops will ensure the stage of pre-processing of those materials by means of, for instance, washing, changing in shape-cutting, granulating, compacting and baling, before conducting the business with the industries that will transform the materials into products again (Medina 2000).

Customary source separation occurs in developing countries due to the condition of low levels of economic development. Poor wages and low prices for products and services create viable profit margins from collecting and selling secondary raw materials. If alternative employment opportunities and associated wages were higher, scavenging would be less financially attractive (Porter 2002 in Wilson *et al.* 2006).

Box 2-1 Quote from pamphlet Advertising Wonpanit Group, a large recycling business sector in Thailand

WONGPANIT GARBAGE RECYCLE SEPARATION PLANT

Wongpanit Garbage Recycle Separation Plant was established in 1974 with principles based on honesty and integrity. It has gained the unrivaled experience in reyclcing business until it reaches a good reputation and earns high acceptance as a leader on waste management in Sourtheast Asia from not only governmental sectors but also from the non-government and industrial organizations on both national and international level

Standard Services

➢ Recommendation

Experts team provides and makes suggestions on Environment Quality Management. Traning courses in all aspects of waste management, including solid and industrial waste. Special emephasis is placed on the source of garbage

➢ Storage

Appropriate storage system which is concerned about the environment and safety.

Recycling System

As one of the most experienced and qualified companies in waste treatment and recycling process, attention on the recycle of waste material and support recycle to convert waste to the ultimate value-added product is always up.

> Transportation

With a very extensive branch network system and manpower, all forms of transportation are provided with emphasis on labour safety, logistic management and environmental protection

Purchase

Buying various types of waste: plastic, metal, steel scrap, copper, aluminium, stainless stell, old machine, industrial machine, old truck, construction debris, paper, glass, wood scrap, etc. with high price.

Special Service

Confidential document destruction services, demolition of building, tools, machine. Operations are carried out in full legal compliance. Technology for recycling management. Industrial waste collection services

Source: Wongpanit advertising pamphlet picked up at the separation plant. Information also available from (<u>www.wongpanit.com.</u>)

Statement above can be supported by consequences according to Lardinois and Furedy (2007) that cities that have extensive customary systems of both reuse and recycling (which incorporate both manufactured materials and organics) are generally characterized by:

- Scarcity or high cost of primary materials;
- Diversity of manufacturing industries, large and small;
- Substantial level of poverty, with social groups associated with waste work and/or numbers of recent migrants seeking work;
- Tolerance of itinerant vendors and buyers (often linked to police corruption);
- Domestic animal husbandry and intensive farming in peri-urban areas and scarcity/expense of artificial fertilizer.



Figure 2-1 Two patterns of source separation for recycling in one community, both started out from household. Source: (Bolaan 2006)

The attitude of the authority toward customary practice is rather negative in most cases. They have little awareness of the customary system of separation and trading and usually do not perceive these practices as reducing the quantities of wastes to be officially collected and disposed of. They do not always regard the customary sector as stake holders in solid waste management and they are not always aware of the changes taking place in large cities that tend to erode customary system (such as bylaws restricting waste traders and itinerant buyers). Organized interventions often aim at changing the view of municipal managers.

Wilson et al. (2006) have mentioned the negative attitude of the formal waste management sector to informal recycling, that, backyard recycling is "backward, unhygienic, and generally incompatible with a modern waste management system." Moreover, for most municipalities increasing of this 'non-decent work' career (ILO 2002, in Nelson and De Bruijn 2005) means 'failure' of the informal operators. It is understood as the failure to comply with regulations that protect employment, the environment and consumers lowers the ceiling on the quality of their development and on their potential for growth and wealth accumulation.

Yet, there are also municipalities and public policies that support customary activity. In accordance with Medina (2000) there are various ways the authorities deal with private recycling sector – repression, neglect, collusion, and *stimulation*. Stimulation has been seen conducted through, among other things, legalization and encourage the formation of the activities for example in Indonesia, the awarding of contracts for collection of mixed waste and the recyclables in some Colombian towns, etc.

2.3.2 Collectively organized interventions (organized)

Organized system is predominantly concerned with obtaining materials for recycling and composting. The exceptions are government-mandated buy-back of certain items such as some soft drink bottles and lead batteries, and the collection for reuse sponsored by non-

profit organizations. Separating collection of materials is usually municipally financed and sometimes nationally mandated. The two main modes of collection are drop-off and kerbside, i.e., collection at the side of the household, shop or institution. Voluntary organizations may play a role. The number of categories into which waste generators are asked to separate differs. Cities that collect mixed recyclables rely on materials recovery facilities (MRFs) to sort out different components (Lardinois and Furedy 2007).

In the South, organized systems have frequently started with voluntary projects by NGOs, individuals, or educational institutions. These interventions are linked to the encouragement of recycling, or improvements of the status and conditions for waste workers (Lardinois and Furedy 2007).

In Thailand, separation at source under organized mode is currently limited to that which is encouraged through, for instance, Garbage Banks or Recyclable Waste Banks which can be recalled as common source separation campaigns. (Box 2-1) The concept of the project is conceived as an initiative to encourage recycling activities at the community level, through which participants receive goods or money in exchange for the recyclable waste (Environment Monitor 2003).

School recyclable waste bank: This program is usually carried out in local school where student can bring recyclable materials for collection. Students receive either cash or a certain number of reward points in exchange for their waste, depending on the volume and the type of material presented. Reward points can be redeemed to procure sports equipment, stationary, and other goods, the purchase of which is funded with profits from the sale of the recyclable materials. Garbage banks are typically managed by students, with support from teachers and parents.

Community recyclable waste bank: It is a variations of the school banks, run by communities and municipalities. In Phitsanulok, a community garbage bank is profitably managed by local youth, with the support of the municipality and a private waste trading firm. In Phichit, profits generated from a garbage bank were used to set up a communal convenience store, where goods are sold to members at a lower price.

The "garbage-for-eggs" project: This was first instituted in one of Bangkok's poorest residential areas by Klong Toey Environmental Protection Group. The primary objective of the project was to solve yearly flooding problems faced by the community, due to the blocking of canals and sewerage systems by improperly discarded waste. Residents where encouraged to collect recyclable materials and exchange them for eggs. Within six months of the program's start-date, the amount of waste in community was reduced by 161 tons. The project is now operating in 23 communities within Bangkok and other provinces.

Waste donation event: Municipalities attempt to encourage recyclable waste separation through the Buddhist donation event that is commonly practiced in Thai community. Normally the Buddhists, often in communities around one temple, will invent trees that have bank note on the them, then donate the money trees to the temples. Waste donation style is to decorate the trees, not with bank notes but, with the recyclates which will later be exchanged into money for the temple at temple by the private recycling business.

Box 2-2 Popular patterns of source separation campaign in Thailand Source: (Thailand Environmental Monitor 2003) In High-income cities, source separation systems are organized by municipalities and rely upon a combination of civic commitment, environmental consciousness, convenience of deposit, public education, and mandatory enforcement. Conversely in Southern cities, the capacity to draw upon such motivations and to provide suitable incentives is weak. Consequently, there is now an interest in understanding why people participate in customary practices, how far they would be prepared to adopt or extend separation, and whether altruistic moves (associated with civic concern and environmental awareness) are on the increase.

2.4 Factors triggering and sustaining a source separation

Public participation in recycling schemes is a key influence on whether a household recycles its waste (Barr and Gilg 2005 in Timlett and Williams 2008). This part of literature review is the section that is very applicable to this study.

Achieving sustainable development, especially for consumption issue like source separation activity where everyday behaviour gives effects almost right away will depend largely on long-term changes in behaviours of individuals, community, firms, and public sector.

The municipalities can play an essential role in changing these behaviours over time. But they have to find a way of engaging with both individuals and the public, in supporting the development of new social norms and fostering facilitating conditions in a strategic and long-term approach to behaviour change.

Individual behaviours are deeply embedded in social situations, institutional contexts and cultural norms. Consumers often find themselves 'locked in' to unsustainable behaviours by a combination of habit, disincentives, social norms and cultural expectations (Defra 2008).

There is the need to make sure that all the factors which are necessary to change behaviour are present, and then assess whether it is likely to be enough.

2.4.1 Behaviour change model (4Es)

There are many studies identifying factors that motivate people to participate in source separation of waste, thus numerous number of elements have been indicated. The author have found that the behaviour change model by Defra (2008) has grouped those factors for policy makers in one system composed of 4E – Enable, Engage, Encourage, and Exemplify - which can make investigation become clearer, as shown in figure 2-2 below.



Figure 2-2 Behaviour change model

Source: (Defra 2008)

(1) Enable

Enable is quite rational to be recognized as the most significant one among the four E, as "there is no point asking people to change if they don't know how – or if they know what to do, but what they need to do is not available", Defra (2008) explained.

It is important helping people make responsible choices by providing them with education, skills and information. If education does not specifically address solid waste there is unlikely to be any effect on waste behaviours; specific school education can affect household habits (Defra 2008). Well-designed information campaigns are also usually a prerequisite for reaping the full potential of structural interventions (Thogersen 2007).

Telling the public 'how to' has not proved to be enough because "[i]nformation does not necessarily lead to increased awareness, and increased awareness does not necessarily lead to action. Information provision, whether through advertisements, leaflets or labeling, must be backed up by other approaches" (Demos and Green Alliance 2003 in Defra 2008).

In making what they need to do available, infrastructures needed have to be provided. Many studies reveal that changing structural conditions is usually more effective than interventions targeting consumer beliefs or attitudes. (Suitable infrastructures and having it ready before promotion)

Removal of barriers is making choices easy with easily accessible alternatives. There is a study showing that household then to give more cooperation with source separation program when municipality deliver convenience, for example, using kerbside system instead of drop-off in the community where transportation is a barrier. Market for secondary materials is also another barrier that policy maker may pay attention to remove; as in accordance with Turner and Thomas (1982), the extent to which source separation schemes can be expanded will depend on the supply of and demand for secondary materials as raw material inputs.

It must be noted that in some cases enabling maybe all that is needed – where for example higher standards are built into the products we buy. In some cases one can change actions without first changing attitudes. (Defra 2008) It is well documented that the best results in terms of behaviour change are usually obtained when important structural conditions are improved in combination with a well-designed information campaign (Thogesen; Manomaivibool 2005; O'Riordan and Turner 1997).

(2) Encouragement

Municipalities should look at the most effective techniques to encourage and, where necessary, enforce, behaviour change. These might include taxes or other ways of giving price signals, peer pressure, league tables, funding, or even regulations. Although it is suggested by Defra that positive incentive to reward good behaviour should be taken into consideration more than penalties. Encouragement appears to be highly useful at the on-set of the program.

(3) Engagement

Engagement in policy from household can be obtained through communication action. There are many ways to communicate with the pubic – media, forum, people network, or direct communication. Yet there are some studies suggesting that remote message from the authority are often not the best way to get people to act and take responsibility. Face-to-face contact often works better (Timlett and Wiliams 2007).

Besides, source separation is the behaviour expected to see in consistency thus the policy needs to make sure that people are involved early and the policies are developed jointly – this approach is known as co-production (Defra 2008).

Information alone rarely changes people behaviour and that short-term communication campaigns alone are insufficient. (Defra 2008) Targeted communications should be part of a larger process of involving the public, co-ordinated with other interventions such as regulation (Encourage), and having the right goods, services and infrastructure (Enable). 'Bottom up' policy is also recommended by Timlett and Williams (2007) to get people involve in the managerial level, leading to the long-term willing to act in as well.

(4) Exemplify

Defra has defined 'Exemplify' by that the government should take the lead by showing good examples. However, in this study where the municipalities are initiator, plus the fact that municipalities themselves needs good examples from outside, the author have adjusted the definition of 'Exemplify' from government's leading to external assistance. Aid from source separation policy experts, domestic or internal, tends to optimize policy outcome that is more participation from the public.

After identifying 4 elements, policy maker should look at how the policies come together as a package and how to use them to trigger change. Then the policy maker will find the 'catalysts' to change habits and ease the way to new policies (Defra 2008).

2.4.2 External factors

There are many other factors influencing waste separating behaviour, individually or collectively. External factors in this place are the factors that are difficult (some are impossible) to deliver from public policies. Yet they are believed to be useful in policy implementation. The following factors are picked up from Lardinois and Furedy (2007) where they fit the cases of Thai cities.

- Habit: householders in customary systems separate and sell recyclable materials without specific reason but because "it has always been done" in the house for a long time. During the research, the author has encountered quite a large number of households with source separation habits as well.
- Income: low income households tend to separate and sell their saleable materials more than affluent households. The occurrence is proved to be going on in Karachi and Bangalore.
- Space in household: households in congested area or without enough space to store saleable material to be sufficiently accumulated for itinerant buyers can be an incentive for separation as evident in Pakistan.
- Gender: there are studies conducted in Pakistan, Bangladesh, and Vietnam finding that women were more involved in source separation than men of the household.

Besides these four expressed factors above Lardinois and Ferudy also suggest other factors such as; 'charitable motive' which says that household with higher status seems to separate certain used products for donations more than the lower ones, and 'wages of household servants' explaining the mostly low-paid servants would separate saleable materials from the mixed waste, etc.

3 Case of Chiang Mai City

3.1 Introduction

Chiang Mai City is the second biggest city in the country, and the economic centre of the northern region. Rapid urbanization has driven production and consumption and eventually waste generation in the city as from, in average, 174 tons per day in 1994 to 316 tons in thirteen years (BPHE 2007).

Solid waste management has been one of the major environmental problems of Chiang Mai City. Its nickname – city of waste – was created due to the major waste crisis in 1998. Then, occurrence of the most severe waste problem in Chiang Mai City was confirmed nationwide in the first page of newspapers. Snap-shots of urban waste piled up everywhere in town as if there had not been any collection for weeks. Horrible smell and awful sight that drove out tourists – one major source of income for this tourism oriented city. Insects and other diseases coming from giant refuse heaps affects citizen living near-by and pedestrians causing annoyance and negative health impacts. Background information

CHIANG MAI CITY (2005) area: 40.216 Sq.km. population: 152,168 density: 3,804.20/ sq.km. household: 65,112 (1998)

WASTE FACT (2007) per day generation: 316 tons per capita generation: 2 kg/day* collection: 80% composition: recyclable 37.8% organic 55.2% hazardous others –

(Chiamchaisri et al. 2007)

Furthermore, waste lingering quandary is adding up urban air pollution problem harming human health due to the 'traditional' domestic waste burning activity. In accordance with Apawacharuch (2008) 'burning' is an adequate mean of treating garbage in the proportion of 8 out of 10 textbooks for Thai primary-level education, and it has been a very common practice as it is cheap, easy and fast to get rid of combustible squander. Most of the burnt materials are the unwanted materials from waste buyers such as milk packs/bags, foam, pieces of craft wood, pieces of textile, etc. (Apawacharuch 2008).

There are various drivers behind the happening, yet basic causes for the city are the short of transfer station and dumping site, inefficient waste collecting system, and the lack of vision and devotion in solving waste problem from the leader side (TSS 2008; Pattanapongsa 1998).

Responsible authority – Chiang Mai City Municipality (CMCM) – has been trying to solve this problem for more than 10 years, though with limited success. Therefore, severe waste problem in Chiang Mai has still been threatening its inhabitants' quality of life and the city's economy continuously.

In addition, regarding waste burning problem, Social Research Institute under Chiang Mai Municipality is currently launching a program aiming to help easing garbage, called "Pangkiyua hupentoon" or "turning garbage into capital" in English. This program is still on its process, and expected to conduct the first evaluation next year (Apawacharuch 2008).

3.2 Municipal Solid Waste Management in Chiang Mai City

3.2.1 Structure

Figure 3-1 below illustrates the units in CMCM that are in charge of municipal solid waste management in Chiang Mai City. Works that need technological knowledge like waste treatment is in the responsibility of Technical Sanitary Section (TSS) under Division of Technical Service. This division is mainly dealing with the activities in landfills and responsibility for future waste treatment innovation. (CMCM 2008) However, the municipality alleged that currently a private waste management company – Chiang Mai Puangsa-ad Group - is taking over all actions in the landfill while the municipality pays for the treatment cost only (TSS 2008).

As for waste collection, since Chiang Mai City covers about 40 square kilometres large, the task is divided according to the 4 municipal districts. (See Fig. 3-1) At the present time the municipality is only looking after waste collection in one of them, Gawila District, while the rest are performed by Chiang Mai Puangsa-ad Group. (BPHE 2008)

Nevertheless, the municipality has full task to be in touch with its people in order to transfer waste related knowledge and information. The mission is conducted by Bureau of Public Health and Environment (BPHE) whose responsibility also covers planning and promoting waste related public education programs. One of the Bureau's programs is the separation at source campaign (BPHE 2008).



Figure 3-1 Chiang Mai City Municipality administration chart, indicating units involving municipal solid waste management. Source: Own figure, information from (BPHE and CMCM webpage URL: <u>http://www.cmcity.go.th/english/structure.php</u>)

3.2.2 System

Like other developing cities, separation at source has been performed in Chiang Mai society for about a century in accordance with Pattanapongsa (1998). The existence of street waste picker community and itinerant waste buyers or wheelers ("sa-leng" in Thai language) is the best evidence. Sangchot (2008) explained that there were four points in waste system that recyclable materials are sorted and collected, which are at source or household by citizen, on garbage trucks by municipal waste collector, on the street by street scavengers, and at final disposal site also by scavengers. It can be inferred that, in fact, the Thais have separated waste for an informal recycling sector, whilst there had been no systematic support from the formal sector (municipality) to encourage or upgrade such a practice as formal waste management system.

After 1997 waste crisis, the significance and the urgent need to implement separation at source for landfill diversion had arisen. CMCM had decided to put source separation for recycling activity in 5-year municipal waste management plan 1999-2003 under the responsibility of BPHE (Pattnapongsa 1998). And the program has been continuing to the present waste management plan as well (BPHE 2007). The main duties of BPHE in this source separation/recycling program are, first, to build environmental awareness and, second, to ensure knowledge and understanding about separating waste at source among Chiang Mai inhabitants. Household, the sector that is creating 61% of municipal solid waste per day, has been the main target for the program.

Under the source separation program responsible by BPHE there are also few other campaigns being done such as "school recyclable waste bank" campaign, "wet-dry-hazardous trash bins" campaign requesting pedestrians to litter in correct bin, "Menrai district recycling centre" project acting as the recyclables transfer station, and "fertilizer from organic waste by using EM¹" campaign instructing public to make EM fluid from food/organic waste for domestic usage. Nonetheless, the first campaign is not ensuing incessantly due to both school break and lack of long-term participation (Sangchot 2008). As well as the second campaign, "it is truly difficult," confessed BPHE, "waste contents in three kinds of trash bins at the street kerbsides –wet, dry, and hazardous- are no different from one another."

However, among various campaigns mentioned above, there are two programs that are incessant and in which positive outcomes are apparent. One is the establishment of recycling centre in Mengrai community or Mengrai recycling centre by the community leaders. And the other is the fertilizer from organic waste campaign.

a) Mengrai district recycling centre

This recycling centre is acting like waste/recycling shop but being run without making profit, thus it can probably be called the recyclables transfer station. Although the initiation of this centre was claimed to belong to Chiang Mai City Municipality as well as the land, infrastructures, and the first investment redundant, the management has been run mostly by Mengrai community committee in cooperation with Wongpanit group – a large franchise recycling business in the country.

¹ EM stands for Effective Microorganisms is a mixture of group of organisms that has a reviving action on human, animals, and the natural environment and has been described as a multi-culture of coexisting anaerobic and aerobic beneficial microorganisms. EM technology was developed during the 1970s at the University of Ryukyu. Okinawa, Japan. (Szymanski and Patterson 2003)

Basically this recycling centre is serving source separation campaign as the first destination where the separate materials in the neighbourhood go to. Glass, paper, metal, and plastic collected by both households and waste buyers are converted into cash with, said to be, reasonable rate. The BPHE officers persuade people in the city to separate sellable waste and help reducing waste to landfill by means of door-to-door communication, distributing pamphlet and poster, and using mass media such as local newspaper, radio and community public announcement. Subsequently, Wongpanit as the wholesaler will buy recyclable materials from the centre and later process them into goods supplying subsequent industries. Money from selling materials to Wongpanit is the capital for purchasing the next lot of incoming wastes. In 2007 total recyclables arrived to the centre was in total 201.58 tons or 552.28 kilograms per day (BPHE 2007).



Picture 3-1 Menrai recycling centre. Top-left picture shows the outside of the centre, topright one is the sign saying "recycling centre (purchase used materials)" together with logos of CMCM and Wongpanit Group, Bottom-left one shows the collecting space for the incoming materials inside the centre waiting for the pick up from Wongpanit Group, and bottom-right picture shows the price notice board updated daily.

Source: Own images

Under the source separation program responsible by BPHE there are also few other campaigns being done such as "bank waste" campaign in several local schools, "wet-dry-hazardous trash bins" campaign requesting pedestrians to litter in correct bin, and "fertilizer from organic waste by using EM" campaign instructing public to make EM fluid from food/organic waste for domestic usage. Nonetheless, the first campaign is not ensuing incessantly due to both school break and lack of long-term participation (Sangchot 2008). As well as the second campaign, "it is truly difficult," confessed by Mr. Juthadech Sangchot from BPHE, "waste contents in three kinds of trash bins at the street kerbsides –wet, dry, and hazardous- are no different from one another." Chiang Mai City citizen, including the author,

probably do not either separating waste for those bins, or even recognize that this campaign still exists.

The "fertilizer from organic waste by using EM" is unlike others as dealing with organic waste not sellable materials. Thus its details are demonstrated consequently below.

b) Fertilizer from organic waste by using EM

Holding the same objective that is to cut organic waste transferred to final disposal site, this campaign is not new rather the successful practice from the neighbour – Lamphun Municipality (LM). CMCM began the EM campaign for treating household organic refuse in June 2002 after consultation with LM and Maejo University who are well-experienced with EM projects.

EM fluid is a very useful microorganism solution; related to waste management matter, it can help effectively decompose organic waste and then convert it into fertilizer. It is so to say that EM help lessening organic waste. If every household in Chiang Mai separate food waste for making EM fertilizer for domestic use, total MSW to be collected would be reduced more than 50%.

The project implementation is first BPHE cultivates EM, which is now carrying out in part of Menrai recycling centre. Then it is followed by expanding knowledge network about EM fertilizer production and for small scaled usage by organizing traning programs and seminars, talking to the communities distributing pamphlets and other publication about EM fertilizer. Then, BPHE actively provide free EM fluid for household or communities interested in the project.

Sangchot (2008) stated that project participant number is increasing, citizens come picking up EM from BPHE regularly since the project started. However there are records by BPHE showing the increasing number of EM fluid distributed, the measure indicating domestic EM fertilizer production is not being carried out. Hence it is difficult to assess project accomplishment.

Collection and treatment

Waste management system in Chiang Mai municipal locale is divided into two sections – collecting and treatment. Waste collecting service is supervised separately in the four municipal districts – Nakornping, Mengrai, Sriwichai, and Kawila. (Fig. 3-2) The collection in Kawila municipal district is conducted by the municipal solid waste collecting crews with the record of approximately 80 tons per day collection, but, the other three municipal districts are in liability of private solid waste management company called Chiang Mai Puangsa-ard group with collecting record of about 260 tons per day (CMCM Sanitary Section 2007).



Figure 3-2 Map of Chiang Mai City showing boarders among the four municipal districts, also their communities and land coverage

Source: Map adjusted from (CMCM Webpage, URL: <u>http://www.cmcity.go.th/aboutus/map.php</u>, information from BPHE 2007)

As mentioned already earlier, though TSS is assigned to be the in-charge, Chiang Mai Puangsa-ard group has also taken over solid waste treatment activity. (BPHE 2007; Dhammasonthi 2008) In other words, currently the municipality is technically looking after merely 20% of the total waste management system in Chiang Mai (TSS 2008).

It has been difficult for CMCM to locate landfill sites for its waste. There are lands outside the city, however, the community residing nearby the site expected to be a big trash hole would always oppose the proposal. "Who would not do so when the authority never constructed "sanitary" landfill as promised but plain dumping space, leaving alone surrounded residents have to put up with 3-centimeter flies flying around them when having lunch?", stated Mr. Thanet Charoenmuang (2008) from Urban Development Institute Foundation or UDIF. He also added that the villagers once showed their anger by gathering in front of the landfill entrance to obstruct garbage trucks from the dumping work. Besides, according to Charoenmuang (2008) Chiang Mai City municipality has now been using lands from other provinces at its periphery, "to unload some if the trucks find vacant spaces on the way to the dump site". However, the municipality claimed that the mystery trash bags along the inter-city roads were from the outskirts outside municipal area since they did not own proper garbage treatment (Sangchot 2008).

Not every community is accessible by the garbage trucks. That is probably a good 'excuse' for the deficient waste collecting rate which is only partly true. Chiang Mai City is an old city full
of complicated tiny paths with the condition that even a normal car can hardly drive through. Besides, some said that the municipality did not have budget to purchase enough garbage trucks, hence at the present time private sector is responsible for waste collecting of as much as 80% of Chiang Mai City municipal area. (TSS 2008) Yet this matter is still a challenge for the authority.



Figure 3-3 Acknowledged structure of solid waste collection and treatment system of CMCM. Source: (own figure)

3.3 The Program Outcome

According to the survey, the behaviour of sampling households in Chiang Mai city in 2008 is as followed.

- 77.4% of the sampling households are performing source separation. And among those citizen 89% of them are separating waste regularly.
- Within people who separate waste, 25.5% of them sort organic waste, 11% of them sort hazardous waste, and 92% of them separate recyclable waste from the ordinaries. While the average number of types that the household is separating is 2.6 out of total 8 types.
- 17.3% of the active household is performing waste separation for CMCM's source separation campaigns, although the cooperation with recycling business is greatly higher as yielding 80.5% of the household.

Despite the evidence of household participation in source separation activity, the municipality source separation can not be understood as a success since the waste quantity carried to the dumpsite is not significantly declining at any points of project implementation time. Discussion about the situation will be made in Chapter 6 together with other 2 case studies.



Figure 3-4 Demonstrating trend of solid waste amount measured annually at municipal landfill from 1994 to 2007 (ton/day).

Source: (BPHE 2007, CMCM 2008)

4 Case of Phitsanulok City

4.1 Introduction

Phitsanulok city is a centre of the lower- northern part of Thailand. It is serving the region as a centre of education, governmental office, and especially as a centre of transportation that links the near provinces between the capital, Bangkok, and the upper-northern provinces.

The rapid urbanization and economic growth in the early 1990s had also boost the city's per capita waste generation to 1.6 kg. per day (1995), which was very high compared other cities (GTZ 2007).

In 1995 Phitsanulok Municipality – became Phitsanulok City Municipality in 1999 – decided to cope with MSW problem significantly. With the company of the technical aid from Deuthsche Gesellschaft für Technische Zusammenarbeit or the German Technical Cooperation Agency (GTZ) from Germany, the municipality has improved solid waste management system and strategy to be more efficient and more Background information

PHITSANULOK CITY area: 18.26 km² population: 80,386 density: 4,949.94/ km² household: 27,014

Waste Fact (2004) per day generation: 82 ton per capita generation: 1 kg/day* composition: recyclable 40% organic 40% others 20%

Source: PCM website (2008)

sustainable under the Thai-German municipal solid waste management project.

As a professional consultancy organization, GTZ with the participation of municipality staffs had came up with detailed analysis of the situation revealing several problems in the area including: 1) the lack of awareness in waste avoidance and source separation at the household level; 2) high amount of organic material which generates methane gas and leachate at landfill making landfill management a difficult task; 3) the lack of technological know-how needed especially for sanitary landfill; 4) the lack of cooperation between the concerned local authority and the central government, and; 5) the lack of budget and responsibility of cost effectiveness (GTZ 2007). The strategies that fit the city characteristic and its specific problem were drawn afterward.

One of the strategies is called Community-based Waste Management or CBM is a good waste management practice case which later resulted in 3 MSWM awards to the municipality from the central government. Besides, MSWM of PCM in reducing waste to landfill is called "Phitsanulok Model" following its successful story.

4.2 Solid waste management system

4.2.1 Structure

MSWM in Phitsanulok city under is under the responsibility of a single bureau that is Bureau of Public Health and Environment. Among three sections of this bureau, two of them carry out MSWM action and the tasks are also divided as shown in figure 4-1. One is Public Health and Environment Support Section, taking care of waste collection and handling.



Figure 4-1 Phitsanulok City Municipality administration chart, indicating units involving in municipal solid waste management.

Source: Own figure, information from (PCM webpage, URL: <u>http://www.phsmun.go.th</u>, text in Thai only)

The other one is Public Health and Environment Service Section and Planning which is in charge of raising awareness about MSW among public and run educational and training programs for the communities. However the direction of the entire waste management system is directed by administrator unit which comes from election by Phitsanulok citizen every 4 years. (PCM 2008)

4.2.2 System

Figure 4-2 below demonstrates guiding principles and waste strategies which are now being implemented by PCM, advised by GTZ to be the most effective way of dealing with waste (GTZ 2007). Following the waste hierarchy, the main principles are the 3R – reduce, reuse, recycle – and the recovery of waste for energy and material substitution. Subsequently the four strategies are outlined for PCM which require the involvement of all the waste actors of waste management: citizen, communities, commercial sector, private enterprises, local and central government.



Figure 4-2 Guiding principles and strategic areas for project intervention. Source: Adapted from (GTZ 2007)

One of the major strategies is CBM at public participation level in order to achieve self sustainability. There, the CBM communities are encouraged to take over the responsibility of taking care of their own environment. Mainly, there are 6 things that the communities have to manage, they are:

- 1) Separate saleable materials from other wastes at source
- 2) Separate organic waste for home or community composting
- 3) Possess 2 bins, for organic waste and others
- 4) Keep garbage bins in household area, and bring them out to the street only during the consigned waste collecting time

- 5) Collecting frequency
- 6) Cooperation in paying monthly waste management fee

At household level, focusing on source separation, wastes are separated into 3 kinds, recyclable or saleable materials, organic waste, and others that are not usable. To reduce waste to landfill as much as possible through CBM, PCM aims to separate 40% of the whole waste that is recyclable to sell to the waste wholesalers, another 40% of the whole waste that is organic to be composted for local usage, and the rest 20% that needs to be treated collected and disposed by the municipality (PCM 2008). However, some communities participating in CBM have even added hazardous waste as another category of waste to be separated.



Figure 4-3 Acknowledged structure of solid waste collection and treatment system of PCM which aims to achieve 'zero landfill'.

Source: own figure, data from (Hantrakool 2006)

To support waste separation activities under CBM, PCM have introduced campaigns as followed.

a) Saleable material management campaign

PCM encourages household to separate saleable materials from the other waste and inform the communities of how to properly conduct saleable waste separation for sale. To promote recycling policy, PCM has defined the term "saleable materials" for waste that are categorized as recyclable waste, meaning to increase positive response and achieve the better understanding from the community side using knock-door approach. This approach has been done twice a week, namely every Thursday and Sunday, where the municipal committee goes to communities to talk and inform citizen about waste matter. Also, the committee will ask for cooperation from the household to first possess own garbage bag and second separate the saleable and bring the rest to the collecting spot at the assign time that the trucks will pick up. As well, PCM keeps the campaign alive by establishing saleable waste gathering points or events in the communities regularly, such as saleable materials market, recyclable waste bank, waste donation, persuading the unemployed to be itinerant waste buyers, etc. Here, the role of private commercial sector, especially Wongpanit Group whose head office is in Phitsanulok city, is also critically contributing to the success of source separation of saleable

materials in Phitsanulok city. PCM has worked together with the business to optimize source separation movement within and around the city in most of the source separation campaigns.

b) Home Composting

In this campaign citizen are to separate organic waste for composting which can be done at home or in composting collaboration with the neighbourhood. PCM in collaboration with the communities provided essential equipments such as containers for both assembling and fermenting organic waste, and other bigger tools for waste composting. Then PCM only give academic and technical support to the community, mainly about composting process and how to deal with problems if happens. Another important duty of PCM is to help finding market for the composted fertilizer which is the product of the organic waste composting.

c) Mechanical-Biological Waste Treatment (MBT)

PCM, with the technical support by GTZ and FABER AMBRA, has been using part of the land in their sanitary landfill performing waste treatment before the final disposal by using German technology called MBT (Schlicht 2003). Aerobic composting is not a need complex technology or infrastructure. The output of the treatment is composted organic material which does not smell, does not originate methane gas, and does not cause negative environmental impacts.



Figure 4-4 MBT by FABER AMBRA and infrastructure needed on the right. Source: (Schlicht 2003)

Part of treated material that contains plastic bags can be sent to another mechanism which provides the substance as a fuel input for Thai cement industry. The other part has the value as composted fertilizer thus it is useful for agricultural sector. Anyhow, these treated matters

have another benefit that they can be compacted up to 1.2 tons per cubic meter which is extension of lifetime of municipal sanitary landfill – from 16 years to 54 years (Schlicht 2003).



Picture 4-1 Photo compilation shows part of the MBT process at municipal landfill. Top-left is the landfill with some covered part, disposal part, and the MBT allocation. Next, top-left picture demonstrate the moisture adding system into the organic substance being treated. Bottom-left photo is the truck for mixing and grinding organic waste, the mechanical treatment. And the bottom-right photo shows the windrow assembly which adds air into the waste.

Source: (Schlicht 2003; Hantrakool 2006)

4.3 The program outcome

According to the survey, the behaviour of sampled households in Phitsanulok city in 2008 is as follows.

- 72% of the respondents are performing source separation. And among those citizen 93% of them are separating waste regularly.
- Within people who separate waste, 14.4% of them sort organic waste, 11% of them sort hazardous waste, and 95% of them separate recyclable waste from the ordinaries. While the average number of types that the household is separating is 3.0 out of total 8 types.

 Only 5% of the active household is performing waste separation for PCM's source separation campaigns, while the cooperation with recycling business is drastically higher as yielding 92% of the household separating waste for the sector.

The evaluation for PCM solid waste strategies is apparently an achievement as seen in figure 4.3.1 below that waste quantity to landfill has dropped significantly after implementing new system supported by GTZ in 1999 and onward.



Figure 4-5 Demonstrating trend of solid waste amount measured annually at municipal landfill from 1993 to 2004 (ton/day).

Source: (PCM 2008)

However it can be noted that the waste amount to landfill started to be reduced before 1999. This can be explained as a product of Wongpanit business success from 1996 when they claimed to receive 80 tons of recyclable waste each day which was the biggest income jump, and even continuing to grow rapidly (Wongcharoen 2008). Thus, probably, both PCM and Wongpanit Group are the players to be highly cherished for the improved waste situation nowadays.

5 Case of Rayong City

5.1 Introduction

Since the establishment of the mega industrial project "Eastern Seaboard" and the two deep seaports in 1981, Rayong city has no longer been just a stop-over destination but the centre of industrial activities and investment in the country. Such rapid economic and population growth, plus the stream of tourists and other temporary residents has resulted in various environmental problems including the classic urban waste dilemma. Similarly with other cities, the main setback is the difficulty to find space to be the final disposal destination.

In general, waste problems in Rayong city are caused by the lack of awareness of its citizen in willing to keep the cleanliness of the environment (ILGI 2003). Plus, the municipal solid waste management system had faced a number of limitations, such as lack of lucid waste management plan and infrastructures are old and malfunctioning. The political instability also resulted in delayed budget approval for projects which later affects hold-up treatment at the landfill.

In Rayong city, since the year 2001 the city's solid waste generation has increased persistently, from 71.3 tons per

Background information

RAYONG CITY area: 16.95 km² population: 54,000 density: 114 per km² household: 22,000

WASTE FACT (2007) per day generation: 72 tons (2007) per capita generation: 1.3 kg/day* collection: composition: recyclables 23% organic 43% hazardous 3% others 31%

> (RCM 2008) *Own calculation

day in 2001 to 80.6 tons per day in 2004. "...And the trend of waste generation is still growing until the present time," said the deputy mayor of Rayong City Municipality (RCM), Mr. Thanit Angkavinijwong, "although the municipality has implemented several programs to reduce waste to landfill up to 95%". In accordance with the deputy mayor, source separation is the main concentration of the whole waste management system improvement, which is initiated by the previous mayor in 1999, with support from central government and Development of Environment and Energy Foundation or DEE. The programs are carried out incessantly and its effectiveness has been improved at this moment (Angkavinijwong 2008).

5.2 Solid waste management system

5.2.1 Structure

MSWM actions in Rayong city under RCM, as demonstrated in Figure 5-1 below, are responsibility of two divisions. One is the Bureau of Public Health and Environment, taking care of raising public awareness about the MSW issue and also looking after waste collection conducted by outsourcing company. The other one is the Division of Technical Service and Planning which is in charge of waste treatment and disposal that need technological knowhow, e.g. landfill, composting plant and petrol plant (RCM 2008). Nevertheless, the direction

of the whole waste management system is under the command of the administrator unit, which is elected by Rayong citizen on a 4-year working term.



Figure 5-1 Rayong City Municipality administration chart, indicating units involved in municipal solid waste management.

Source: Own figure, information from (RMC webpage. URL: http://www.rayongcity.net/data.php?content_id=13&PHPSESSID=709148031e080db4e88c68f84bb04776, text in Thai only)

5.2.2 System

Waste management of RCM can be divided into 3 groups; a) recyclable and hazardous waste management, b) organic waste management, and c) ordinary waste management. (Makmee 2004) As shown in Figure 5-2 below, it is apparent that the effectiveness of the system is greatly relying on cooperation from communities to separate recyclable and organic waste from household.



Figure 5-2 Municipal Solid Waste stream and the Management system of Rayong municipal vicinity from the origin to the final points.

Source: (Makmee 2004)

a) Recyclable waste management

To stimulate source separation performance, for recyclable waste, RCM encourages the public to participate in recycling campaigns such as the recyclable waste bank project, which is done once/twice a month in communities and once a week in schools. (RCM 2008)

The recyclable waste bank in schools started in Rayong in 2000. The principle and the process is the same as how it is done in other cities in Thailand. Two years after the trial, the positive result had come out quite clear, since the waste volume collected was reduced by 20% and the city appeared to be very clean.

Based on the accomplishment in schools, an expansion of the program to the community level began in 2002 (RCM 2005). The recyclable waste bank projects in community are understood to have a better consistency other than the ones in schools, since school has semester break 2 or 3 times a year. However, the community recyclable waste bank system in Rayong City is different from the common waste bank system. That is, instead of members turning in recyclable and hazardous waste to receive money in their bank account in return and being able to withdraw cash when they wish, the submitted materials are converted in to

'points' depending on types of materials and volume. Points are accumulated like a money deposit but members can choose to receive a variety of brand new goods at their withdrawal, not money. For example, one has 700 points in his account, and he wants to use all his points he may choose an electric fan (690 points), or 2 boxes of detergent (170 points each) together with 3 big boxes of skin powder (105 points each). Moreover, a member can make commodity requests to RCM. For instance, someone wishes to obtain a refrigerator from his waste points but it is not in the goods list, he can inform RCM about his wish and RCM will set up the number of points required for a refrigerator.

Through this system, it is believed that members are encouraged to participate in the campaign incessantly because they have individual aims that is, to obtain the products they desire. Also members are supposed to gain a better understanding about resource recovery by practice when they can see that they can turn waste into something useful. Some of the members who know that they can make a lot of money from the recyclables, have started to separate waste for private recycling business for money instead of the banks. RCM considers such incidents as success in raising source separation awareness. Nowadays RCM has 3 branches of community waste banks serving 600 account holders.

As next step, when the bank event is over, the sorted recyclables will be collected and delivered to further recycling processes by the informal recycling sector – waste buyers or wholesalers – or kept at the dumping site waiting for appropriate treatment. (Makmee 2004) Mr. Angkavinijwong (2008), RCM deputy mayor, stated confidently that the waste recycling business sector creates economic incentive among households, and significantly helps facilitate the waste reduction program, "...thus we started household waste separation with the recyclables before other kinds." Besides, the cost of recyclable materials transportation falls on the waste buyers, therefore there is also a 23% collection cost saving for the municipality (Angkavinijwong 2008).

b) Organic/food waste management

Along side with the source separation for recycling campaigns, started from 2004, RCM has been promoting food waste separation actively. The reason for the municipality to push this program is not only because organic waste is the biggest portion in the waste composition, but probably also the investment for the composting plant, which had already been constructed years before. Consequently, bins for organic waste were distributed to all houses, beginning with two pilot communities (RCM 2008).

It is important to note that RCM's source separation program intended to deal with organic waste as a priority since it is large in volume and problematic at the landfill. This can be proven by the construction of a composting plant to support diverting organic waste from the landfill, and which was completed before the campaigns for organic waste. But campaigns for recyclable material were carried out as the first course since it was thought to be easier to persuade household to set them aside, and easier to start raising source separation awareness for the entire program later on (Natabamroong 2008).

Since the beginning of the project the Development for Environment and Energy Foundation (DEE) has been the core player, who demonstrates the project to the citizens and informs them of how to perform it, while RCM is responsible for waste collection and the treatment at the composting plants. Later RCM has come to be in charge of the entire project owing to the recent withdrawal of DEE in 2006 (Natabamroong 2008).

The composting plant can accept 60 tons or organic waste everyday as input. Besides producing fertilizer by an anaerobic digestion technique, giving away around 0.84 ton per day,

methane gas from the process is utilized for electricity generation (DEE 2004). The Ministry of Energy considered this as great chance for developing renewable energy production, thus provided 135 million Baht to RCM to act upon this pilot project. Each day the plant can create 625 kWh of electricity from 3-4 hours of operation, and the electricity is purchased by the regional Electricity Generating Authority of Thailand to supply the national electricity consumption (Natabamroong 2008).

Yet, the incoming waste amount is yielding only 20 tons per day today whilst the capacity is 3 times higher (Natabamroong 2008). "The 60-ton capacity was designed to attain nightsoils, though they later discover that picked up nightsoils no longer contain much methane for the plant," Miss Wilawan Natabamroong from RCM explained. Accordingly, it is evident that the plant is generating electricity very much under its full capacity. However this record is an improvement, from 10 tons in 2006, due to the success of the recent "pig chow bucket for energy²" project³, that is distributing whole food waste bins expecting cooperation from restaurants and fresh-market, and in additional from households, to convey wholesome food waste without contamination to produce more electricity and the better quality fertilizer (Natabamroong 2008).

Currently RCM and the Ministry of Energy are on the verge of running a Polish pyrolysis technology, which turns plastics into petroleum or refuse-derived fuel (RDF). The project aims to deal with plastic bags, which are not recyclable and usually thrown away together with organic food as packages (Angkavinijwong 2008). RCM deputy mayor has informed that, according to a study, plastic waste is generated as much as 10 tons per day. "... [T]he petrol factory will help get rid of 6 tons of plastic, while producing 4,500 litres of petroleum which PTT Public Company Limited – a Thai oil and gas company – has agreed to purchase the distil." Moreover, RCM is also making arrangements to excavate the buried landfill for plastic waste, and feed the rest of the excavated material to the composting plant. The factory is expected to start running by the end of this year (Angkavinijwong 2008).

c) Ordinary waste management

Other mixed waste is to be collected by RCM every other day, provided that there are common bins for the waste to be deposited. Ordinary waste collection is carried out by dividing Rayong city into 9 regions (Fig. 5-3). This waste used to be taken care of by RCM solely. Nonetheless, since 2006, a private waste management company is taking responsibility for collecting from 70% of the entire area, leaving the rest 30% to the municipality, who possesses 9 municipal garbage trucks collecting in total 5 tons of waste each round everyday (RCM 2008).

² Own translation

³ Traditionally the Thai separate meal leftover and collect it in a bucket for their pigs. Pigs used to be a kind of common farm animal kept near by the house and their food must be whole organic without contamination. Such organic material preparation is identical to what the composting plant requires thus using the image of a pig chow bucket with the project is believed to pass a clear understanding to the community easily and effectively.



Figure 5-3 Map of Rayong city municipal vicinity (top), and the same city map with the 9 ordinary waste collecting regions illustrated (bottom).

Source: (RMC webpage. URL:

http://www.rayongcity.net/data.php?content_id=13&PHPSESSID=709148031e080db4e88c68f84bb04776, *text in Thai only*)

Waste which needs to be discarded will be transferred to the present landfill located 4 kilometres away from city centre. This landfill is believed to be able to attain waste from the city only for 3-5 more years. In fact, RCM has already purchased a new land in the 1998 to obtain a future squander with 10 times larger waste capacity compared to the current one (Angkavinijwong 2008). Conversely, the plan by RCM is to reuse the current landfill once old waste is excavated for the petrol distilling factory and the composting plant (Angkavinijwong 2008).

5.4 Outcome

According to the survey, the behaviour of sampling households in Rayong city in 2008 is as follows.

- 96.2% of the sampled population is performing source separation. Among those citizen 90% are separating waste regularly.
- Among people who separate waste, 33% of them sort organic waste, 11% of them sort hazardous waste, and 99.5% of them separate recyclable waste from the ordinaries. While the average number of types that the household is separating is 3.7.
- 37.5% of the active households are performing waste separation for RCM's source separation campaigns, although the cooperation with recycling business is still higher and covers 59% of the household.

As a consequence, regardless the motive behind the behaviour, which will be analyzed in Chapter 6, it can be concluded that Rayong city dwellers are very active in source separation activities. This is clearly contributing to the reduction of waste that has to be buried at the dumpsite as seen in Figure 5-4 below. Due to the unavailability of records, yet, further improvement cannot be explained at this point.



Figure 5-4 Demonstrating solid waste trend in Rayong city from 2001 to 2004 (ton/day). The first line represents waste collected by RCM, and the line below is the trend of waste amount transferred to municipal landfill.

Source: (Makmee 2004)

From 2003 there was the start of decreased waste amounts collected. This is believed to be the effect of the "Garbage for Eggs" and "Recyclable Waste Bank" projects, while the decline from 2002 of waste to final disposal can be assumed as the product of improved source separation for the composting plant project (Natabamroong 2008).

6 Analysis and Discussion

6.1 Result comparison

Chapters 3, 4 and 5 have demonstrated source separation programs in the cases of Chiang Mai City, Phitsanulok City, and Rayong City, including outcomes of these programs. This section is going to compare these three case studies, first on the measured outcomes as a preparation for the research analysis.

6.1.1 Waste to landfill

A very important reason for the municipalities to start adopting source separation programs was due to the landfill shortage, thus they attempt to reduce waste to the present landfills to expand the functional life-time. Since the implementation of source separation programs, based on the objective mentioned, their performance could be reviewed from Figure 6-1 below.



Figure 6-1 Trend of solid waste generation in Chiang Mai City, Phitsanulok City, and Rayong City from 1994 to 2004. Record from Rayong is available from 2001 only.

Source: (CMCM 2008, PCM 2008, RCM 2008)

From the figure presented, we can see that the amount of waste to landfill in2004 in the case of CMCM was higher than the starting point of records. While the other two shows a trend of gradual decline. Especially in the case of PCM, the quantity of waste had dropped and stayed quite stable which may imply that the present source separation was acting in its full extent under the limit of the current situation. Even though we can also think from the other angle, that, it cannot be judged if the source separation campaigns by CMCM is the least successful ones because CMCM might have the highest gap between waste generation and to landfill. Also, probably because it is a mega city hence the rate of waste generation may be

rather much higher. Therefore the other indicator, household behaviour, is also taken into consideration for the better assessment of the program's outcome.

6.1.2 Household behaviour

The mechanism of separation at source is centred at households, whether they act upon it or not. Measuring household participation is thus probably the most appropriate way to check the level of program achievement. A summary of involvement from community side is presented in the following table.

Table 6-1 Source separation performance in three cities- Chiang Mai City, Phitsanulok City, and Rayong City in the year 2008. This is the compilation of program outcomes available in Chapters 3 - 5.

	Chiang Mai	Phitsanulok	Rayong
Set certain waste aside* Separate materials for	77.4%	72.0%	96.20%
municipality's program*	17.30%	5%	37.50%
Separate materials for recycling business*	80.50%	9 2%	59%
Regularly perform source separation	89.0%	93.0%	90.00%
Material separated			
Organic*	25.50%	14.40%	33%
Hazardous	11%	11%	11%
Recyclable *	92%	95%	99.50%
Turne of compared metaricl (overcos)*			
i ype of separated material (average)^ (average, max = 8)	2.6	3.0	3.7
* statistical significance			

Source: Own table

A lucid message referred from the table is that the sampled group of households in Rayong City is profoundly performing source separation activities the best among the three cases. As we see, 96% of households claimed to separate certain post-consumer materials, more over, 90% among them separate waste regularly which is the highest percentage among the three. From the data, more people from Chiang Mai are doing source separation than among Phitsanulok city dwellers. But it is more important to see how many people are separating regularly. The numbers state a little more regular separation in Phitsanulok, thus it is difficult to come to a decision here which city is doing better than the other.

Also, at the top of the table, the numbers represent number of households that separate materials for municipalities' source separation programs, while the other stake is private recycling sector e.g. itinerant buyers and waste wholesalers. (Other than the private recycling sector, some data indicate 'domestic reuse' and 'donation' as the purpose of the sorted materials) It seems that RCM has gained most public participation from its source separation programs, 37.5%, especially when PCM shows merely 5% which is relatively low.

When taking a look at the kinds of materials separated which are divided into 3 kinds, organic, hazardous and recyclable, a remarkable reading is put in appearance. All cases yield very high percentage – more than 90% of sampled households separating recyclable waste or saleable 40

materials, especially in Rayong city that gives in just almost 100% of people asked. Interestingly, every case shows identical 11% of household separating hazardous waste. On the other hand there is an apparent distinction in case of organic waste, where the Rayong case is the most active with an activity at 33%, followed by Chiang Mai 25.5%, and 14.4% in Phitsanulok. Therefore the major difference here can be the focus at organic waste separation.

The following question is: to what extent a single household is contributing to source separation programs? One potential method is to weigh the separated materials, and find how many kilograms of materials each household is setting aside per year, in average. Such measurement was not possible when conducting this research, but from data collected, it can be estimated how many types of materials each household in a city is sorting from the mixed. The table shows that, from 8 kinds of waste listed for the sample groups, the household group from Rayong are separating 3.7 kinds, Phitsanulok group are sorting 3 kinds and 2.6 kinds by the Chiang Mai group. This might support the assumption that, though Chiang Mai City and Rayong City are not much different in number of household separating waste, but households in Rayong City are performing it to a higher extent than households in Chiang Mai City.

6.1.3 Interpretation

After comparing the case studies, according to the data, RCM's source separation campaign has gained the most accomplishment. It has the highest percentage of people separating waste regularly, kinds of materials separated, as well as percentage of households that separate waste for the campaign. Different from PCM and CMCM, RCM's households seem to cooperate quite better in separating organic waste for the composting plant project.

We can say that the outcome of PCM is fair when seeing Table 6-1 which shows a significant waste reduction. Judging from the lowest percentage of organic waste sorted; probably the reduction is almost solely relying on saleable waste, which is going to the recycling business. In a sense, Phitsanulok is a fortunate city because it has a highly active informal recycling sector, as seen from the abundance of wheelers and trucks running all over the town looking for houses that prepare the materials they want, and also the home base of Wongpanit Group.

Lastly, CMCM, although the number of household separating waste there is more or less the same with PCM's, the quality of source separating action is behind both RCM and PCM as it has least kinds of material separated and the least regular. Moreover, according to own observation, when visiting households that claim to separate waste regularly in Chiang Mai City and Phitsanulok City, there is difference as separating households in Phitsanulok City actually have bags of, for example, plastic bottles collected and put in front of the house gate waiting for the wheelers to pick them up. And there are other kinds of waste e.g. newspaper and magazine gathered behind their houses, while it is rare to notice this occurrence in Chiang Mai City's separating households. Therefore, we might say that CMCM's source separation campaign is the least successful one among selected cases.

Further more, none of the municipalities has set systematic collection, transfer and treatment facility for household hazardous waste. Thus, probably there is no distinction among their households' behaviour regarding hazardous materials.

6.2 Analysis

Factors that are necessary to change behaviour toward more sustainable way defined by Defra (2007), constitute the analytical framework in this study. Each separation policy is looked into whether they fulfil the requirement according to the model. Subsequently external factors which are not completely under control by the policy maker will also be tested.

6.2.1 Independent variable: Analysis by 4Es Model

For the clearer image of model's analysis, figures below help indicate the allocation of municipality's program characteristics. At the outset, the case of RCM is demonstrated in Figure 6-2 below.



Figure 6-2 4Es Analysis on case of RCM using 4Es model Source: Adapt from (Defra 2008)

What underlies the accomplishment of RCM's program in the presence of high rate source separating household, in line with the change behaviour model, is probably that the program and the supporting mechanism fairly provided to respond to the four E factors. And that everything comes as a policy package.

RCM has a very outstanding level concerning Enable and Encourage, especially infrastructure in Enable section. Noticeable infrastructure such as systematic collection and composting plant seems to be the key to positive program outcome. As mentioned in Chapter 2, infrastructure is highly important for the decision to change behaviour. It is thankful for the central government to grant investment budget for such expensive technology like electricity power plant from methane and petroleum factory.

Besides, RCM uses local informal recycling sector's infrastructure for recyclable waste in the community by co-organizing campaign and recycling activity with them. RCM's public

engagement scheme is very well-known as a high performance, as the questionnaire result shows that 46%-50% of the sampled households have heard about the municipality's source separation programs from municipality officers (compared to 15%-17% for CMCM and 3%-5% for PCM). This pubic engagement might account for RCM's highest rate of people separating materials for the campaigns. Credit must also go to DEE who first enhance a people-based waste management system and established good communication with the community.

The other thing that the other two cases do not have is the various strategies for the program to persuade public participation as seen in Encourage/Enforce section.

Next is the case of PCM, the 4Es analysis is presented below.



Figure 6-3 4Es Analysis on case of PCM using 4Es model Source: Adapt from (Defra 2008)

Judging from the model analysis, PCM has all the necessary elements for household behaviour change, so we have seen the positive household behaviour shown earlier. Everything comes together as a policy package as well.

PCM seems to be strong at 'enable', firstly its training for all stakeholders about CBM and other waste strategies has been very out standing. More importantly, it has great connection with Wongpanit Group, which means they indirectly possess recycling infrastructure and their marketing skill. The fact that there are many wheelers and trucks wandering around the town makes it more convenient for households to give away their collected materials. As a result, Phitsanulok City has remarkable recyclable materials sorting performance from households.

On the other hand, regarding organic waste, the problem in finding market for home the composting project is an obstacle for PCM to sustain the program and later influence source separating behaviour. Thus PCM has shifted the focus from organic waste separating scheme

to own organic waste treatment project at landfill. Though actually not affecting household behaviour in separating at source, this has contributed to the city's cleanliness and reduced waste volume to landfill while providing alternative energy for the cement industry at the same time.

As for Exemplify, PCM has had GTZ as an adviser professionally guiding the MSWM from the very basic things in quality strategic planning to technological know-how introduction from Germany. The decision to ask for external support by PCM has appeared to be highly worthwhile.

Nonetheless, PCM's weak point in 4Es model is 'engage', despite the fact that PCM has very intensive communication though almost all kinds of mass and high-tech communication means. A from the very low percentage (5%) of sampled households cooperate with the municipality's campaign, even though we have noticed that, citizens tend to separate materials that the private recycling sector purchase. What is missing here is probably sufficient face-to-face, personalized communication with households.

Lastly, the analytical diagram for the case of CMCM is shown in Fig 6-4 below. The first two things, which we can notice is the absence of exemplify and the diffuse of the four parts. Maybe this is because of the MSWM tasks are divided for several departments and divisions and districts, especially collection and treatment, which are mostly left to the private waste management company.



Figure 6-4 4Es Analysis on case of CMCM using 4Es model Source: Adapt from (Defra 2008)

Then we can notice that CMCM has very weak 'enable' due to the shortage of infrastructure almost all the since collection all the way until the final disposal. Source separation is now mostly conducted under customary mode, in other words the action is focused around recyclable materials. Even though there is a visible recycling centre supported by the municipality, CMCM has solid movement to integrate the informal recycling sector in to the waste management system. Thus, no matter how much information and campaign given, lack

of policy enabler from infrastructure side leads to message rejection to collaborate from communities.

With weak enabler, without exemplifier, one can say that it is extremely difficult to expect a high level of source separation in Chiang Mai City.

6.2.2 External factors

The external factors chosen to fit the cases of Thai cities are from those demonstrated by Lardinois and Furedy (2007). They are habit, income, space in households, level of education and gender. After the chi-squared tests, the elements that shows statistically significant relationships with different aspects of source separation behaviour are illustrated table 6-2, and the SPSS output tables are available in (Appendix 4).

Table 6-2 Influences of external factors to the household waste separation in 3 selected cases. The \bullet mark indicates the statistical significance among the results, and the opposite meaning for the \circ mark.

External Factors	Habit		Gender			Space in household				
		Yes	No		Female	Male		No	Some	Yes
Set certain waste aside	•	97%	7 6 %	•	84%	76%	•	<mark>66%</mark>	84%	88%
Material separated										
Organic	0	-	-	0	-	-	0	-	-	-
Hazardous	0	-	-	0	-	-	0	-	-	-
Recyclable										
Glass	•	83%	76%	•	81%	74%	•	75%	80%	87%
Plastic	•	95%	88%	0	-	-	•	86%	82%	91%
Bax	•	81%	69%	0	-	-	•	69%	61%	77%
Newspaper, magazine	•	74%	55%	0	-	-	•	61%	47%	63%
Old clothes	•	19%	12%	0	-	-	0	-	-	-

Note: These percentages represent rates among groups of people (have/not have separation habit, male/female, no/some/large space in household) who answered whether they set certain waste aside and what they separate. For example, at "Habit-Yes" means 97% of people who claimed to have source separation habit do set certain waste aside, and at "Habit-No" refers that only 76% of the rest of the sampled household who do not have separation habit perform sorce separation.

Source: Own table

In the sampling households from cities selected, level of education and income do not prove significant influence on source separation behaviour. Fortunately, habit, gender, and space in household demonstrate interesting results.

Habit

The hypothesis about habit is that people who have been separating certain waste for a long time without specific reason as if it is their habit tend to separate waste more than others.

The results prove the analysis by stating that among sampling units that indicate to have such source separating habit (answering "there is no particular reason but it has been practiced for a long time as a habit") there are 97% of them performing source separation. As for sampling unit that do not have the habit, 76% of them claim to set certain waste aside. If policy makers can intervene consumption activity that somehow result in source separating being routinized as a habit for household in these 3 cities the degree of source separation might be much higher.

However, the routine source separators tend not sort everything. The result shows that they are only active to separate saleable materials which are easier to sort and sell.

Gender

The assumption about gender and source separation is that housewives, females, are more active in separating at source than their male counterparts as they are likely to be the housework organizers. The result also states the same message that, in the sampling group, females tend to separate waste more than male by the percentage of 84% over 76%. However when looking at the materials separated, there is no significant difference among hazardous and organic materials, even the recyclable waste, except for glass. The reason could be that glass bottle and other glass products are the products for food and drinks to be mainly consumed in the kitchen and responsible by housewives.

Space in household

Certainly that household cannot sell collected material anytime they wish, the buyers only purchase in kilogram unit. Thus, sorted materials have to be accumulated and this needs space. One of the reason occasionally found in the research questionnaires that asks why one do not separate waste is that they do not have a place to keep those wastes to wait for the time to deliver them. The statistical tests show that the percentage of sampling household, if they have space in the house (detached house with surrounding e.g. yard) they appear to separate recyclable materials more than those who has less space (commercial building, townhouse) and no space (dormitory, condominium). However there was no significant difference among organic, household hazardous waste. Old clothes do not appeal to relate with space in household either, which might be because, regardless of the housing types, they are kept in the cupboard, and it is usually sorted for the purpose of donation, not selling on kilogram basis.

Factors such as habit, space in household and gender are truly external where policies have difficulty to influence. That was in the sense that the parameters cannot be changed within a program. On the other hand, the municipality may use this information about their influences to enhance their campaigns such as putting housewife association as the first source separation campaign's target.

6.3 Discussion

The potential and performance of separating recyclables are observable in cities that informal recycling sector and related recycling industry exist. Without intervention from municipality there is always customary mode of source separation. Therefore as we can perceive from case of RCM, even though the regarded materials of the source separation campaign covers wider scope, the recyclates is the best type of waste that source separation encouragement should set out from. Policy intervention is proved to enhance the scale of customary source

separation. Municipality may wish to promote recycling business by removing economic barrier such as applying tax holiday, etc.

Speaking of economic tools such as tax and penalty, this tool under 'encourage' element in the 4Es can be quite difficult to implement in Thai cities despite the fact that municipalities have discretion under the Public Health Act to adjust the service charge. Due to the NIMY syndrome among local politicians (not in my years), methods that could easily impact the popularity and might effect the votes in next election are not quite favourable. Thus, there might be a room for the central agency to intervene at a national level.

It looks like the politics issue and municipal solid waste management is the relationship of dilemma. Waste problem is set as the issue of high priority among other environmental problems in the responsibility of municipalities, because waste problem is highly visible, i.e. it can be noticed very easily as well as giving effect to everyone's everyday life in no time. Yet, the possible reason explaining the remain of the problem could be that the politicians might not wish to get rid of the problem completely as it can be a matter to promote their next term of election – 'solid waste problem solving is on the go and need to be consistent, so please choose us'. In the case of Chiang Mai City, it is acknowledged that it is almost impossible to separate politics from municipal solid waste problem. (Pattanapongsa 1998; Charoenmuang 2008)

Another point is that, if every household separate waste effectively, the poor who live their lives by sorting saleable waste from communal kerbside would have to lose their income. Some municipalities concern that they would have to come up with another policy to support the poor.

As we can see that politicians are also playing crucial role in deciding the outcome of source separation scheme. A serious devotion by the mayor and the administrative team in dealing with solid waste problem could turn the crisis in to the example cases within a decade as happened in the cases of PCM and RCM. PCM decided not to spend budget on some projects recommended by central government when they saw no further improvement could happen, instead PCM as a municipality directly asked for technological advices from GTZ. (GTZ 2007) This could be regarded as the starting point of dedication standing out from the Thai conventional politicians. Similarly, in the RCM's case, the earnestness to improve waste crisis in Rayong City started from the previous administrative team who were working hard with DEE to make an obvious better change. The good courage seems to be carried on by the present team too, drawing from the project stability.

Having mentioned that the key point that caused the dramatic different outcome between CMCM and the other two municipalities is the infrastructure provided, there is one point regarding the appropriateness of waste treatment technology RCM and PCM are using.

Is advanced and expensive waste treatment technology really good in the long run for RCM? RCM has been frequently facing number of mechanical problem occurred within the plant causing frequent operation cease. And the maintenance cost is definitely high while the plant is not making any profit. On the other hand MBT is the less complicated technology even though it has the different purpose, not to raise organic-waste separation awareness but performing central sorting. The point making here is that, although a composting plant project does not look for economic profit but more for the change of household behaviour to facilitate further source separation programs in the future, it might be a sensible idea to also look for simpler and equipment that are much less capital-intensive to assure the program's sustainability.

One thing that sampling households in all three selected cases have in common is the rate of separating household hazardous waste. The rate of 11% should be improved by all means. Probably the central government should start the clearer framework for the municipality to draw supporting regulations. The Pollution Control Department, the Ministry of Natural Resources and Environment, has been working on such a framework to promote the management of hazardous waste from used products.

Lastly, behaviour change is not something that one should expect to see right away. According to Defra (2008) behaviour change may reveal over months or years. And in the case of the radical behaviour shift like, perhaps, sorting and keeping what used to be easily disposed of for all one's life, it might take decades. Policy makers may have to set a reasonable time frame for source separation programs.

7. Conclusion

7.1 Findings and lessons learned

MSWM in 3 cities were studied to understand the achievements and levels of source separation in Chiang Mai, Phitsanulok, and Rayong. They are big cities with a lot of economic and industrial activities. They are facing solid waste problems since waste generation is very high while the disposal capacity is diminishing. In addition, finding new space for landfill is becoming difficult. Following the waste management trend in the southern countries, recycling has become an attraction among policy makers, and later the concept of source separation was also adopted.

It is clear that source separation has been performed in Thai society for a long time as defined by the term 'customary source separation'. The customary practices, especially recycling businesses, ease the solid waste problem as they divert a considerable amount of recyclable materials from the main waste stream.

As for organized practices, source separation schemes have been incorporated as part of municipal waste management policy in many municipalities in Thailand including the three selected cases. The schemes are normally under the responsibility of one Bureau which does not look after waste collection and treatment tasks, but is focusing on giving information and education related to solid waste issues. Thus, it turns out that the main duty of the municipalities in source separation campaigns is to initiate source separation projects for communities to run by themselves and give education of how to sort materials properly. The main character of the campaign is to raise awareness among consumers through a number of common Thai-styled campaigns such as school-community recyclable waste bank, home composting, and donating waste to temple events. Materials encouraged to separate are mainly the recyclables, the bio-degradables, and the hazardous waste. However, information and education is not a sufficient condition for behavioural change and source separation has to be connected with other MSW activities.

The main findings agree with the main hypothesis that, municipal source separation policy which completely equipped *4 elements of behaviour change model* tend to obtain satisfied level of household waste separation behaviour. Also, it can be suggested that in the case of Thailand, *'enabler'* could be all that the municipalities need to provide in the policy first, while 'exemplify' 'encourage' and 'engage' may come to boost the performance later.

At policy level, the model analysis has shown that CMCM's strength in 'engage' does not help compensate the weak 'enable' and 'encourage' components. The consequence is that the volume of waste to landfill which has increased continuously and household source separation lags behind the other two cases. In addition, CMCM lacks *external assistance*, which could otherwise improve policy performance since most municipality administrators are not as proficient in environmental issues as the professionals.

On the contrary, the PCM case suggests that *cooperating with private recycling business* can reinforce the separation of saleable materials. It shows the most impressive recyclable material separation behaviour among the three. Another advantage of this partnership is that the municipality does not have to build infrastructure for the recyclates. Furthermore, when most recyclable materials are removed from the waste stream, it is more convenient to treat rest waste with other technology.

The case with top performance is RCM, which shows the strongest 'enable', RCM does provide infrastructure for every campaign, and engages intensively with its citizens at a household level. This is possible thanks to a generous grant from the national government. In this sense, the study confirms the effectiveness of changing *structural condition* which is usually *more effective than* intervention targeting consumer beliefs or attitudes through *education*. The analysis states that RCM receives the better cooperation from households to sort organic waste than PCM since RCM has an obvious infrastructure for organic waste infrastructure resulted in the lowest rate of organic waste separation in Phitsanulok. However, PCM is coping with organic fractions in mixed waste by central sorting and MBT.

Regarding external factors that influences source separation behaviour in Chiang Mai, Phitsanulik and Rayong, the data confirmed the role of habit, gender, and space in households. Although these elements are not easy to intervene into, knowing their effects can help policy makers to improve the design of source separation schemes, e.g. by identifying target groups and appropriate approaches for different groups of population.

Lastly, two topics that emerged from the analysis are discussed. The first is over the compatibility of technologies with the doubt about composting technology that RCM is using. The plant often breaks down and the maintenance cost is considerable. So, simpler technology, to be discovered, might be a better alternative for the program's sustainability. The other issue is about the socio-political environment of the country which is still rather elite-oriented and the position of civil society is not clearly presented, so probably it is more of a challenge to expect active participation in waste management from grassroot level, e.g. CBM. Achievement of environmental policy in Thailand still heavily relies on the decision makers, mayors in this case, as shown in the case of PCM and RCM.

7.2 Recommendation for future research

One area for future research is to identify and test material recovery and waste disposal technologies suitable for the context of Thai cities. This is especially true for the organic fraction which now has no developed market unlike recyclates.

The management of hazardous waste from communities is another hot spot. The toxicity resulting from disposing it in mixed waste is high while the effects of source separation schemes on this fraction is relatively low in all cases.

The author has encountered the subject of difficulty in running source separation campaign among the group of immigrants from neighbouring countries. According to interview and personal observation, they tend to isolate themselves from the majority and refuse to cooperate with municipal officers during the campaigns partly because they do not speak Thai. It was stated that it is quite difficult to approach them. It may be interesting to discover the relationship between state and the immigrants under the framework of social engagement for effective environmental policy implementation.

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Abbreviations

MSW	Municipal Solid Waste
MSWM	Municipal Solid Waste Management
UNEP	United Nations Environmental Programs
NIMBY	Not In My Back Yard
DEFRA	Department for Environment, Food and Rural Affairs
SPSS	Statistical package for social sciences
MRFs	Materials Recovery Facilities
MCMUA	Morris County Municipal Utilities Authority
ILO	International Labor Organization
NGO	Non-Governmental Organization
BPHE	Bureau of Public Health and Environment
CMCM	Chiang Mai City Municipality
TSS	Technical Sanitary Section
EM	Effective Microorganism
LM	Lamphun Municipality
GTZ	Gesellschaft für Technische Zusammenarbeit
CBM	Community-based Waste Management
PCM	Phitsanulok City Municipality
MBT	Mechanical-Biological Waste Treatment
ILGI	Institute for Local Government Initiations
RCM	Rayong City Municipality
DEE	Development for Environment and Energy Foundation
RDF	Refuse-Derived Fuel

Appendix

	population	confidence level						
	size	±1% ±2%		±3%	±4%	±5%	±10%	
	500	-	-	-	-	222	83	
	1,000	-	-	-	385	286	91	
	1,500	-	-	638	441	361	94	
	2,000	-	-	718	476	333	95	
	2,500	-	1,250	769	500	345	96	
	3,000	-	1,364	811	517	353	97	
	3,500	-	1,458	843	530	359	97	
	4,000	-	1,538	870	541	364	98	
	4,500	-	1,607	891	549	367	98	
	5,000	-	1,667	909	556	370	98	
	6,000	-	1,765	938	566	375	98	
	7,000	-	1,842	959	574	378	99	
	8,000	-	1,905	976	580	381	99	
	9,000	-	1,957	989	584	383	99	
	10,000	5,000	2,000	1,000	588	385	99	
	15,000	6,000	2,143	1,034	600	390	99	
	20,000	6,667	2,222	1,053	606	392	100	
	25,000	7,143	2,273	1,064	610	394	100	
	50,000	8,333	2,381	1,087	617	397	100	
	100,000	9,091	2,439	1,099	621	398	100	
>	100,000	10,000	2,500	1,111	625	400	100	

Appendix 1: Taro Yamane's Sample Size Table

Appendix 2: Research questionnairs to households

แบบสอบถาม เรื่อง การมีส่วนร่วมจากภาคประชาชนในกิจกรรมแยกขยะในครัวเรือน

คำชี้แจง ้แบบสอบถามนี้เป็นส่วนหนึ่งของวิทยานิพนธ์ปริญญาโทเรื่อง "ตัวแปรความสำเร็จของนโยบายการแยกขยะจากครัวเรือนในประเทศไทย กรณีศึกษาเปรียบเทียบระหว่างเขตเทศบาลนครเชียงใหม่ เขตเทศบาลเมืองพิษณุโลก และ เขตเทศบาลเมืองระยอง" ของ นางสาว ญาณิน จิวะกิดาการ ในหลักสูตร Master of Environmental Science, Policy and Management มหาวิทยาลัย Aegean, Central European, Lund และ Manchester ข้อมูลและความคิดเห็นที่ได้จากแบบสอบถามนี้จะนำไปใช้เพื่อการศึกษาเท่านั้น

- 1. ท่านมีความตระหนักถึงปัญหาขยะมูลฝอยในเชียงใหม่มากน้อยเพียงใด O เป็นอย่างมาก O เล็กน้อย O พอสมควร 0 ไม่ทราบถึงปัญหา
- 2. ท่านรู้สึกว่าปัญหาขยะมูลฝอยมีผลกระทบต่อชีวิตประจำวันของท่านมากน้อยเพียง ใด
 - O กระทบมาก O กระทบบ้าง O ไม่รู้สึกว่ามีผลกระทบ
- ท่านคิดว่า การแยกขยะจากครัวเรือนเพื่อการนำกลับมาใช้ใหม่เป็นการช่วยแก้ปัญหาขยะใน เชียงใหม่ O ຈ5ิง

O ไม่จริง

 ท่านมีความรู้ความเข้าใจว่า ขยะมูลฝอยประเภทใด เป็นวัสดุที่สามารถนำกลับมาใช้ใหม่ได้ O มีความรู้บ้าง O มีความรู้ความเข้าใจดี O มีความรู้แต่ไม่แน่ใจO ไม่มีความร้ในเรื่องนี้

ท่านเคยได้ยินหรือเข้าร่วมกิจกรรมรณรงค์เหล่านี้หรือไม่ (ถ้าไม่เคยได้ยินกรุณาข้ามไปตอบข้อ 6)

- การรณรงค์ให้มีการแยกขยะ เป็นขยะเปียก แห้ง และ ขยะอันตราย 51 โดยเทศบาลฯ
- O ได้ยินและเข้าร่วม O ได้ยินแต่ไม่ได้เข้าร่วม โดยท่านได้ยินเกี่ยวกับกิจกรรมนี้ผ่านทาง
- O ผู้นำและคนในชุมชน O พนักงานเทศบาลฯ O สื่อสิ่งพิมพ์ในท้องถิ่น O สื่อวิทยุโทรทัศน์
- O อื่น ๆ (ระบ).....
- โครงการธนาคารขยะหรือศูนย์คัดแยกขยะ โดยเทศบาลฯ 5.2
- O ได้ยินและเข้าร่วม O ได้ยินแต่ไม่ได้เข้าร่วม
 - **โดยท่านได้ยินเกี่ยวกับกิจกรรมนี้ผ่านทาง**
- O พนักงานเทศบาลฯ O สื่อสิ่งพิมพ์ในท้องถิ่น O ผ้นำและคนในชมชน O สื่อวิทยุโทรทัศน์
- O อื่น ๆ (ระบุ).....
- 5.3 โครงการแป่งขี้เหยื้อหื้อเป่นทุน โดยสถาบันวิจัยสังคม

O ได้ยินและเข้าร่วม O ได้ยินแต่ไม่ได้เข้าร่วม **โดยท่านได้ยินเกี่ยวกับกิจกรรมนี้ผ่านทาง** O ผู้นำและคนในชุมชน O พนักงานเทศบาลฯ O สื่อสิ่งพิมพ์ในท้องถิ่น O สื่อวิทยโทรทัศน์ O อื่น ๆ (ระบฺ)..... ท่านแยกขยะที่สามารถนำกลับมาใช้ใหม่ได้ โดยไม่ทิ้งรวมกับขยะอื่น ๆ O ใช่ O ไม่ใช่ เพราะ (หากตอบว่า ไม่ใช่ กรณาข้ามไปข้อ 11) ท่านแยกขยะที่นำกลับมาใช้ได้ให้กับ O โครงการของเทศบาลฯ O โครงการของสถาบันวิจัยสังคม O ซาเล้ง/คนเก็บขยะ O อื่น ๆ(ระบฺ) 8. **วัสดุที่ท่านแยก** (ตอบได้มากกว่า 1 ข้อ) O ขเวดแก้ว O ขวดพลาสติก O กระดาษกล่อง 0 หนังสือพิมพ์/นิตยสาร O เสื้อผ้าเก่า O ถ่านไฟฉาย/หลอดไฟ O ใบไม้แห้ง/เศษอาหาร O อื่น ๆ (ระบ) 9. **เหตุผลที่ท่านแยกขยะ** (ตอบได้มากกว่า 1 คำตอบ) O ไม่มีเหตุผลพิเศษแต่ปฏิบัติมานาน เป็นความเคยชิน เป็นเวลาประมาณบี O เป็นการช่วยเหลือซาเล้ง และคนเก็บขยะ O สร้างรายได้ให้ครัวเรือน O เจ้าหน้าที่จากเทศบาล ฯ มาชักชวน 0 ร่วมมือกับโครงการรณรงค์แยกขยะเพราะเห็นว่าช่วยแก้ปัญหาขยะมูลฝอยในเชียงใ หม่ O อื่น ๆ (ระบ) 10. ครัวเรือนของท่านแยกขยะอย่างสม่ำเสมอ O ใช่ O ไม่ใช่ เพราะ..... 11. ท่านรู้สึกว่าเป็นเรื่องลำบากและเสียเวลาที่ต้องแยกขยะมูลฝอยเป็นประเภทต่าง ๆ หรือไม่ O ใช่ O ไม่ใช่ 12. ท่านจะให้ความร่วมมือมากน้อยเพียงใด หากทางเทศบาลจัดถังขยะสำหรับมูลฝอยประเภทต่าง ๆ ้แก่ท่านเพื่อส่งเสริมการแยกขยะจากครัวเรือน และมีบริการจัดเก็บวัสดูแต่ละชนิดอย่างเป็นระบบ O ร่วมมือเต็มที่ O อาจจะร่วมมือ

O ไม่ให้ความร่วมมือ เนื่องจาก O ไม่ทราบ 13. หน่วยงานที่ท่านคิดว่าจะมีประสิทธิภาพในการจัดการขยะมากที่สุด O ครัวเรือน/ชุมชนจัดการเอง O เทศบาลฯ 0 เอกชน/บริษัทรับจัดการขยะ O เอกชนร่วมกับแทศบาล O ประชาชน เทศบาล และ เอกชน ร่วมมือกัน O อื่นๆ O ไม่มีหน่วยงานใดมีประสิทธิภาพ (ระบุ)..... ¹⁴ ข้อมูลส่วนตัวของท่าน เพศ..... อายุ..... ภูมิลำเนา อาชีพ.....อาชีพ.....จำนวนสมาชิกในครอบครัว..... การศึกษา รายได้ต่อเดือน O ต่ำกว่า 5,000 บาท O 5,000 - 15,000 บาท O 15,001 – 35,000 บาท O มากกว่า 35,000 บาท NOTICE (กรอกโดยผู้วิจัย)

▶ลักษณะอาคาร และ บริเวณใกล้เคียง

►ความคิดเห็นอื่น ๆ
Questionnaire: Public Participation in Source Separation Campaigns

<u>Acknowledgement</u> this questionnaire is part of a Master Thesis studying about factors influencing outcome of source separation policies in Thailand. It is a comparative study between 3 cases: Chiang Mai City Municipality, Phitsanulok City Municipality, and Rayong city Municipality. The thesis is being conducted under Ms. Yanin Chivakidakarn, in completing Master of Environmental Science, Policy and Management from University of Aegean, Central European University, Lund University and University of Manchester. Data and opinion obtained from the questionnaire will be used for academic purpose only.

- How much are you aware of solid waste situation in Chiang Mai?
 O very much
 O somewhat
 O little
 O not aware
- How much do you feel the impact of solid waste situation in Chiang Mai?
 O very much
 O somewhat
 O do not feel the impact
- Do you agree that separating reusable/recyclable material from mixed waste helps solving waste problem in Chiang Mai?
 O yes
 O no
- 4. In what level to you think you know which materials can be sorted from other wastes
- O very well O somewhat O some, but not sure O do not know
- 5. Have you heard of or taken part in these campaigns?⁴ If not please continue to no. 6
- **5.1** Wet-Dry-Hazardous wastes separation campaign, by municipality O heard and took part O heard but not take part You have heard about this campaign through O community leader O municipality officer O local printings O Radio/TV O Others (please indicate)..... **5.2** Waste bank and Recycling centre, by municipality O heard and took part O heard but not take part You have heard about this campaign through O community leader O municipality officer O local printings O Radio/TV O Others (please indicate)..... 5.3 Turning waste into capital, by Social Research Institute (SRI) O heard and took part O heard but not take part You have heard about this campaign through O community leader O municipality officer O local printings O Radio/TV O Others (please indicate)..... Do you separate certain kinds of waste at source? 6. O yes O no, because (if answer 'no' please skip to no.11) 7. You separate certain materials for... O Municipality's campaigns O SRI's campaign O Others (indicate) O Recycling business

⁴ This question will be different for the case of PCM and RCM depends on the campaigns they are launching.

8.	Which materials do you separa answer)	ate? (you choose mc	pre than 1
	O Glass botte O Plastic bottle	O Boxpaper	0
	O old clothes O batteries/bulbs (indicate)	O organic waste O	others
9.	What is/are the reason that make y O no specific reason, it has always be O want to help waste pickers and whe O increase income for the household O officers from municipality persuade O think that if would help solving was	you separate wastes? (ca en done for years eelers ed to do ste problem in Chiang Mai	n answer more than 1) i City
10.	Do your household performing sou	Irce separation regularly	?
	O Yes O No, because)	
	(indicate)		
11.	Do you feel that you have to sarcrif	fice your time and effort	to separate waste?
12.	O Yes O No Would you cooperate with Chiang different kinds of bins are provided conducted?	Mai City Municipality's I and systematic collection	campaigns if on is assured to be
	O Yes	O May be	
	O Do not know	O No, because	
13.	Sector that is the most effective in your opinion is	performing solid waste r	management in
	O community O municipality O private company and municipality O noone	O private waste managemer O community, municipality O others (indicate)	nt company and private company
14.	Your personal information Gender Age Occupation Number Education Income	Origir er of household member	J
	O Below 5,000 Baht ⁵	O 5,000 – 15,000 Baht	
	O 15,001 – 35,000 Baht	O Above 35,000 Baht	

NOTICE (fill in by researcher)

Type of building and surrounding

other opinion

⁵ 32 THB (Thai Baht) = 1 USD

Appendix 3: Main interview questions to the Deputy Mayors of PCM and RCM

- 1. As an administrator, how much do you put priority on municipal solid waste matter comparing to other environmental issue in the city?
- 2. What are the reasons behind the source separation campaigns?
- Please tell use about your campaigns in details
 Initiator, target set, strategies, partners, external support
- 4. How would you evaluate the outcome of the campaigns so far?
- 5. Have there been any obstacles?
- 6. What is the future plan regarding source separation?

Appendix 4: Chi-Square test result for independent variable

Relation: City and Number of respondents answered if they separate waste

Crossian						
	Yesnos	eparate				
	.00	1.00	Total			
Count	97	329	426			
% within City	22.8%	77.2%	100.0%			
Count	114	298	412			
% within City	27.7%	72.3%	100.0%			
Count	19	360	379			
% within City	5.0%	95.0%	100.0%			
Count	230	987	1217			
% within City	18.9%	81.1%	100.0%			
	Count % within City Count % within City Count % within City Count % within City	Yesnos .00 Count 97 % within City 22.8% Count 114 % within City 27.7% Count 19 % within City 5.0% Count 230 % within City 18.9%	Yesnoseparate .00 1.00 Count 97 329 % within City 22.8% 77.2% Count 114 298 % within City 27.7% 72.3% Count 19 360 % within City 5.0% 95.0% Count 230 987 % within City 18.9% 81.1%			

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	72.521 ^a	2	.000
Likelihood Ratio	86.038	2	.000
Linear-by-Linear Association	38.774	1	.000
N of Valid Cases	1217		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 71.63.

Relalation: City and Number of respondents answered if they separate waste regularly

Crosstab						
			RegSe	parate		
			.00	1.00	Total	
City	Chiang Mai	Count	40	288	328	
		% within City	12.2%	87.8%	100.0%	
	Phitanulok	Count	15	278	293	
		% within City	5.1%	94.9%	100.0%	
	Rayong	Count	44	315	359	
		% within City	12.3%	87.7%	100.0%	
Total		Count	99	881	980	
		% within City	10.1%	89.9%	100.0%	

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	11.427 ^a	2	.003
Likelihood Ratio	12.826	2	.002
Linear-by-Linear Association	.012	1	.912
N of Valid Cases	980		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 29.60.

Relation: City and Number of respondents answered if they separate glass bottle

			Glass	bottle		
			.00	1.00	Total	
City	Chiang Mai	Count	100	231	331	
		% within City	30.2%	69.8%	100.0%	
	Phitanulok	Count	37	261	298	
		% within City	12.4%	87.6%	100.0%	
	Rayong	Count	77	283	360	
		% within City	21.4%	78.6%	100.0%	
Total		Count	214	775	989	
		% within City	21.6%	78.4%	100.0%	

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	29.308 ^a	2	.000
Likelihood Ratio	30.209	2	.000
Linear-by-Linear Association	7.316	1	.007
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 64.48.

	Crosstab						
			plastic	bottle			
			.00	1.00	Total		
City	Chiang Mai	Count	33	298	331		
		% within City	10.0%	90.0%	100.0%		
	Phitanulok	Count	15	283	298		
		% within City	5.0%	95.0%	100.0%		
	Rayong	Count	48	312	360		
		% within City	13.3%	86.7%	100.0%		
Total		Count	96	893	989		
		% within City	9.7%	90.3%	100.0%		

Relation: City and Number of respondents answered if they separate plastic bottle

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	12.854 ^a	2	.002
Likelihood Ratio	13.781	2	.001
Linear-by-Linear Association	2.452	1	.117
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 28.93.

Relation: City and Number of respondents answered if they separate box paper

			Bo	ЭХ	
			.00	1.00	Total
City	Chiang Mai	Count	114	217	331
		% within City	34.4%	65.6%	100.0%
	Phitanulok	Count	27	271	298
		% within City	9.1%	90.9%	100.0%
	Rayong	Count	128	232	360
		% within City	35.6%	64.4%	100.0%
Total		Count	269	720	989
		% within City	27.2%	72.8%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	70.978 ^a	2	.000
Likelihood Ratio	81.578	2	.000
Linear-by-Linear Association	.273	1	.601
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 81.05.

Relation: City and Number of respondents answered if they separate newspaper/magazine

			News	sMag		
			.00	1.00	Total	
City	Chiang Mai	Count	163	168	331	
		% within City	49.2%	50.8%	100.0%	
	Phitanulok	Count	61	237	298	
		% within City	20.5%	79.5%	100.0%	
	Rayong	Count	169	191	360	
		% within City	46.9%	53.1%	100.0%	
Total		Count	393	596	989	
		% within City	39.7%	60.3%	100.0%	

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	66.501 ^a	2	.000
Likelihood Ratio	70.491	2	.000
Linear-by-Linear Association	.184	1	.668
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 118.42.

Crosstab							
			oldclo	othes			
			.00	1.00	Total		
City	Chiang Mai	Count	278	53	331		
		% within City	84.0%	16.0%	100.0%		
	Phitanulok	Count	246	52	298		
		% within City	82.6%	17.4%	100.0%		
	Rayong	Count	326	34	360		
		% within City	90.6%	9.4%	100.0%		
Total		Count	850	139	989		
		% within City	85.9%	14.1%	100.0%		

Relation: City and Number of respondents answered if they separate old clothes

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	10.228 ^a	2	.006
Likelihood Ratio	10.721	2	.005
Linear-by-Linear Association	6.381	1	.012
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 41.88.

Relation: City and Number of respondents answered if they separate hazardous waste

			HHw	aste	
			.00	1.00	Total
City	Chiang Mai	Count	284	47	331
		% within City	85.8%	14.2%	100.0%
	Phitanulok	Count	254	44	298
		% within City	85.2%	14.8%	100.0%
	Rayong	Count	321	39	360
		% within City	89.2%	10.8%	100.0%
Total		Count	859	130	989
		% within City	86.9%	13.1%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.692 ^a	2	.260
Likelihood Ratio	2.755	2	.252
Linear-by-Linear Association	1.769	1	.184
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 39.17.

Relation: City and Number of respondents answered if they separate organic waste

	Crosstab							
			Orga	nicW				
			.00	1.00	Total			
City	Chiang Mai	Count	247	84	331			
		% within City	74.6%	25.4%	100.0%			
	Phitanulok	Count	255	43	298			
		% within City	85.6%	14.4%	100.0%			
	Rayong	Count	243	117	360			
		% within City	67.5%	32.5%	100.0%			
Total		Count	745	244	989			
		% within City	75.3%	24.7%	100.0%			

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	28.780 ^a	2	.000
Likelihood Ratio	30.135	2	.000
Linear-by-Linear Association	5.203	1	.023
N of Valid Cases	989		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 73.52.

Appendix 5: Chi-Square test result for external factors

Relation: Habit and Number of respondents answered if they separate waste

			Yesnos	eparate	
			.00	1.00	Total
Habit	.00	Count	224	729	953
		% within Habit	23.5%	76.5%	100.0%
	1.00	Count	6	258	264
		% within Habit	2.3%	97.7%	100.0%
Total		Count	230	987	1217
		% within Habit	18.9%	81.1%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	60.803 ^b	1	.000		
Continuity Correction	59.426	1	.000		
Likelihood Ratio	83.270	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	60.753	1	.000		
N of Valid Cases	1217				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 49. 89.

Relation: Habit and Number of respondents answered if they separate glass bottle

			Glass	bottle	
			.00	1.00	Total
Habit	.00	Count	171	559	730
		% within Habit	23.4%	76.6%	100.0%
	1.00	Count	43	216	259
		% within Habit	16.6%	83.4%	100.0%
Total		Count	214	775	989
		% within Habit	21.6%	78.4%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	5.248 ^b	1	.022		
Continuity Correction	4.853	1	.028		
Likelihood Ratio	5.472	1	.019		
Fisher's Exact Test				.022	.013
Linear-by-Linear Association	5.242	1	.022		
N of Valid Cases	989				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 56. 04.

Relation: Habit and Number of respondents answered if they separate plastic bottle

			plastic	plasticbottle	
			.00	1.00	Total
Habit	.00	Count	83	647	730
		% within Habit	11.4%	88.6%	100.0%
	1.00	Count	13	246	259
		% within Habit	5.0%	95.0%	100.0%
Total		Count	96	893	989
		% within Habit	9.7%	90.3%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	8.797 ^b	1	.003		
Continuity Correction	8.087	1	.004		
Likelihood Ratio	9.948	1	.002		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	8.788	1	.003		
N of Valid Cases	989				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 25. 14.

Relation: Habit and Number of respondents answered if they separate boxpaper

Crosstab										
			Во	х						
			.00	1.00	Total					
Habit	.00	Count	222	508	730					
		% within Habit	30.4%	69.6%	100.0%					
	1.00	Count	47	212	259					
		% within Habit	18.1%	81.9%	100.0%					
Total		Count	269	720	989					
		% within Habit	27.2%	72.8%	100.0%					

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	14.522 ^b	1	.000		
Continuity Correction	13.909	1	.000		
Likelihood Ratio	15.367	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	14.507	1	.000		
N of Valid Cases	989				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 70. 45.

Relation: Habit and Number of respondents answered if they separate newspaper&magazine

		News	Mag	
		.00	1.00	Total
.00	Count	326	404	730
	% within Habit	44.7%	55.3%	100.0%
1.00	Count	67	192	259
	% within Habit	25.9%	74.1%	100.0%
	Count	393	596	989
	% within Habit	39.7%	60.3%	100.0%
	.00	.00 Count % within Habit 1.00 Count % within Habit Count % within Habit	News .00 .00 Count % within Habit 44.7% 1.00 Count % within Habit 25.9% Count % within Habit 393 % within Habit	NewsMag .00 1.00 .00 Count 326 404 % within Habit 44.7% 55.3% 1.00 Count 67 192 % within Habit 25.9% 74.1% Count 393 596 % within Habit 39.7% 60.3%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	28.182 ^b	1	.000		
Continuity Correction	27.403	1	.000		
Likelihood Ratio	29.306	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	28.154	1	.000		
N of Valid Cases	989				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 102.
92.

Relation: Habit and Number of respondents answered if they separate old clothes

			HHwaste		
			.00	1.00	Total
Habit	.00	Count	629	101	730
		% within Habit	86.2%	13.8%	100.0%
	1.00	Count	230	29	259
		% within Habit	88.8%	11.2%	100.0%
Total		Count	859	130	989
		% within Habit	86.9%	13.1%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.166 ^b	1	.280		
Continuity Correction	.946	1	.331		
Likelihood Ratio	1.201	1	.273		
Fisher's Exact Test				.335	.165
Linear-by-Linear Association	1.165	1	.280		
N of Valid Cases	989				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 34. 04.

Total

Crosstab								
			OrganicW					
			.00	1.00	Total			
Habit	.00	Count	545	185	730			
		% within Habit	74.7%	25.3%	100.0%			
	1.00	Count	200	59	259			
		% within Habit	77.2%	22.8%	100.0%			

Relation: Habit and Number of respondents answered if they separate organic waste

Chi-Square Tests

745

75.3%

244

24.7%

989

100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.675 ^b	1	.411		
Continuity Correction	.545	1	.461		
Likelihood Ratio	.683	1	.408		
Fisher's Exact Test				.451	.231
Linear-by-Linear Association	.675	1	.411		
N of Valid Cases	989				

a. Computed only for a 2x2 table

Count

% within Habit

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 63. 90.

Relation: Gender and Number of respondents answered if they separate waste

Crosstab									
			Yesnose	Yesnoseparate					
			.00	1.00	Total				
Gender	Female	Count	115	620	735				
		% within Gender	15.6%	84.4%	100.0%				
	Male	Count	105	350	455				
		% within Gender	23.1%	76.9%	100.0%				
Total		Count	220	970	1190				
		% within Gender	18.5%	81.5%	100.0%				

CEU eTD Collection

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	10.297 ^b	1	.001		
Continuity Correction	9.810	1	.002		
Likelihood Ratio	10.107	1	.001		
Fisher's Exact Test				.002	.001
Linear-by-Linear Association	10.288	1	.001		
N of Valid Cases	1190				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 84. 12.

Relation: Gender and Number of respondents answered if they separate glass bottle

			Glassbottle		
			.00	1.00	Total
Gender	Female	Count	115	507	622
		% within Gender	18.5%	81.5%	100.0%
	Male	Count	89	261	350
		% within Gender	25.4%	74.6%	100.0%
Total		Count	204	768	972
		% within Gender	21.0%	79.0%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig.	Exact Sig.	Exact Sig.
Deersen Chi Sauere		ui		(Z-Slueu)	(1-sided)
Pearson Chi-Square	6.505	1	.011		
Continuity Correction	6.093	1	.014		
Likelihood Ratio	6.384	1	.012		
Fisher's Exact Test				.014	.007
Linear-by-Linear Association	6.498	1	.011		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 73.
 46.

Crosstab							
			plastic	bottle			
			.00	1.00	Total		
Gender	Female	Count	53	569	622		
		% within Gender	8.5%	91.5%	100.0%		
	Male	Count	37	313	350		
		% within Gender	10.6%	89.4%	100.0%		
Total		Count	90	882	972		
		% within Gender	9.3%	90.7%	100.0%		

Relation: Gender and Number of respondents answered if they separate plastic bottle

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.121 ^b	1	.290		
Continuity Correction	.890	1	.345		
Likelihood Ratio	1.102	1	.294		
Fisher's Exact Test				.301	.172
Linear-by-Linear Association	1.120	1	.290		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 32. 41.

Relation: Gender and Number of respondents answered if they separate boxpaper

Crosstab

			Box		
			.00	1.00	Total
Gender	Female	Count	159	463	622
		% within Gender	25.6%	74.4%	100.0%
	Male	Count	104	246	350
		% within Gender	29.7%	70.3%	100.0%
Total		Count	263	709	972
		% within Gender	27.1%	72.9%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.956 ^b	1	.162		
Continuity Correction	1.751	1	.186		
Likelihood Ratio	1.940	1	.164		
Fisher's Exact Test				.176	.093
Linear-by-Linear Association	1.954	1	.162		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 94.
 70.

Relation: Gender and Number of respondents answered if they separate newspaper&magazine

			NewsMag		
			.00	1.00	Total
Gender	Female	Count	242	380	622
		% within Gender	38.9%	61.1%	100.0%
	Male	Count	147	203	350
		% within Gender	42.0%	58.0%	100.0%
Total		Count	389	583	972
		% within Gender	40.0%	60.0%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.893 ^b	1	.345		
Continuity Correction	.769	1	.381		
Likelihood Ratio	.891	1	.345		
Fisher's Exact Test				.375	.190
Linear-by-Linear Association	.892	1	.345		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 140. 07.

Crosstab							
			oldclo				
			.00	1.00	Total		
Gender	Female	Count	526	96	622		
		% within Gender	84.6%	15.4%	100.0%		
	Male	Count	308	42	350		
		% within Gender	88.0%	12.0%	100.0%		
Total		Count	834	138	972		
		% within Gender	85.8%	14.2%	100.0%		

Relation: Gender and Number of respondents answered if they separate old clothes

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	2.168 ^b	1	.141		
Continuity Correction	1.895	1	.169		
Likelihood Ratio	2.215	1	.137		
Fisher's Exact Test				.152	.083
Linear-by-Linear Association	2.166	1	.141		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 49. 69.

Relation: Gender and Number of respondents answered if they separate hazardous waste

Crosstab

			HHwaste		
			.00	1.00	Total
Gender	Female	Count	538	84	622
		% within Gender	86.5%	13.5%	100.0%
	Male	Count	307	43	350
		% within Gender	87.7%	12.3%	100.0%
Total		Count	845	127	972
		% within Gender	86.9%	13.1%	100.0%

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.293 ^b	1	.588		
Continuity Correction	.196	1	.658		
Likelihood Ratio	.295	1	.587		
Fisher's Exact Test				.621	.331
Linear-by-Linear Association	.293	1	.588		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 45. 73.

Relation: Gender and Number of respondents answered if they separate organic waste

			OrganicW		
			.00	1.00	Total
Gender	Female	Count	462	160	622
		% within Gender	74.3%	25.7%	100.0%
	Male	Count	273	77	350
		% within Gender	78.0%	22.0%	100.0%
Total		Count	735	237	972
		% within Gender	75.6%	24.4%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	1.684 ^b	1	.194		
Continuity Correction	1.488	1	.222		
Likelihood Ratio	1.702	1	.192		
Fisher's Exact Test				.213	.111
Linear-by-Linear Association	1.682	1	.195		
N of Valid Cases	972				

a. Computed only for a 2x2 table

b. 0 cells (.0%) have expected count less than 5. The minimum expected count is 85. 34.

Crosstab						
			Yesnos	eparate		
			.00	1.00	Total	
Building	1.00	Count	35	68	103	
		% within Building	34.0%	66.0%	100.0%	
	2.00	Count	19	102	121	
		% within Building	15.7%	84.3%	100.0%	
	3.00	Count	72	546	618	
		% within Building	11.7%	88.3%	100.0%	
Total		Count	126	716	842	
		% within Building	15.0%	85.0%	100.0%	

Relation: Space in household and Number of respondents answered if they separate waste

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	34.655 ^a	2	.000
Likelihood Ratio	28.736	2	.000
Linear-by-Linear Association	31.035	1	.000
N of Valid Cases	842		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 15.41.

Relation: Space in household and Number of respondents answered if they separate glass bottle

			Glassbottle		
			.00	1.00	Total
Building	1.00	Count	17	51	68
		% within Building	25.0%	75.0%	100.0%
	2.00	Count	20	82	102
		% within Building	19.6%	80.4%	100.0%
	3.00	Count	69	477	546
		% within Building	12.6%	87.4%	100.0%
Total		Count	106	610	716
		% within Building	14.8%	85.2%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.503 ^a	2	.009
Likelihood Ratio	8.658	2	.013
Linear-by-Linear Association	9.455	1	.002
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 10.07.

Relation: Space in household and Number of respondents answered if they separate plastic bottle

			plastic	bottle	
			.00	1.00	Total
Building	1.00	Count	9	59	68
		% within Building	13.2%	86.8%	100.0%
	2.00	Count	18	84	102
		% within Building	17.6%	82.4%	100.0%
	3.00	Count	44	502	546
		% within Building	8.1%	91.9%	100.0%
Total		Count	71	645	716
		% within Building	9.9%	90.1%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.772 ^a	2	.008
Likelihood Ratio	8.682	2	.013
Linear-by-Linear Association	5.828	1	.016
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 6.74.

Crosstab						
			Bo	рх		
			.00	1.00	Total	
Building	1.00	Count	21	47	68	
		% within Building	30.9%	69.1%	100.0%	
	2.00	Count	39	63	102	
		% within Building	38.2%	61.8%	100.0%	
	3.00	Count	121	425	546	
		% within Building	22.2%	77.8%	100.0%	
Total		Count	181	535	716	
		% within Building	25.3%	74.7%	100.0%	

Relation: Space in household and Number of respondents answered if they separate boxpaper

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	13.005 ^a	2	.001
Likelihood Ratio	12.255	2	.002
Linear-by-Linear Association	7.783	1	.005
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.19.

Relation: Space in household and Number of respondents answered if they separate newspaper&magazine

			NewsMag		
			.00	1.00	Total
Building	1.00	Count	26	42	68
		% within Building	38.2%	61.8%	100.0%
	2.00	Count	54	48	102
		% within Building	52.9%	47.1%	100.0%
	3.00	Count	199	347	546
		% within Building	36.4%	63.6%	100.0%
Total		Count	279	437	716
		% within Building	39.0%	61.0%	100.0%

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	9.849 ^a	2	.007
Likelihood Ratio	9.622	2	.008
Linear-by-Linear Association	2.504	1	.114
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 26.50.

Relation: Space in household and Number of respondents answered if they separate old clothes

			oldclothes		
			.00	1.00	Total
Building	1.00	Count	58	10	68
		% within Building	85.3%	14.7%	100.0%
	2.00	Count	88	14	102
		% within Building	86.3%	13.7%	100.0%
	3.00	Count	480	66	546
		% within Building	87.9%	12.1%	100.0%
Total		Count	626	90	716
		% within Building	87.4%	12.6%	100.0%

Crosstab

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	.522 ^a	2	.770
Likelihood Ratio	.507	2	.776
Linear-by-Linear Association	.514	1	.473
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 8.55.

Crosstab					
			HHwaste		
			.00	1.00	Total
Building	1.00	Count	55	13	68
		% within Building	80.9%	19.1%	100.0%
	2.00	Count	91	11	102
		% within Building	89.2%	10.8%	100.0%
	3.00	Count	475	71	546
		% within Building	87.0%	13.0%	100.0%
Total		Count	621	95	716
		% within Building	86.7%	13.3%	100.0%

Relation: Space in household and Number of respondents answered if they separate hazardous waste

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	2.602 ^a	2	.272
Likelihood Ratio	2.428	2	.297
Linear-by-Linear Association	.865	1	.352
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 9.02.

Crosstab OrganicW 1.00 .00 Total Building 1.00 Count 54 14 68 % within Building 79.4% 20.6% 100.0% 2.00 Count 67 35 102 34.3% % within Building 65.7% 100.0% 3.00 Count 412 134 546 % within Building 75.5% 24.5% 100.0% Total Count 533 183 716 % within Building 74.4% 25.6% 100.0%

Relation: Space in household and Number of respondents answered if they separate organic waste

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	5.289 ^a	2	.071
Likelihood Ratio	5.078	2	.079
Linear-by-Linear Association	.084	1	.772
N of Valid Cases	716		

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 17.38.