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LO CHI HANG

Policy and Design for Waste Recycling in Hong Kong Communities

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The waste management and environmental policies of Hong Kong rely on non-legislative command and control decisions made by the government. Thus, there is a necessity to review and examine waste recycling and its direction in Hong Kong. This research investigates and reviews the waste recycling policies of densely populated Asian cities whose lifestyles and residential conditions are comparable to those of Hong Kong. Utilising the findings from an empirical study of Hong Kong, the study investigates how various living environments and social change have affected waste recycling activities in Hong Kong. This study addresses concerns over the design of recycling facilities and their provision, which encourage community and household participation in waste recycling. Ultimately, this thesis explains the attitudes and behaviour towards recycling of Hong Kong people in the lower socio-economic stratum, and suggest possible recycling guidelines and feasible designs for waste recycling facilities in Hong Kong.

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POLICY AND DESIGN FOR WASTE RECYCLING IN HONG KONG COMMUNITIES

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School of Design

Policy and Design for Waste Recycling in Hong Kong Communities

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A thesis submitted in partial fulfilment of the requirements for the degree of Doctor of Philosophy

May 2015

CERTIFICATE OF ORIGINALITY

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_____ (Signed)

LO Chi Hang (Name of Student)

Abstract

The promotion of waste recycling is a key direction in environmental protection. It can help to decrease the demand for raw materials and their extraction, minimise problems encountered in transporting materials and reduce the amount of resources consumed in the transportation process. It can also lower the energy consumed and manpower employed in product production processes. Moreover, negative environmental impacts such as increases in the production of municipal solid waste can be significantly minimised through recycling. The life of landfills can be extended and the cost of managing waste reduced. More importantly, recycling can both directly and indirectly support and encourage positive lifestyles and attitudes among citizens by raising their awareness of environmental and human needs.

One of the critical elements of recycling is household recycling. Encouraging individuals and communities to contribute to environmental protection can bring about a better living environment for all. In this regard, education and public promotion are necessary tools for helping the public to understand the importance of participating in household recycling. In other words, it is important to raise public awareness of the crucial role played by each member of society and each household in the quest to attain a better living environment. To achieve greater household participation in recycling, policymakers, professionals and the public at large must take internal and external environmental factors, cultural factors and physical factors into account. It is only through careful long-term planning, implementation and management that household recycling can be encouraged and made successful.

According to previous studies, the participation rate of communities and households in waste minimisation and recycling is still very low. Complex and crowded living conditions and modern lifestyles have contributed to the societal neglect of environmental issues. Specifically, the waste recycling implementation in Hong Kong is still unsatisfactory. City's waste management and environmental policy continues to be based on non-legislative command and control decisions made by the government. Consequently, despite the prolonged recycling campaign and the minimisation policy among the community and industry, the amount of municipal solid waste has been increasing and the disposal problem growing for the past three decades. It is thus necessary to review and examine waste recycling and its direction in Hong Kong so that a better environment can be created for future generations.

This study discusses the issue of recycling, first by examining and reviewing the waste recycling policies of densely populated Asian cities with lifestyles and residential conditions comparable to those of Hong Kong. It then empirically investigates how various living environments and social change affect the activities of waste recycling in Hong Kong. Finally, concerns over the design of recycling facilities and their provision, which encourage community and household participation in waste recycling, are addressed. The objectives are to (i) review and investigate the existing waste management, recycling policies, designs and practices in modern Asian cities that have lower waste generation rates than Hong Kong, (ii) understand the attitudes and behaviour towards recycling of Hong Kong people in the lower socioeconomic stratum, (iii) suggest possible recycling guidelines for Hong Kong, and (iv) explore feasible designs for waste recycling facilities in Hong Kong.

To understand and observe the attitudes and behaviour toward recycling of Hong Kong people in the lower socioeconomic stratum, an experiment was conducted involving 200 households in public housing estates. Various questionnaires and forms were distributed to collect data on recycling attitudes and behaviour within a designated period.

The results indicate that the success of recycling and waste management depends on demographic factors. The lower socioeconomic households surveyed showed greater environmental awareness than households with higher levels of education and socioeconomic status. The community's recycling attitudes and behaviour are major factors influencing the success of recycling campaigns. Recycling behaviour is influenced by a neighbourhood's attitudes, especially in high-rise buildings or densely populated areas. In addition, the results show that is necessary to raise environmental awareness in a Chinese community. Chinese people often consider recycling to be an economic activity rather than viewing it from an environmental perspective. Their understanding and perceptions of recycling must be reconstructed though public education and promotion over the long term. Recycling should not be just an alternative method of waste disposal but a meaningful task in which the community must cooperate and put considerable effort into to accomplish.

Publications Arising from the Thesis

Journal papers:

- Lo, C. H., & Siu, K. W. M. (2012). Failure of household recycling participation in a densely populated city: Insights for public design. *The International Journal of the Humanities, 9*(6), 23-33.

- Siu, K. W. M., & Lo, C. H. (2011). Environmental sustainability: Public housing household participation in recycling and implication for public design. *The International Journal of Environmental, Cultural, Economic and Social Sustainability, 7*(3), 365-375.

- Lo, C. H., & Siu, K. W. M. (2010). Lifestyles and recycling: Living environments, social changes and facilities in a densely populated city. *The International Journal of Interdisciplinary Social Sciences, 5*(2), 439-450.

Conference presentations:

- Siu, K. W. M., & Lo, C. H. (2012). Design for the better management: All-round design consideration for promoting household participation in recycling. 12th International Conference on Knowledge, Culture and Change Management. University Center, Chicago, USA, July 6-8, 2012.

- Siu, K. W. M., & Lo, C. H. (2012). Flexible public design for environmental sustainability: SmartBin for waste recycling. 8th International Conference on Environmental, Cultural, Economic and Social Sustainability. Organised by the University of Illinois at Urbana-Champaign and the University of British Columbia. University of Columbia, Vancouver, Canada, January 10-12, 2012.

- Lo, C. H., & Siu, K. W. M. (2011). Failure of household recycling participation: Insights for public design. 9th International Conference on New Directions in the Humanities. Universidad de Granada, Campus La Cartuja, Granada, Spain, June 8-11, 2011.

- Siu, K. W. M., & Lo, C. H. (2011). Environmental sustainability: Public design for household participation in waste recycling. 7th International Conference on Environmental, Cultural, Economic and Social Sustainability. Supported by the College of Education, University of Illinois at Urbana-Champaign. University of Waikato, Hamilton, New Zealand, January 5-7, 2011.

- Lo, C. H., & Siu, K. W. M. (2010). Lifestyles and recycling: Living environments, social changes and facilities in a densely populated city. 5th International Conference on Interdisciplinary Social Sciences. University of Cambridge, Cambridge, United Kingdom, August 2-5, 2010

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Chapter 1 Introduction

1.1 Background

Globalisation has had a significant impact on city development. Mass production, high-level consumption and large-scale disposal are now common in many cities, pushing them away from environmental sustainability. Additionally, rapid and continuous population growth, serious pollution, and health problems are threatening the environment in developing cities.

The accelerated and increasing consumption of resources caused by population expansion makes environmental sustainability difficult all around the world. Although people express concern about environmental issues, many have not taken any practical action to improve the situation. People enjoy consumption, but this not only means the ever increasing use of resources but also the perpetual generation of waste.

Against this backdrop, environmental sustainability has been recognised as one of the most important issues of the 21st century (United Nations, 2002). Governments in developed and developing countries have made the environment a major concern, allocating increased resources to maintain the quality of the environment. Many summits and meetings on environmental issues have been convened in recent years and much planning has been undertaken, but little improvement to environmental protection has been observed despite mass media and environmental groups continuously warning governments and their leaders.

Amid this situation, academia and the professions have not been silent. Many researchers and environmentalists have advocated strategies for preserving limited

resources and maintaining environmental quality through minimising, reusing and recycling resources. The key is resource conservation (Lo & Siu, 2010; Loeffe, 2007), because it implies a process of managing existing resources, rather than consuming new ones. It also suggests that the quantity of waste disposed of can be minimised and reduced (see also McCorquodale & Hanaor, 2006; Sakai et al., 1996). Waste recycling is part of this approach, and it is the most effective and direct way to reduce the quantity of waste by redefining it as resource recovery (Meadows, Randers & Meadows, 2004; see also Tam & Tam, 2006).Through recycling, 'waste' can be transformed into a 'usable resource'. This concept seems simple but it is conceptually important: waste can be transformed through the recycling process.

Waste management is crucial for urban development nowadays, and Hong Kong's. Landfills and incinerators efficiently process waste. However, citizens do not want these kinds of facilities located near their homes because they affect their property values (Zeiss, 1989). Moreover, some citizens believe that waste management facilities cause health problems when they are adjacent to residential areas (Allsopp, 2001). As a result, even though landfills and incinerators effectively manage waste, they are a short-term solution, and this affects the sustainability planning of the city. Sustainable waste management requires community participation in recycling, which studies have shown also makes the community better. In addition to transforming waste into a useable resource, recycling may include the relocation of municipal solid waste (MSW) from landfills and incinerators to other sites to prevent the emission of greenhouse gases and pollutants.

In Hong Kong, waste management is a major environmental concern. According to data obtained from the Hong Kong Environmental Protection Department (2013), as

shown in Figure 1.1, 14,311 tonnes of MSW were generated by domestic households in 2013. This was more than double the 6,359 tonnes generated in the commercial and industrial sectors. Domestic households contribute nearly 40% of the total daily waste in Hong Kong, making them the primary source of waste (Chung & Poon, 1999). The government contends that successfully minimising waste overall depends on controlling this domestic waste.. Reduction, recycling and reuse (3Rs) should thus become the major strategy for household waste management. To raise awareness, teach appropriate behaviour and change the waste management practices of domestic households, the Hong Kong government has indeed launched a 3Rs campaign to promote environmental sustainability. The Environmental Protection Department (EPD) encourages participation in the campaign through various means, such as the Programme on Source Separation of Domestic Waste, the Rechargeable Battery Recycling Programme, and the Community Recycling Network.

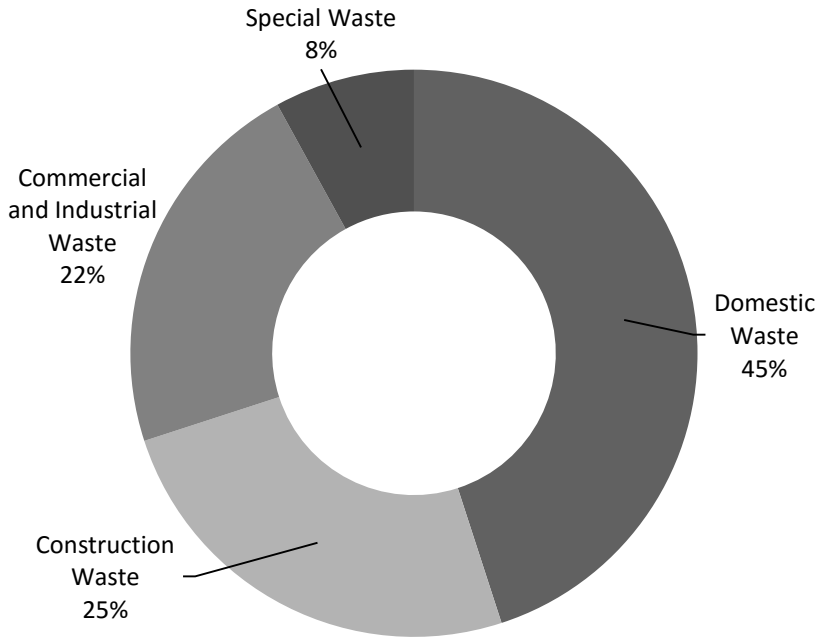

Figure 1.1 Types of Solid Waste Disposed at Landfills in Hong Kong

(Data extracted from Hong Kong Environmental Protection Department, 2013)

The Hong Kong government has been promoting household recycling for two decades, and since 1998, it has promoted a source separation scheme for waste recycling. However, waste reduction has been insignificant. The per capita ratio of successfully recycled MSW has continued to rise from 1.28 kg in 1991 to 1.33 kg in 2013 (Figure 1.2). Although the volume of MSW in Hong Kong has remained high, the ratio of recycled waste to the total amount of MSW remains low. As a result, environmental protection groups and environmentalists have criticised Hong Kong's recycling efforts and have had their concerns justified by the very unsatisfactory results of Hong Kong's recycling initiatives compared with other cities with similar living standards. This situation reinforces the belief that households are among the key offenders influencing the efficiency and effectiveness of Hong Kong's recycling scheme.

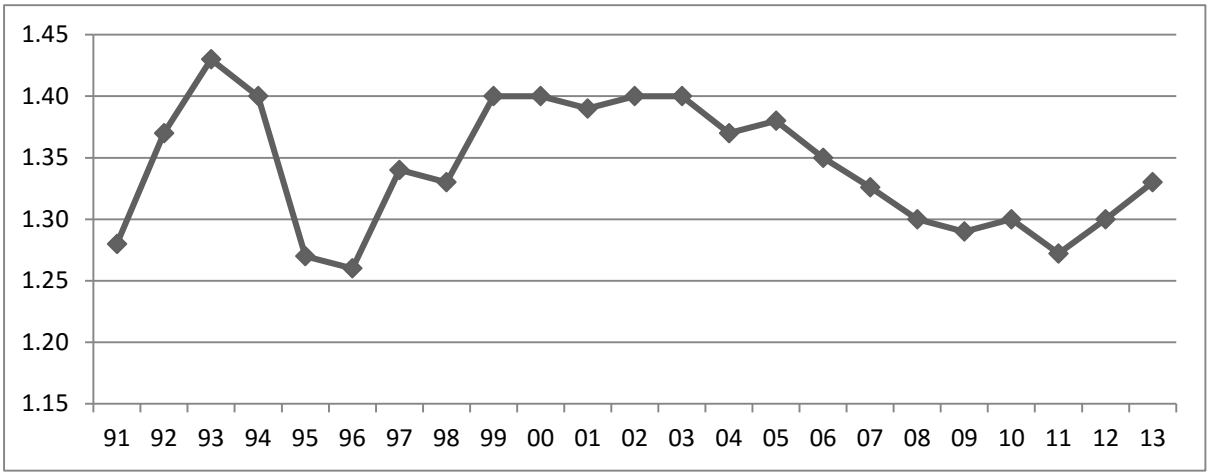

Figure 1.2 Per Capita Disposal Rates of Municipal in Hong Kong from 1991 to 2013

(Data extracted from Environmental Protection Department, 2009)

In practice, effective household recycling relies on people's motivation to recycle and the existence of a well-designed infrastructure. Hong Kong is a densely populated city in which 97% of the population lives in high-rise buildings (Census and Statistics Department, 2006). This compounds the waste management problem because living spaces and public areas are not conducive to maintaining recycling habits (Lo & Siu, 2000). Furthermore, Hong Kong's consumption-led lifestyle puts enormous pressure on the city's three strategic landfills. Hong Kong needs a more sustainable way to minimise the amount of its MSW.

1.2 Aims and Objectives

Through reviewing, investigating and discussing environmental and recycling issues in Hong Kong, this study seeks to explore the reasons for the failure of local recycling

programmes from social, cultural, environmental and physical perspectives. The specific objectives are to:

(i) review and investigate existing waste management and recycling policies, designs and practices in modern Asian cities that have lower waste generation rates than Hong Kong;

(ii) understand the attitudes toward and behaviour in relation to recycling among Hong Kong people from lower socioeconomic backgrounds;

(iii) suggest possible recycling guidelines for Hong Kong; and

(iv) explore feasible designs for waste recycling facilities in Hong Kong.

1.3 Research Questions

This study seeks to answer the following research questions.

1. What are the existing waste management and recycling policies, designs and practices in Asian cities other than Hong Kong?
2. What attitudes toward and behaviour with regard to recycling are evident among households in the lower socioeconomic stratum? Will these households change their attitudes towards recycling after participating in recycling activities?
3. What are the incentives for lower socioeconomic households to maintain and sustain recycling?
4. What recycling guidelines would best suit Hong Kong?

1.4 Significance of the study

Recycling not only reduces the amount of trash in landfills, but also the number of resources needed to manufacture new products. A well-developed recycling strategy can deal with disposal problems and reduce the consumption of valuable resources, benefiting society as a whole. Recycling is thus an essential research topic, particularly because the waste management problem in Hong Kong requires an immediate solution.

From a theoretical viewpoint, the relationship between attitudes and behaviour has long fascinated psychologists. Wicker (1969) reviewed the literature in this area and concluded that attitudes were unrelated or only slightly related to behaviour. In contrast, Fazio (1986) concluded that the attitude to behaviour correlation could be very high or very low, depending on the specific situation. In the current study, the relationship between attitudes and behaviour is examined in the context of what strategies should be used to help citizens live more environmentally friendly lives. Products that facilitate recycling should have a more focused direction to guide citizens performing recycling activities. In other words, the findings of this study are not limited to contributing to the body of recycling knowledge but also to help formulate policies that are beneficial to sustainability development.

1.5 Outline of this thesis

This thesis is divided into two major sections. The first section is a review of policy, design and the understanding of waste management in four modern Asian cities and countries. It includes a review of human attitudes and behaviour in recycling, provides a general understanding of waste management from different points of view and explores possible solutions. The second part addresses the waste management situation in Hong Kong and illustrates this through the results of experiments conducted with Hong Kong residents living in public housing estates. The findings, data analysis and conclusions of the study are included in the second section. The following briefly describe the contents of each chapter.

Chapter 1 provides a general overview of the study, including the research aims and objectives, and the scope and contributions of the study.

Chapter 2 reviews the literature related to waste management, covering the history of recycling and theories pertinent to human attitudes and behaviour. The links between human activities, attitudes and behaviour are also explicated.

Chapter 3 explains the methodology used in the study, covering the study's four phases.

Chapter 4 addresses the waste management strategies used in four of Hong Kong's Asian neighbours: Japan, South Korea, Singapore, and Taiwan. The geographical and

demographic information of these countries is reviewed, and their policies and waste management campaigns discussed.

Chapter 5 focuses on the characteristics and issues of waste management in Hong Kong, identifying the city's waste problem from different perspectives.

Chapter 6 describes Hong Kong's recycling activities, discussing the associated policies and campaigns, including reasons for failure. A field study on existing recycling facilities is also discussed, and an actionable assessment of experimental recycling facilities is offered.

Chapter 7 illustrates the waste-related behaviour of the households that participated in the field study. First, it describes the characteristics of Hong Kong's public housing estates based on the four estates selected. The details of the experimental design and surveys are then described, with a summary of the results given.

Chapter 8 introduces a new approach to recycling and its corresponding design recommendations for recycling activities. The approach and recommendations seek to provide multiple directions for households to perform recycling activities.

Chapter 9 outlines the reasons household recycling has failed in Hong Kong, particularly in public housing estates, Suggested new recycling behaviour is introduced based on different aspects of human recycling behaviour.

Chapter 10 draws conclusions based on the study's overall findings. Comprehensive considerations of recycling are proposed to enhance the effectiveness of waste

management and recycling for the general public. The limitations of the study are then discussed, followed by directions for future work.

Chapter 2 Literature Review

2.1 History of Recycling

Recycling has been common throughout human history, with Plato mentioning it as early as 400 BC. It can be defined as the process of transforming waste into valuable resources through the collection and sorting of used materials that are remanufactured and reused (Ruiz, 1993; USEPA, 2015).

In the pre-industrial age, the need to recycle was a by-product of production. European blacksmiths collected precious metals to be melted down and perpetually reused. Some craftsman in Britain collected dust and ash from wood and coal fires and then used them as base materials for brickmaking. Craftsmen participating in this type of recycling were considered as having an economic advantage, because they could obtain recycled materials without having to obtain the originals.

Waste Paper recycling began in Britain during 1921, when the British Waste Paper Association was established. World War I caused resources shortages and other world changing events had critically encouraged public in recycling. Government intensively promoted recycling campaigns during late of World War II in every combatant country, arousing citizens to donate metal and conserve fibre, as a matter of patriotic importance. Resource conservation programmes established when the war continued in some other countries, such as Japan, which had few natural resources after the world war was ended.

In the US during the 1970s, rising energy costs led governments to launch critical recycling campaigns. In 1973, the city of Berkeley in California began one of the first

community collection campaign with pickups of newspapers monthly from residential homes. After few months, New Jersey became the first state to launch a mandatory recycling campaign. Meanwhile, several other states started and expanded various doorstep collection schemes. In 1987, a new debate on waste management and recycling took place when over 3,000 tonnes of garbage was refused entry into the port of North Carolina. In 1989, another recycling effort was made in Berkeley when the city government banned the use of polystyrene packaging for McDonald's hamburgers. This campaign aroused an awareness of environmental issues that led the world's largest manufacturer of polystyrene, Dow Chemical, to become the first major company to develop plastic recycling technology. Nationwide, Recyclebank was established to award the participants money for recycling. It aims to encourage people to support recycling and environmentally friendly in everyday life. The Recyclebank connect with businesses, communities and arouse participants in environmental awareness which help household to achieve sustainable lifestyles. Also, Recyclebank developed an online promotion and recycling program for 300 communities to improve household recycling rate. Participants can through Recyclebank's online website to receive points from questioning and answering, green activities practise for rewards. It helped communities to develop a green lifestyle continuously. In education, Recyclebank promoted a green school programme for student to arouse their interest on green living. 150 schools were joined the programme to design a new green environment to improve their school life. Recyclebank helped student to develop the sustainable ideas for execution from their classrooms and communities. By 2014, the recycling and waste industries in the European Union had gained a 50% share of the world market. The European Union required its member states to a reach a recycling rate of 39%, while other leading countries were required to achieve around 65% (EU, 2015).

2.2 Understanding Recycling Attitudes and Behaviour

An attitude is an internal disposition in a variety of situations that can be used to evaluate a person's emotional and intentional reactions (Eagly, 1992) In this light, it can be argued that attitudes and behaviour are the two main factors affecting daily recycling practices, which can differ in different populations..

Sheth and Frazier (1982) proposed a model to explain social marketing situations in different population segments, introducing different strategies to study the behaviour of specifically targeted groups. It is difficult for people with negative attitudes to change them through strategic activities. In addition, changing negative attitudes could affect the overall attitude of the population in which an attitudinal agreement is reached. Because such an agreement affects productivity, it is important for people with negative attitudes to change their existing behaviour, and it is more efficient to initiate behavioural change through strategic activities. In the following subsections, theories on attitudes and behaviour are reviewed.

2.2.1 Theory of Reasoned Action

Both the theory of reasoned action (Ajzen & Fishbein, 1980) and the theory of planned behaviour (Ajzen, 1996) indicate that a change in human behaviour can explain or predict behavioural intention. These two theories assume that human behaviour is based on rational action and that it manages information systematically to allow a particular voluntary behaviour to be exhibited by a human being.

Empirical studies related to recycling behaviour have discussed the role of attitude and the applicability of Ajzen and Fishbein's (1980) theory of reasoned action to it. They have shown that convenience in an institutional context plays a major role in recycling behaviour that the link between attitudes and behaviour is multi-directional, and that exposure to public recycling programmes may induce behaviour that in turn affects attitudes.

The theory of reasoned action is a general model that helps to link attitudes, intentions, and behaviour. Ajzen and Fishbein (1980) argued that the alteration of human behaviour could be predicted by guided behaviour in cognitive processes.

Intentions can be understood as having two functions: as subjective norms and as attitudes. Subjective norms are affected by the social environment and pressure to exhibit in a particular kind of behaviour. An attitude is defined as the sum of beliefs with regard to a particular behaviour. It could be used to evaluate the value of human behaviour.

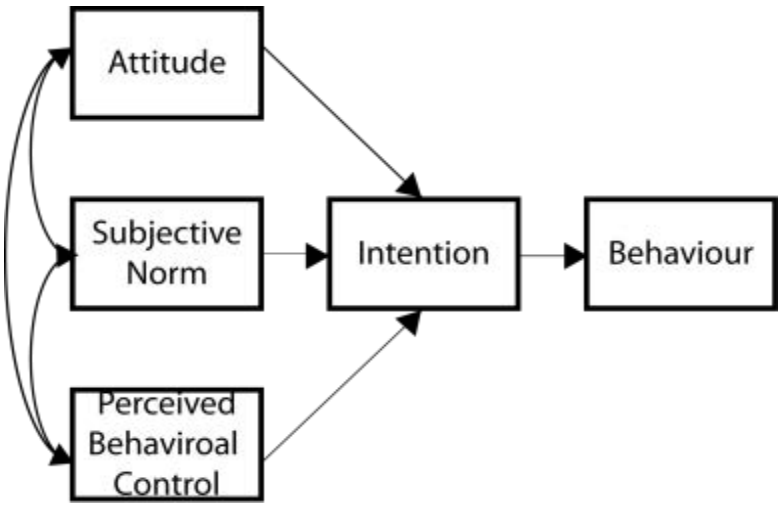

Figure 2.1 Theory of planned behaviour (Ajzen, 1991)

Ajzen and Fishbein (1980) argued that human behaviour could be predicted by subjective norms, attitudes and intentions. They asserted that the presence or absence of certain kind of beliefs could explain why people maintain certain attitudes or subjective norms. Their theory considers behavioural beliefs as the construct of attitudes, and normative beliefs as the construct of subjective norms. Behavioural beliefs reveal the perception of change to a particular behaviour. A change in beliefs can foster a change of attitudes, which allows intentions to drive behaviour and directly influence actual behaviour. In terms of normative beliefs, human behaviour is largely affected by pressure from social norms. There is a possibility that people can modify certain behaviour only if the behaviour is allowed.

Ajzen and Fishbein (1980) used demographic characteristics, the direction of attitudes and the nature of personality as the external factors in their models. These external factors, they argued, could explain the variation in attitudes and subjective norms that guide behavioural intentions. Ajzen and Fishbein also observed that changes in human behaviour are driven by belief when new types of information are revealed. A change in belief without a corresponding shift in attitudes or subjective norms will not lead to behavioural change. Indeed, the theory of reasoned action states that in behavioural change all other factors can only be changed after beliefs are changed.

2.2.2 Theory of Planned Action

The theory of planned action associates beliefs with behaviour. Perceived behavioural control is included in the theory of reasoned action to explain that behaviour is not completely governed by choice. The concept of behavioural control shows that it is possible to have a belief without engaging in behaviour. For example, members of a household cannot engage in a certain kinds of behaviour if they cannot access the facilities or related equipment even when they have positive attitudes and positive subject norms. The theory of planned action has been widely applied to human attitude behaviour, such as in predicting the dishonest actions of college students (Beck & Ajzen, 1991) and in relation to travelling (Bamberg & Sebastian, 2003). Additionally, the theory of has been applied to understanding recycling attitudes and behaviour. People who have pro-recycling attitudes are similar to those who take action in terms of recycling behaviour.

2.3 Empirical Studies on Recycling and Human Behaviour

Researchers have commented that recycling practice is driven by human behaviour and the relationship among attitudes, beliefs, behaviour and public policies. The following sections address major recycling research that discusses the key factors affecting recycling schemes.

2.3.1 Demographic Factors in Recycling

Different researchers have commented on the importance of demographic factors in recycling behaviour (Berger, 1997; Hornik et al., 1995; Mercier, 2001). Comprehensive reviews indicate that flat owners, wealthier people, and those who have higher levels of education have a greater potential for engaging in recycling activities than poorer and less educated individuals (Dickerson, Macintosh, Owens 2000). Derkesn and Gartrell (1993) agreed that individuals who are more mature, wealthier, and better educated are more willing to recycle. Hornik (1995) found that the demographic factors were constructed of multiple variables, and this was a strong predictor of recycling.

According to Berger (1997), education, income and residence are all significant demographic predictors of recycling. He recommended that policy makers should focus on changing the contextual factors by making access to recycling more readily available. Others have found that the social context of recycling is highly correlated with demographic factors (Barr, Ford, & Gilg, 2001). People who own larger flats with recyclable storage space, are better educated and earn more are more highly motivated to join recycling programmes. In sum, demographic factors are related to recycling behaviour, which in turn influences recycling attitudes, behavioural intentions and behavioural change.

2.3.2 Role of Environmental Behaviour

Witmer and Geller (1976) examined the effects of a promotional contest on the recycling behaviour of college students, whereby flyers were placed in each resident's room, urging them to recycle. The aim was to prove that rewards encourage recycling, and that promotion has a very minimal effect on it. The authors reported that the majority of students who joined the programme during baseline condition were those who resided on the first floor and lived closest to the collection room. Rewards had a larger effect on the participation of students living on the other floors. Witmer and Geller thus pointed out the importance of economic and accessibility factors to participating in recycling.

Behavioural change can also influence a desired behaviour. In that regard, designed intervention can result in the development of new habits. Hopper and Nielsen (1991) suggested that a block leader volunteer in a building could be designated to promote recycling and change people's behaviour and attitudes. The block leader's role would be to exert social pressure on the neighbours by reminding them to pick up curbside waste and to act as role models for their neighbours. The researchers found that active block leaders could promote the development of a normative process that encourages recycling. They argued that the block leaders' activities created dissonance by reminding or encouraging neighbours to recycle.

In contrast, residents in neighbourhoods that only received information or brochures did not experience significant change in their underlying recycling attitudes. Hopper and Nielsen (1991) concluded that modelling and imitation techniques could better

increase the frequency of recycling behaviour, which in turn could facilitate change to recycling attitudes.

Researchers have also explored different ways of examining the relationship between certain norms that can increase the frequency of a desired behaviour. Schultz (1998) used feedback techniques to prove that a change in personal norms affects the frequency of a desired behaviour. In his study, feedback was used to activate social and personal norms to increase residential recycling participation. Six hundred middle-class households were involved in a voluntary curbside collection programme, in which they were asked to separate four different items into separate bins at the curb. Schultz concluded that normative feedback intervention could increase the level of curbside recycling. However, he added that recycling is a highly visible behaviour. The participants might have felt pressured to continue recycling because of the social context of the experiment. Social context and social desirability affect each other in a positive way to foster long-term recycling behaviour.

Wang and Katzev (1990) reported that participants who were asked to give a verbal or written commitment to recycle were able to sustain their behaviour. Persuasion techniques involved providing information about the benefits of recycling and attempting to convince the user to try it. Research suggests that positive recycling behaviour can be significantly developed through commitment (Burn and Oskamp, 1986).

De Young (1986) found that participant satisfaction was increased by intrinsic reward. Long-term changes in recycling behaviour were produced, and the effects persisted longer than they did with extrinsic rewards. This finding, however, conflicts with that

of Wang and Katzev (1990) who investigated the use of incentive techniques to produce recycling behaviour. Monetary rewards were given to participants who joined the recycling campaign. The participants were more active in the recycling campaign and the frequency of their recycling behaviour increased when the incentive – monetary reward – was added to the campaign. Conversely, the participants ceased their recycling when the incentive was withdrawn.

2.3.3 Role of Environmental Attitudes

Environmental attitudes were once considered to be part of a general environmental concern or specific attitude towards recycling practices. This approach was used to evaluate whether having a general environmental concern was helpful to predicting or understanding recycling behaviour. It was also used to identify environmental attitudes (Dunlap et al., 2000). Schultz and Oskamp (1996) used it to explain changes in the intensity or efficiency of recycling behaviour among recycling households.

General environmental concern has also been posited as important to recycling behaviour. Domina and Koch (2002) noted that recycling attitudes could explain the participants' behaviour in recycling campaigns. Cook and Berrenberg (1981) suggested that measuring specific attitudes might be more effective than relying on the indicators of generalised environmental concern in predicting particular conservation behaviour in recycling.

McGuire (1984) studied the disposal patterns of several neighbourhoods in Tucson, Arizona, reporting on the recycling behaviour of households of different socioeconomic levels. Although people from higher income households reported more recycling behaviour, actual measured behaviour was similar for both high and low-income households. No socioeconomic variable was found to be related to disposal behaviour. McGuire also addressed the major factors that might affect newspaper recycling, positing that increasing the recycling price for newspaper could result in long term recycling behaviour.

The recycling studies of Hornik et al. (1995) analysed attitudes toward recycling, actual recycling behaviour and behavioural intentions. They concluded that recyclers with positive attitudes should have a high frequency of collection and classification of recyclables, express commitment to recycling, possess high levels of recycling knowledge, have highly perceived social influence, and have good accessibility to recycling facilities.

Specific recycling attitudes do not necessarily guarantee that those with positive recycling attitudes will engage in recycling behaviour. Hunter (1998) reported that 95% of his respondents indicated that recycling was either ‘very important’ or ‘somewhat important’ to them. Yet only 68% indicated that they occasionally recycled their household garbage.

Recycling attitudes are one of predictors of people’s recycling behaviour, and certain attitudes have been found to be important in predicting recycling frequency and intensity (Scott, 1999). In particular, individuals who do not have strong recycling attitudes are less likely to recycle than those who already have access to recycling

facilities (Derksen & Gartrell, 1993). Conversely, those who recycle intensely have been found to have stronger pro-recycling attitudes and receive higher intrinsic satisfaction from recycling than their counterparts (Scott, 1999). Recycling intensity is thus an important factor in policy discussions, as Scott (1999) noted:

> *"The intensity of less active recyclers also has the effect of decreasing programme costs, a vital consideration for program administrators. Low-intensity recyclers' drive up collection costs by increasing the number of stops (thus decreasing collection efficiency) while contributing relatively little material for resale."*

2.3.4 Prior Behaviour and Convenience Elements

Prior behaviour, social norms and recycling attitudes affect the intention of the community to participate in recycling. For example, an experienced person can help motivate new recyclers to recycle. Some have concluded that, 'If norms develop by individual trial and community response, the positive consequences of prior behaviour may serve to encourage future intent' (Dahab, 1995). Similarly, Cheung, Chan and Wong (1999) found that recycling behaviour is a habit, and therefore recycling experience may influence future action. Recycling behaviour is a significant predictor of curbside recycling policies where people who already recycle support expanded public recycling programmes.

Barr (2003) suggested that the influence of attitudes on behaviour is moderated by the perceived effort required to recycle and perceived control over one's own recycling options. Most people have positive sentiments towards recycling, but many do not participate because they perceive it as being too inconvenient. Half of the participants in Barr's research stated they would like to recycle when the curbside programme had a neighbourhood drop-off.

Although it is more convenient to recycle, the relationship between people's general environmental concerns and their recycling behaviour has become less significant. Derksen and Gartrell (1993) found that even unconcerned individuals recycled when exposed to a structured and convenient programme. Barr (2003) also reported that:

> *"Individuals appear to be well aware of the need to recycle and will generally do so if given the means. Those without kerbside recycling, despite being enthusiastic about such behaviour, were unlikely to recycle material."*

A structured recycling programme is sufficient to encourage the desired recycling behaviour in this situation. In that sense, social context is independent of attitudes. Launching a recycling programme that makes recycling easier may be important, and the convenience factor may be added to the theory of reasoned action.

Chapter 3 Methodology

3.1 Brief Introduction

In the 1990s, Asian cities experienced rapid industrialisation and strong growth rates. High population density created a need for living space in most Asian countries and cities such as Hong Kong, Tokyo and Singapore. Concurrently, large amounts of waste were being generated from households and industry. Some countries set a good example when they were faced with these serious waste problems. Hong Kong holds itself out as an international city; it has become a leading international financial centre. However, its waste management policy has lagged behind those of other Asian cities. Because Hong Kong has a fundamentally different type of waste management system and facilities, public environmental awareness is still low. Even though the Hong Kong government and Environmental Protection Department (EDP) has launched a series of promotions and policies over the past three decades, waste generation has rapidly increased every year. Therefore, the methodology used in this study has been broken into four main stages to help untangle the complex nature of waste management in Asian cities.

3.2 Stage 1: Case Studies of Asian Cities and Countries

A clear framework for this study was developed by reviewing the literature, accessing information and data related to waste management and recycling from a number of environmental departments in different countries, and identifying the role of government in waste management and waste reduction. Additionally, existing policies and designs for waste management and recycling practices in different Asian

countries and cities were also reviewed, to allow comparisons for comparison. The Asian countries included in this study are Japan, South Korea, Singapore and Taiwan, all of which have similar living standards and lifestyles. However, each of their governments has taken a different approach to the waste management problem. Therefore, case studies on different Asian cities and countries are used to help identify the existing limitations and problems with Hong Kong's policy and design for waste management and its recycling practices in the Hong Kong community.

3.3 Stage 2: Review of Hong Kong's Recycling Situation

Case studies were carried out to identify the factors influencing waste management, recycling programmes, and waste and recycling facilities in public housing estates. In furtherance of these objectives, data were collected from selected public housing estates detailing their arrangements for waste and recycling. In addition, the attitudes of the public housing residents toward recycling and their behaviour with regard to recycling were addressed during field research.

3.4 Stage 3: Survey of Hong Kong Households' Attitudes and Behaviour

This study used data from a panel study (January 2010 to January 2012) of Hong Kong public housing estate residents to evaluate whether exposure to a structured recycling programme affected the recycling attitudes and behaviour of the

respondents. The basic study was designed to examine four public housing estates in Hong Kong, and to conduct a survey of the households within these estates to determine their baseline levels of behaviour, attitudes and beliefs on a range of recycling subjects.

3.4.1 Detailed Sampling and Response Rates

Households were sampled on public housing estates in four areas of Hong Kong: Aldrich Bay, Sai Wan Ho, Shaukeiwan and Yiu Tung (see Table 3.1).

Table 3.1 Detailed sampling condition by residential area

Area	Year of Intake	Number of Block	Number of Rental Flats	Number of Households
Aldrich Bay	2001	6	3900	9100
Sai Wan Ho	1996	4	2100	6600
Shaukeiwan	1962	13	3100	6600
Yiu Tung	1994	11	5200	15800

To ensure a representative sample, households were selected from each of the four participating public housing estates in proportion to the number of residential waste customers existing at the first stage of assessment. In total, 200 households were identified in this manner for inclusion in this assessment.

During the first phase of the assessment, from January to March 2010, the selected households were surveyed and some residents were interviewed regarding their recycling practices and behaviour. Each household received a short description of this study and a letter further explaining its details. A drop off and pick up method was used to distribute a recyclable assessment form to document the households' recycling practices. The selected households were asked to record the quantities of their recyclables daily. The first phase assessment addressed the sampled households' understanding and motivation with regard to their recycling behaviour. Visits by the research team and assessments took place every month to monitor the progress of their activities and to ensure that the recyclable assessment form given to them was completed. In this stage, 250 households were surveyed and interviewed. Usable responses from 200 households were received after three months. The remaining responses from were disqualified due to missing data or information on the recyclables assessment forms. The response rate was 80% (Appendix A).

The second phase aimed to understand the social norms that might influence recycling behaviour. The sampled households were continuously asked to finish the recyclable assessment forms. Additionally, a set of recycling data reports generated in the first stage was delivered to the sampled households. It included data comparisons regarding the use of recyclables among similar sized households in the same public housing estate. This phase began in April 2010 and ended in June 2010. Monthly interviews were conducted with the households. All 200 households gave valid responses for a response rate of 100% (Appendix B).

The third phase of this study was designed to arouse the sampled households' concerns over general environmental and recycling practices. Households received

recyclable assessment forms to record the quantity of recyclables, and the recycling data report was attached for their reference. Further, temporal recycling bags for collecting recyclables were given to them. Households were asked to place the recycling bags inside their living space. Efforts were made to ensure that the households were able to manage their recyclables in a simple and convenient manner. This phase was conducted from July 2010 to September 2010. A total of 155 respondents out of 200 households were willing to participate in the experiment at this stage. The forty-five households refusing to participate indicated they were unable to provide extra space to install the recycling bags. The response rate was 77.5%.

The final phase examined the changes to recycling attitudes among the sampled households. A drop off and pick up method was applied to distribute a recyclables assessment form for recording their recycling practices. The households were asked to record the amount of their collected recyclables daily. Of the original 200 participants, 18 of them failed to complete the follow-up assessment form. Thus, 91% of the sampled households participating in this stage completed the entire data collection process.

A design experiment was introduced to investigate the change in the attitudes and behaviour of the public housing residents with regard to recycling. The experiment lasted for 12 months. A set of waste management design samples was distributed to householders in the public housing estate. Photos were taken and usage data were collected every three months. This experiment involved 200 households who were randomly selected from four public housing estates in Hong Kong. The feasibility of the design for waste recycling catering to the needs of Hong Kong's lower

socioeconomic stratum was then explored. An all-round approach of design development for waste recycling in the Hong Kong community was constructed.

3.4.2 Details of Recycling Experiment

Before the recycling experiment was begun, a survey was conducted among the household respondents to properly address their attitudes toward and behaviour with regard to recycling. Quantitative and qualitative data were then collected through interviews and surveys. At the end of each stage of the experiment they had participated in an assessment form was given to the respondents. Their comments showed that they had changed their recycling attitudes and were able to address the changes in their recycling behaviour learned from the experiment.

In 2010, there were four public housing estates located in Shau Kei Wan:

- Ming Wah Dai Ha Estate;
- Yiu Tung Estate;
- Hing Tung Estate; and
- Aldrich Garden.

The following subsections describe the composition of these four estates.

3.4.2.1 Min Wah Dai Ha Estate

Ming Wah Dai Ha Estate was built in the 1960s. It was the first public housing estate to be located in the eastern part of Shau Kei Wan and it is the oldest existing public housing estate which developed by the Hong Kong Housing Society. Ming Wah Dai Ha was named after Bishop Ronald Owen Hall, who was one of the founders of the Hong Kong Housing Society. Today, there are 13 contiguous residential buildings located on the hillside. Due to this special geographical situation, each building has only nine storeys. The total number of flats in the estate is 3,169.

Figure 3.1 Location of Ming Wah Da Ha Estate

Figure 3.2 Ming Wah Dai Ha interior design

Ming Wah Dai Ha was built over 50 years ago, and only the basic needs were provided, matching 1960s building standards. All of the flats are tiny (200 to 500 square feet). None of the blocks contain elevators, rubbish collection rooms or public lobbies. Each block only provides a small waste collection room at a ground floor outdoor location, and several waste bins and recycling bins are located outside the waste collection room. Hygiene is poor because the waste collection room is in an outdoor area, and its small size is inadequate for storing the large volume of domestic waste accumulated each day from about 300 flats in the block. When the bins are full, the residents dispose of their domestic waste beside them.

A private cleaning company provides a waste collection service only in the evening. Until then the residents are supposed to keep their domestic waste at home. When evening comes they must carry their waste down to the ground floor, because there are no waste collection or recycling facilities on the individual floors.

Figure 3.3 Outlook design of Ming Wah Da Ha

3.4.2.2 Yiu Tung Estate and Hing Tung Estate

Yiu Tung Estate and Hing Tung Estate are both located on the upper hill of the southwest sector of Shau Kei Wan. There are a total of 13,185 flats with approximately 30,000 residents living in 24 blocks. Before the mid-1990s, the southwest sector of Shau Kei Wan was a squatter area. The living environment was poor, the living space was extremely congested, hygienic conditions were bad and there was neither electricity nor a water supply. The Hong Kong Housing Authority redeveloped the area in the mid-1990s, and the Yiu Tung and Hing Tung Estates were built to replace the squatter camps in 1994 and 1996 respectively. Yiu Tung Estate and Hing Tung Estate were built according to the 'Harmony' model of housing. The blocks in both estates consist of a 42 storey, high-rise design (for different types of Harmony style public housing blocks, see Hong Kong Housing

Figure 3.4 Locations of Yiu Tung and Hing Tung estates

Authority, 2010d). Each block has a waste collection room on every floor and an elevator to all floors. The waste collection room is connected to a centralised refuse-chute (CRC) that allows residential refuse to be discharged directly from the high-rise floors to a central refuse container located at a ground floor central refuse collection room. The recycling bins are located at the main entrance to the ground floor.

Due to the residents' misuse of the CRC and complaints from residents about the noise, the refuse collection rooms are kept locked and only authorised cleaning personnel are allowed access to the centralised refuse-chute. To compensate for this, the Hong Kong Housing Authority places a large volume refuse container next to the elevator entrance in the public corridor on each floor. Although this large container is intended to replace the CRC, it is unable to hold the amount of waste generated from

the flats. This has resulted in an observable hygiene problem. In addition, because the recycling bins are only located on the ground floor, most of the residents do not collect or separate their waste into recyclables and disposables, or take them downstairs to the correct location. Instead, they prefer to place domestic waste and recyclables together in the refuse container, even if it is full.

3.4.2.3 Aldrich Garden

Aldrich Garden was built in 1997 on reclaimed land (formerly the Aldrich Bay Typhoon Shelter). It is located at the northern end of the Shau Kei Wan waterfront. This estate consists of 10 residential buildings with approximately 27,000 residents. The main roads, a bus terminal and the subway system were linked with the Shau Kei Wan Mass Transit Railway (MTR) station in 2000. There is mixture of building types in Aldirch Garden. Residential buildings are the ‘Harmony’ type, in both small household blocks and non-standard models

Figure 3.5 Location of Aldrich Garden

The buildings have good lighting, and elevators that reach all floors. Each floor consists of large common corridors, a waste collection room and CRC system. According to reported observations, the facilities appear to be better and more adequate than the cases presented above. However, as before, to prevent misuse and accidents, the waste collection room and CRC system are locked throughout the day, and only the authorised cleaning workers are allowed to use them. A large volume trash container is placed in the common corridor on each floor (i.e., in an open area). This arrangement causes hygiene problems. In addition, these improved containers are only for waste collection. The facilities for residents to dispose of recyclables are still very limited. Only a few recycling bins are located at the ground floor, even though the number of residents on each floor is not small. The lack of facilities serve as negative motivation for the residents to collect, separate and dispose of their recyclables.

3.5 Measurement of Recyclers

Five surveys were conducted at each stage of the experiment: a pre-assessment survey before the design experiments and a new environmental paradigm (NEP) conduct survey at the end of each stage. The surveys were developed to obtain information on demographic characteristics, general environmental concerns, recycling attitudes, recycling behaviour and recycling beliefs to test the various key concepts.

The demographic elements sought were age, educational attainment, income and gender. Age, education and income have been found to be related to recycling behaviour and recycling intensity (Domina and Kock 2002).

3.6 Stage 4: Experiment on Changes in Attitudes and Behaviour

The experiment was performed in four phases over a period of one year. Basic surveys were administered and activities and reports were recorded in 200 random households located within four Hong Kong public housing estates to determine the respondents' understanding of recycling, recycling attitudes and behaviour with regard to recycling.

The respondents were asked to record their daily recyclables and take photos as needed. The results of the recycling experiment show how the respondents changed their recycling attitudes at each stage of the experiment. In addition, many respondents stated that they had observed the changes in their own attitudes towards recycling and their recycling behaviour after joining the research study.

Chapter 4 Waste Management in Modern Asian Cities and Countries

4.1 Brief Introduction to the Cases

Japan, South Korea, Singapore and Taiwan are four developed countries in Asia. They all have high standards of living and good quality living environments. As the consumption and waste generated in these countries has increased they have developed various practices and strategies for better waste management. This chapter reviews the waste management strategies in these four high-density Asian countries.

4.2 Japan

Japan is a densely populated country. Being a developed country, mass consumption and production activities are inevitable. Each year over 53 million tonnes of MSW are generated from community. Seventy-eight per cent of this is transported to incinerators for the production of energy. The remaining 22% is transported to landfills for disposal.

In the 1950s, the Japanese government implemented several fundamental waste management policies. In the 1960s, Japan experienced rapid economic growth and environmental deterioration. This period was called the 'Japanese post-war economic miracle' (Johnson, 1982). A large number of factories were built during this time. Because of the high volume of manufacturing and the illegally disposed of industrial waste, industrial pollution became a social issue. In order to solve this problem, strenuous efforts were undertaken in the 1970s in furtherance of environmental

conservation. The Japanese government started its municipal waste management programme in the 1980s.

Local government legislated to shifting and increasing the Japanese MSW management market segment. Decreed in 2000, the government legislated for establishing a Recycling Based Society required the recycling and waste management understanding, in order to domestic reduce, reuse, recycle, reserve and recover on energy consuming and dispose of domestic manipulate solid waste and waste management facilities appropriately. The 3R campaign aimed to decrease the volume of untreatable waste by half by 2010. It has shown some success as the total volume of disposable waste has decreased in recent years notwithstanding the increase in the overall volume of waste. Eco-towns has been developed. One significant political measurement of 3R initiative has been developed by Eco-towns. There were 27 Eco-towns had been established in July 2007. Government strived to decreasing waste generation by granting subsidies for building and operating recycling facilities and management in local areas. According to the Japan Ministry of Environment, the waste management recycling market in Japan grew from $33 billion in 2000 to $70 billion in 2010 and is expected to reach $102.0 billion by 2020.

4.2.1 Incineration and communities

Japan is difficult to maintain with sufficient landfill site, as the geometrical limitation. Japan governmental suggested using incineration for final disposal approach. Incineration can be reduced the waste to 1/6 or 1/7, thereby landfill loading can be

released and waste transportation can be decrease. Therefore, 75% of the total waste in japan is currently managed by incineration. In 2006, Japan was setup 1,374 incineration facilities in different zone. It acted as an important role in waste management in Japan. 195.952 tones were managed by incineration per day. Although incineration was an effective method for waste management, carbon dioxide, dioxin emission and air pollution was generated from the incinerator. As most of incineration facilities were in small to medium size and maintained in conventional burning systems (fluidized bed types or stocker). It drew a lot of community's attention and concern in 1990s. Communities stared against and elevated the hazardous pollutant emitted from the incineration facilities. Government enacted the new regulation for building new incineration facilities and proposed incineration should be trend toward to waste recovery energy system by using advanced gasification and new melting technologies to prevent the pollutant generation. Heat and electricity generated by waste incineration plants. In 1965 Nishiyodo Plant of Oska City provided the first surplus heat for electricity generation and promoted by the national government. Government subsidised new waste incineration facilities or renewed existing incinerator which have built to use surplus heat. At the end of 1994, there were 135 waste incineration facilities were allowed to generate energy with 450,000kW. It equal to 1.2 million household's power consumption. About 60 local incineration facilities sold excess energy to electric power companies. In 2007, the waste to energy strategy was successful to reduce the weight and volume of domestic waste and produced electricity by incineration. The incineration technology enhancement provided the efficient and safe waste to energy system. Hitachi Metals cooperated with Westinghous Plasma Corporations setup with two commercial wastes to energy plasma gasification plants in Japan. New incinerators have been allowed to burn plastic materials and increased the electricity generation. As the waste plastic

materials made up a large proportion of municipal incombustible waste and plastic was released harmful gases when high temperature incineration. 1,630 MW were generated by incineration facilities to support the local district consumption in 2007. In Tokyo, there were 18 incinerator were generated 239 MW from their own district solid waste. Though the average power generation efficiency is lower compare with the advanced and larger incinerator, the environmental awareness to public concern and economic incentive was arouse. Also, the landfill life cycle was extended through these local incineration facilities. In 2015,

4.2.2 Waste Minimisation in Communities

Sustainable development is the major waste management concern in Asian countries today. In Japan, as the population and economy have grown over the past decades, high-energy consumption lifestyles have become common. A large volume of MSW is generated every day and local governments spend millions of Yen for waste management. Incineration and landfilling are still the most direct and effective methods to manage MSW. However, they have damaged and polluted the surrounding areas, and a large amount of money is needed to maintain the incinerators and landfill sites. In addition, local communities do not welcome these facilities, as their locations are often too close to residential areas. In light of this situation, local governments try to promote different campaigns encouraging households to minimise, reuse and recycle. These kinds of campaigns aim at helping communities become environmentally sustainable.

4.2.3 Eco-account Book

The eco-account book is a tool provided by local governments, offering guidance to households wanting to address their daily consumption. The book includes instructions for the correct ways to use energy, and to assess eco-manner, and guidelines to save the extra-costs incurred for daily waste management. An eco-balance sheet is provided for households to record the amounts they consume and recycle each month to understand their eco-manner. It has two components: energy consumption and waste generation. The items related to energy consumption, include electricity, gas (LPG), gasoline, lamp oil and water. The items related to waste generation, include the recycle volume of aluminium cans, paper containers, glass bottles, plastic bottles, steel cans and trash. The eco-balance sheet also provides a simple carbon dioxide calculation formula, which enables household members to compute the degree to which they pollute in their everyday domestic lives, and allows them to assess their progress in reducing emissions each month, thereby encouraging them to place more effort on minimisation. Through this eco-account book campaign, local governments educate their communities and encourage their residents to develop recycling and energy saving habits. Families learn how to maintain their domestic lifestyles based on environmental concerns, thereby successfully protecting the environment and contributing to their communities.

4.2.4 Junior Eco-Club Program (Kodomo Eco-Club)

The Ministry of Environment in Japan runs a programme named the Junior Eco-Club, an extracurricular activity for children and teenagers aimed at arousing environmental awareness and interest. Established in 1995, the club allows school students to form their own groups and register in their region (with the environmental section of the local government). Members are required to spend two to three hours a week participating in two kinds of environmental activities. Each club is asked to develop a yearly plan setting forth their goals and activities related to environmental protection. These may include recycling, cleaning up waste, publishing news related to environmental protection in local newspapers and studying wildlife. The Junior Eco-Club brings about positive impact and thus has become popular in Japan. There are currently 4,300 clubs in Japan involving 82,300 elementary and junior high school students.

4.2.5 Eco-Town Project

The Eco-Town project promoted by the Ministry of Economy, Trade and Industry and Ministry of Environment in Japan. The Ministry of Economy aims at constructing a resources-recycling economic society through the development of industries. The objective is to utilise local industrial accumulations, prevent waste, and promote the recycling of waste according to the unique characteristics of local districts. The Eco-

Town project is operated by local authorities to support advanced environmentally-conscious buildings in their towns through the cooperation of local residents and industries. Local authorities create Eco-Town Plans during Eco-Town projects. When creativity and a pioneering spirit receive a reasonable level of recognition with regard to the basic concept and specific plan for the project, and if the plan can serve as a good model for other local authorities, the Ministry of Economy and the Ministry of Environment will jointly approve it. The two ministries will also provide financial support to leading recycling facility maintenance projects contributing to the formation of a recycling society, which will be managed by local authorities and private organisations.

Twenty-six Eco-Town Plans have been approved throughout the nation. Through these projects, local authorities and businesses are currently working hard to achieve zero emissions. To develop a future recycling economic society through these projects, it is essential to share experiences, knowhow, and problems encountered in building the environmentally-conscious towns that have already been cultivated in each Eco-Town area, to mutually engage in discussions and to work to develop new Eco-Town projects.

4.2.6 Community Recycling Policy

In 2005, 51.6 million tonnes of MSW were discarded, 35 tonnes of which were from households. Local governments had established waste management facilities such as incinerators and landfill sites to process the large volume of municipal waste.

However, these facilities had not always been welcomed in the communities (Lee, 1994) who opposed their construction even though they agreed they were necessary. Because of the high-density housing in Japan, waste management facilities can be built near residential areas. In these situations the NIMBY (not in my back yard) phenomenon may be manifested in the surrounding residential area. For example, in 1971, local Tokyo residents started a 'waste war' when the New Yumenoshima landfill site was located next to a residential area. The residents joined together in a large-scale public demonstration against the construction of the landfill site that lasted for almost three years. This war highlighted the importance of the waste problem and attracted social attention. It forced the government to consider its approach and to establish a new relationship between waste management and the society. Reducing waste and recycling became the first priority for waste management.

In support of the 3R initiative, Japan's government have been introduced a number of environmental programmes thought a wide range of products from construction debris to lithium-ion batteries. For MSW, three major laws affect the demand for new recycling technologies.

The Law for Recycling of Specified Kinds of Home Appliances was enacted in 2001. The law cover over 80% items of home appliances which produced by Japan to pay recycling and waste management fee. Consumer requires paying their used home appliances for collected and recycled which contains with air conditioners, refrigerator, television and washing machines. All appliance manufacturers, including the electronic dominant enterprise: Fujitsu, Hitachi, Panasonic, Sanyo, Sharp, Sony and Toshiba, support to operate 27 recycling plants across in Japan. As a result, nearly 12 million used electronic products were processed in 2006. This law has also

motivated the development of advance technologies for recycling electronic waste. One of the pioneer electronic manufacturing company: Matsushita (Panasonic) Eco Technology Center, which allow to recycle one million domestic appliances every year. It has covered 68 patent applications since the business started.

Furthermore, Japan MSW accounts for approximately 30% food waste in total volume. Enacted in 2001 by Food Wastes Recycling Law, government promoted many innovative project with communities and commercial. One of the significant recycling project is implemented by Sapporo Kichen Garbage Recycle Center who operated by Mitsui Zosen. It using a special food waste treatment process to transforms 50 tonnes of food waste daily and collected into 10 tonnes of dehydrated cattle feed from 188 local companies, hospitals and schools. Recently, heavy manufacturing industry also transform food waste to energy use. JFE Steel Plant is derived from methane fermentation from food waste at the Chiba Biogas Center for energy source. Also, Nippon Steel Engineering transformed 400 litres of ethanol from 10 tonnes of food waste pre day which produced in Kitakyushu Eco-Town pilot plant.

Recognising that domestic containers and packages represented about 60% of the volume of MSW in Japan. In 1997, government legislated the Container and Packaging Recycling Law. It aimed to reduce waste from glass and plastic containers, paper and plastic packages, PET made bottles and paper cartons from communities and industry. The manufacturing company required to collect and recycle their products and transform containers and packaging into minimisation and recyclable resources. In 2007, the local manufacturers which include: Fuji Heavy Industries, Hitachi Zosen, IHI, JFE Environmental Solutions and Rasa Industries were collected 1.4 million tonnes of container and packages for recycling.

4.3 South Korea

The Republic of Korean is one of the Asian tigers, known for performing economic miracles. However, urbanisation has significantly increased in South Korea, from 79.7% in 2000 to 81.5% in 2005. By 2012, a population of 22,742,00 occupied the country's metropolitan areas, including Gyeonggi, Incheon and Seoul. The population density consisted of 474 people per 1 km^2, with Gyeonggi being the most densely populated area, housing 22% of the total population. As more Koreans have moved to urban residential areas it has aggravated South Korea's environmental load and the consumption patterns of the public have also been affected. The public's willingness to purchase luxurious goods has resulted in a shorter product life span for items such as furniture and home appliances. At the same time, waste management authorities have been facing a large volume of disposable products from household necessities, excessive packaging and food waste. The South Korean government has noted that the waste treatment facilities have been unable satisfy the gradually increasing demand brought about by economic growth and urbanisation. However, because of NIMBY syndrome, communities do not welcome noxious waste treatment facilities near their residential areas. This has resulted in social conflict among local communities. Therefore, the government has concentrated on reducing the amount of waste and maximising the possibilities for recycling unavoidable waste. Various policies have been presented to implement and archive a zero waste society in past decades.

4.3.1 Waste Management Act (1986)

The Waste Management Act established the basic legal framework for Korea's waste policy. This act promulgates the classification of waste, the responsibilities of the central and local governments and their citizens, comprehensive waste management plans, standards and rules for waste discharge and treatment procedures, and certification for treatment of designated waste (toxic and hazardous waste). Regulations pertaining to municipal waste reduction were added to the Waste Management Act as a basis for introducing the Volume-based Waste Fee System in 1995. According to the Waste Management Act, the federal government should devise a basic policy for waste management and provide technical and financial support to the local governments. Metropolitan local governments (cities and provinces) should mediate and also provide financial support to local governments.

Under the Waste Management Act, the term 'waste' included materials such as burnt refuse, garbage, sludge, waste acid, waste alkali, waste oil and animal carcasses, i.e., materials that are no longer useful to human life or business activities (Waste Management Act, Article 2). These were divided into municipal waste and industrial waste according to their source and the volume generated.

Due to the rise in incomes, changes to lifestyles, and the diversification of waste in terms of quality and quantity, the classification of waste subsequently changed. Before the Waste Management Act in 1986, waste had been divided into general waste and industrial waste. Hazardous waste was not defined in the act, but in one ordinance, 'special industrial waste' was. When the Waste Management Act was

amended in 1991, waste was divided into municipal general waste, industrial general waste, and designated waste.

In 1995, the waste classification system was again reorganised based on harmfulness. Waste was classified into two categories based onto its source of origin: industrial waste from business sites and municipal waste generated from households or large scale factories (waste generated above 300kg/day). Industrial waste was divided into two sub-categories: ‘general industrial waste’ which consisted of non-hazardous materials such as ash, construction waste, dust, and slag and ‘designated waste’ consisting of toxic wastes such as waste acid, waste alkali, waste oil, and waste organic solvents. Later waste management was bifurcated into a dual system based on the responsibility of the generator. The local government became responsible for the final disposal of municipal waste, while the discharger of industrial waste became responsible for its final disposal.

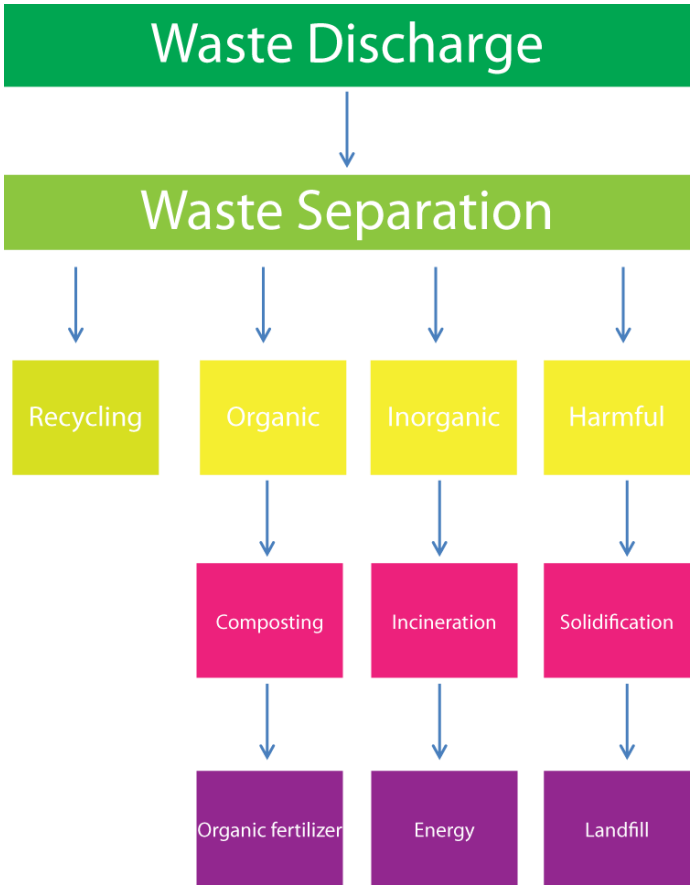

Figure 4.1 Waste classification system in South Korea

4.3.2 Act on the Promotion of Resources Saving and Recycling (1992)

This act promulgates the basic framework for waste recycling including the basic plans for recycling by the government and the roles and responsibilities of enterprises and citizens for promoting waste recycling. It establishes a waste labelling system and a programme for the separate collection and discharge of recyclable waste. It also provides regulations for the reduction of packaging waste, the Waste Charge System.

4.3.3 Volume-Based Waste Fee System (1995)

South Korean household waste treatment costs are levied proportionally based on residence size and past property taxes. However, in 1995, the Volume-Based Waste Fee System was also launched. This system imposed the cost of waste disposal on individual waste generators to reduce the amount of waste generated and to promote a separate source of waste disposal. Households ask to purchase plastic volume-based waste bags for disposal. Recyclable waste is then sorted and disposed of in separate recycling bins without any cost. As a result of this system the household waste per capita disposal rate significantly decreased from 1.33kg in 1994 to 0.99 kg in 2005. The disposal rate of municipal waste designated for landfills and incinerators also decreased to 56.3%, while the collection rate of recyclables increased from 15.4% in 1994 to 56.3% in 2008, and the amount of waste disposed of in landfills decreased from 81.1% to 27.7% through the Volume-Based Waste Fee System. In addition to playing a significant role in reducing the amount of waste generated and fostering recycling in households, this system has minimised the cost of waste management and established the fundamental concept of ‘environmentally-friendly’ communities with minimal waste generation.

4.3.4 Preventing Illegal Disposal

To prevent illegal disposal in the community, a maximum fine of 1 million won (US$870) is imposed on the violator. The purpose of this fine is to avoid indiscriminate disposals by citizens in inappropriate places and the discard of waste

without using VBWF bags. To oversee illegal behaviour, supervision-specialists are employed for long term monitoring. Local environmental group members and citizen's behaviour groups are designated as monitoring personnel to devise enforcement strategies targeted at illegal activities.

4.3.5 Re-usable Bags

In 1999, South Korea restricted the use of free disposable vinyl bags distributed by grocery stores. Approximately 15 billion sheets of vinyl bags are still being used at the present time. To further minimise the use of disposable vinyl bags re-usable VBWF bags were introduced by the Ministry of Environment. Citizens can purchase them at the grocery for use as shopping bags and later use them for disposing of waste. In consideration of the reusable concept, reusable VBWF bags come in different shapes with disposal VBWF. They also have user-friendly hand straps for easy carrying.

4.4 Singapore

Singapore gained independence from Malaysia and became the Republic of Singapore in 1965. According to Singapore's Department of Statistics (2012), the country has a population over 518 million living on 682 km^2 of land. This is the second highest population density in the world. Because Singapore is a highly urbanised and industrialised city-state its MSW has increased over 6 times in the past 30 years, from

about 1,300 tonnes per day in 1970 to about 7000 tonnes in 2006. Singapore is aware of its demographic and geographic constraints and it is taking measures to overcome them, looking to sustainable development as the major direction for its future. In 1972, the Singaporean government formed the Ministry of Environment. Through this it aims to provide a high standard, hygienic living environment, and manage both hazardous substances and municipal solid waste. In 2002, the National Environmental Agency (NEA) was created to promote public health and a clean living environment in Singapore. In 1979, MSW was primarily disposed of in incineration plants and sanitary landfills in coastal swampy areas. However, these facilities could not keep up with Singapore's rapid economic development and population growth. To address its waste challenges, the Singaporean government has implemented certain strategies. Among these, the NEA has adopted waste minimisation and recycling exercises as part of a long-term solution, and to elucidate the need for MSW management.

4.4.1 National Recycling Programme (NRP)

The NEA launched the National Recycling Programme (NRP) in April 2001. Its objective was to maintain a high degree of accessibility and dependable solutions for recycling waste generated in Singapore's communities. Recyclable waste includes clothing, glass containers, metal containers, paper, and plastic. The NEA provides a door-to-door recyclable collection service once every fortnight for 85% of the population. The appointed public waste collectors (PWCs) provide recycling bags and containers to households and have placed 1,600 centralised recycling depositories at Housing and Development Board (HDB) estates. The objective is to provide a

convenient way for householders to separate their recyclables in their homes. In addition, the NEA has provided or relocated recycling bins at some high density public areas, such as pedestrian paths, street intersections, mass transit stations, schools, shopping malls and residential areas. As a result of these efforts, the recycling participation rate of Singapore's residential public housing estates has increased from 15% at the beginning of the programme to 45% in 2003. The Singaporean government advocates public awareness as the key to the success of this programme.

4.4.2 Bring Your Own Bag Day

About 2.6 billion plastic bags are discarded every year in Singapore. To address this problem, the National Environment Agency worked with the Singapore Environment Council to launch a monthly campaign in April 2007. Its purpose was to encourage customers to carry their own shopping bags instead of using the plastic bags provided by stores. Fourteen supermarkets and shops were supported in this campaign. Every Wednesday, customers were invited to bring their own shopping bags. They could purchase reusable cloth bags in participating shops or donate 10 cents for every plastic bag taken from the checkout cashier. After three years of the campaign, two-thirds of the participating customers said they were more appreciative of recycling. NEA surveys also reported that customers were willing to increase the frequency of 'Bring Your Own Bag Day'. Sixty per cent of the customers stated they would either use their own shopping bags, buy reusable cloth bags or purchase the extra bags needed.

4.4.3 Youth Environment Envoy Programme (YEE)

This programme, inaugurated in 2005, targets youth (aged 17 to 35) in primary and secondary schools, and Institutes of Technical Education (ITE) who are interested in the environment and committed to environmental change. The programme's objective is to educate and construct a network among youth to study aspects of environmental sustainability. Participants are encouraged to become 'leaders and change agents, moving their peers and the community towards environmental ownership and sustainability' (NEA Youth Environment Envoy Programme). They join the training course to strengthen their knowledge of environmental concerns. To support them in their proactive roles as leaders and agents of environmental sustainability, tailor made workshops are provided to build up their networking, communication, facilitation, and motivational skills, and project management abilities.

Participation in the programme is related to and involves projects within the community, including recycling, conservation, surveys, mentoring of environmental champions from primary and secondary schools, organising environmental youth events, and engaging in forums and dialogues with programme peers.

4.4.4 Recycling Week 2011

Recycling Week 2011 was held on 5 June 2011 by Environment and Water Resources department. The aim was to inspire Singaporeans to arouse and protect their living environment by implementing an environmentally friendly lifestyle, enhance public awareness in 3Rs action in recycling, reducing, reusing and engage the community participation through the Recycling Week. The NEA expected this campaign reduce the waste from community sent to Singapore's incineration plants, thereby increasing the lifespan of Semakau Island. Also, it helped to decreasing the landfill loading from the public waste generation. Recycling Week 2011 was jointly organised by the NEA, the PWCs, the National Library Board (NLB), the People's Association (PA), town councils, schools, and grassroots organisations. It featured a series of activities and programmes designed to spread the 3R message. Its highlights included:

1. The exchange of recyclables (cans, glass, old clothing , paper and plastics) for groceries at community outreach events, where the public also participated in a Champion Recycler contest that awarded cash vouchers to the participation who collected with the most recyclables (by weight).

2. The e-waste take-back programme, which involved public recycling of unused electronic equipment and small household electric appliances, thereby reducing the quantity of waste at Singapore's disposal facilities. This programme also included storytelling and arts and crafts sessions, as well as book displays about recycling and the environment, at NLB's libraries; activities and educational exhibits which focusing on the reducing, reusing and

recycling at the event sites; and campaign with NEA's partners to promote the 3Rs, such as the car boot sale held by MediaCorp at Marina Square from 11 to 12 June 2011. During 2011, Veolia ES Singapore, the PWC for the Tampines waste collection sector, also launched its inaugural online recycling reward programme – Grow your Recycling Incentives Now (GRIN). GRIN strives to encourage recycling participation among Singapore residents by awarding GRIN points in proportion to the amount of recyclables they deposit into recycling bins. The recycling bins for each private household and HDB estate are tagged with unique radio frequency identification. This allows GRIN points to be credited into the household's or Resident Committee's account whenever the recyclables are weighed by the collection vehicles during their collection rounds. Accumulated GRIN points can be used to redeem gift vouchers via Veolia's web portal. In addition, a new standardised recycling bin with a label designed to indicate the types of recyclables that can be deposited has been introduced. These bins were rolled out on 1 July 2011 and 1 Nov 2011 at the Pasir Ris-Tampines and Bedok waste collection sectors respectively. Eventually, the new bins will be introduced to the other collection sectors in Singapore to promote a common recycling identity, and to encourage the proper use of recycling bins.

3. Resource Conservation Badge

The Resource Conservation Badge programme was developed to encourage expend environmental awareness with respect to the 3Rs and energy efficiency. Mr Tan Cheng Kiong, Chief Commissioner of the Singapore Scouts Association officially launched it at the Clean and Green Singapore (CGS) Schools' Carnival on 11 November 2009. A total of 135 students from the four

Uniform Groups (The Boys' Brigade in Singapore and The Girls' Brigade, The Singapore Scout Association, Girl Guides Singapore,) qualified for the Resource Conservation Badge

To become eligible to receive the RC badge, two merit badges must first be obtained: the 3R Badge, pertaining to waste management and the 3Rs, and the Energy Efficient Badge, pertaining to conservation and energy efficiency. To qualify for the 3R badge, members of the Uniform Groups must attend a lecture on 3R and require to complete two green projects listed in the badge booklet within two months of attending the lectures. Then, they require to share the project's knowledge and practices which they have acquired through the lectures and projects with their classmates.

The Energy Efficient Badge is directed at the ways Uniform Group members can become ambassadors for energy efficiency in their homes and communities. To qualify for this merit badge they must first participate in designated hands-on activities and creative projects, to learn some of the routine habits important to the reduction of electricity consumption.

Uniform Group members who satisfied the eligibility requirements for both the 3R Badge and the Energy Efficient Badge were awarded the Resource Conservation Badge and certificate at an award ceremony (National Environment Agency Badge Course 2011 Information Sheet).

4.5 Taiwan

In 1984, Taiwan's central government enacted the Waste Disposal Act. Its focus was on waste disposal via landfilling and government support of local governments in the construction of fundamental sanitary landfills. These landfills were primitive and poorly supervised. Primary waste treatment was applied when the waste was disposed of, and the public was allowed free waste disposal. Waste categorisation was neglected. Construction waste, domestic waste and industrial waste were placed in the same landfill. Environmental pollution and negligence of hygiene occurred. Therefore, this primitive waste management was not welcomed by the local residents. As the population increased, land limitations and serious pollution from the fundamental landfill also increased, and the government realised that the fundamental landfills needed to be strengthened to match the changing situation. Community hygienic concerns, recovery of biogas for electricity generation and waste transportation system were considered and applied in landfill development.

With the maturity of incineration technology, Taiwan's central government revised the Waste Disposal Act to state that 'incineration is the strategic solution in waste management. The fundamental sanitary landfills were phased out and replaced with incineration for waste management. According to the Environmental Production Administration, the total waste volume for incineration increased from 2.4% in 1984 to 64% in 2002. Although incineration was an efficient method to handle the waste problem, some local districts did not welcome the facility near residential areas and were opposed to building incinerators in many local communities. Therefore,

government revised the waste management plan and proposed waste deduction planning, including source separation, reuse and recycling.

In 1997, the Environmental Protection Administration (EPA) carried out a large-scale recycling campaign called the ‘Resource Recycling Four-in-One Program’. Local government invited participation from the community, local government cleaning division, the recycling industry and recycling funding associations for support. This recycling fund required importers, manufacturers and vendors of recyclable waste to pay fees that were used to establish firm prices for recyclables and subsidise local recycling activities. The aim of the programme is to promote waste minimisation and waste source separation and to arouse the public regarding environmental awareness in their community. Local governments, based on their districts waste disposal situation, provided corresponding waste transportation service to classify normal domestic waste and recyclables.

Figure 4.2 Taiwanese source-separation recycling bins.

In 2005, 10 cities and 94 towns launched the first phase of a compulsory waste classification programme and food waste recycling programme. Fifteen cities launched the second-phase compulsory waste classification programme in 2006. The programmes required the public to separate waste before dumping. Recyclables, food waste and normal trash should be categorised and disposed of in specific eco-plastic bags. The governments assigned inspectors to perform random checks. Households were punished with fines of NT $1,200 to $6,000 for illegal dumping. According to data from the EPA, Taiwan's nationwide domestic recycling rate is 22.59%. The average of particular cities' domestic recycling rate was 25.82% when the recycling programme was launched, and it is significantly higher than the nationwide average. The recycling funds supported and promoted activities to arouse the public environmental awareness. Public waste generation was reduced despite the economic growth in recent years. In 1998, the waste generation and transportation volume showed negative growth after the Resource Recycling Four-in-One Program had been executed for a decade.

4.6 Summary

Waste management policies in Japan, Singapore, South Korea and Taiwan are important in arousing environmental awareness. Policies can encourage communities to reduce the quantity of their waste. Programmes such as those that encourage the source separation of waste not only help communities to reduce waste but also show support for the recycling industry. South Korea and Taiwan have promoted effective ways to reduce waste over the past two decades compared with Hong Kong (Fig. 11). A volume-based municipal solid waste (MSW) charging programme for domestic,

commercial and industry and continuing public education enhance environmental awareness. With laws and education, people can be persuaded to change their behaviour and understanding. South Korea and Taiwan have turned MSW into effective and valuable goods by burning MSW for energy while reducing the volume of waste in landfills. The waste of transportation cost and maintenance costs of landfills are decreasing. Therefore, public behaviour and environmental awareness require a certain period of time to sustain perseverance by authorities and communities, South Korea and Taiwan had to execute waste charging through different channels. They adopted a volume-based charging scheme, Producer Responsibility Schemes and Polluter Pays Principle, to effectively change the behaviour of commerce and industry to redesign products and production, reduce unnecessary packaging and avoid excess waste. The Producer Responsibility Schemes in Taiwan and South Korea had positive effects for the public. Commercial businesses created new industries and green job positions for recycling their products, which helped to encourage the incremental development of recycling industries. Waste recycling as an economic incentive was accepted by the public and enjoyed by communities.

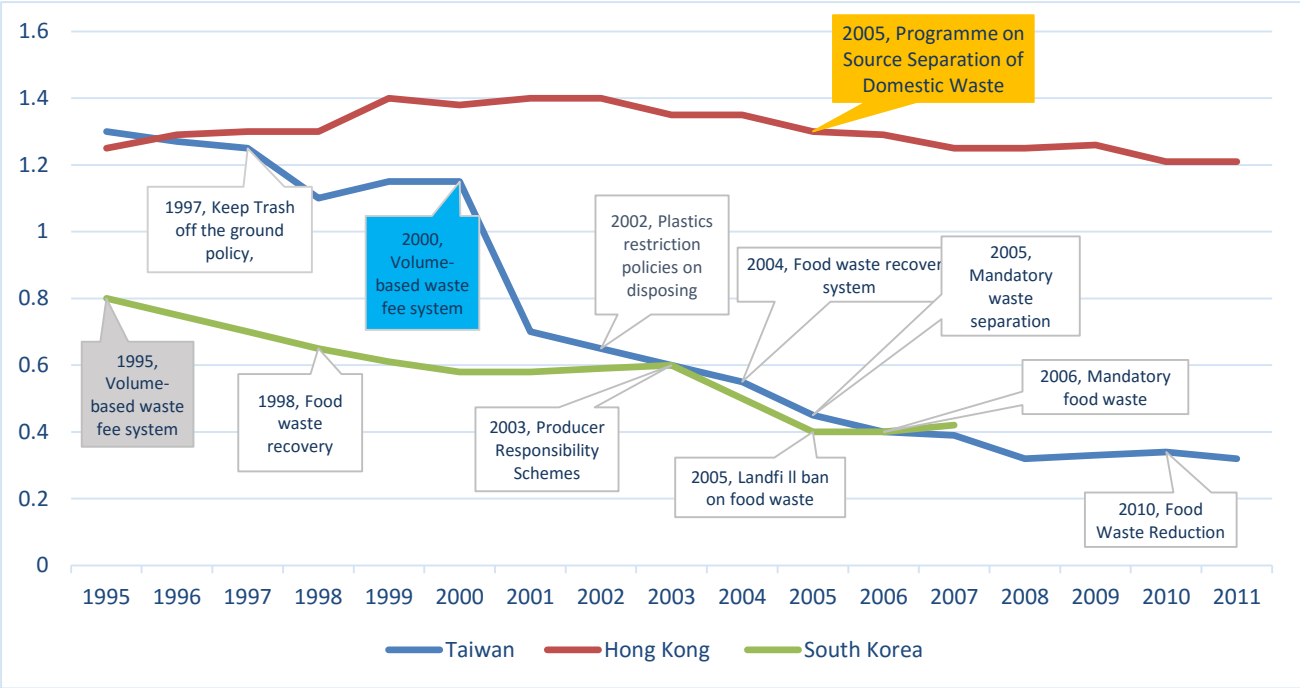

Figure 4.3 Waste disposal rates and policies in Hong Kong, Taiwan and South Korea.

Taiwan and Hong Kong had similar daily per capita waste disposal rates, but Taiwan's disposal rate has decreased significantly since 2000 when the volume-based waste fee system was launched. The most dramatic drop in waste disposal took place between 2000 and 2011. The per capita disposal rate of household garbage in Taiwan decreased 65% from 1.11 kg to 0.39 kg. The remaining waste was treated in three incinerators, and 4200 tonnes were landfilled daily. In contrast, South Korea used four incinerators with a daily capacity of 2850 tonnes for a population of more than 10 million in Seoul. The data in Fig. 11 show that Taiwan and South Korea achieved a waste decrease through public environmental education and volume-based MSW fee charging. Furthermore, landfill disposal rates decreased as waste was used for energy generation.

Through such programmes, waste can be transformed from a useless material into a new and valuable resource. Waste reduction can also help to relieve the burden on landfills and develop new economic opportunities for the recycling industry. If the Hong Kong government could learn from these countries, it is possible that the cost of waste management in Hong Kong could be reduced. For example, Hong Kong could implement a programme in which it charges households for prepaid waste bags, or it could require the public to pay for the volume of waste of which they dispose. This is fair to all citizens, whether they are residents of public housing estates or individual private household buildings. The government must also increase its manpower to enhance the quality of its public waste management facilities and its monitoring of citizens who illegally dispose of their waste. Furthermore, environmental awareness is a major reason for waste reduction. The public should be educated to understand that sustainable development is important to Hong King's future. The government should promote the importance of the public's contribution and encourage people to change their behaviour by producing less waste, adopting a green living style and supporting green development for Hong Kong. The government could also link with green organisations, public housing estates and schools to explore green education for the public. Even though the Hong Kong government promotes green and sustainability knowledge in its schools, the level of understanding regarding green living is insufficient for students to execute on their own. The government delivers instructions and information about green living, but there are not enough facilities and activities to support the public. Hong Kong could learn from Japan, where fundamental environmental awareness is taught in childhood. The separation of waste sources, saving resources and green living attitudes are learnt when children are young. The Hong Kong government could also help the public to build and maintain environmental awareness on a daily basis. In terms of recycling, it could organise

recycling resource centres in different districts to help the public with access to recycling facilities, especially those who live in buildings that are in poor condition and cannot accommodate recycling facilities for their residents. The installation of additional recycling facilities instead of increasing the number of roadside waste bins could also be explored to prevent the public from disposing of domestic waste.

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Chapter 5 Issues of Waste Management in Hong Kong

5.1 Waste Characteristics in Hong Kong

Recycling attitudes and behaviour are discussed in Chapter 2, and the practices of waste management in Asian cities and countries are discussed in Chapter 4. Because of urbanisation, cities everywhere are urgently facing environmental consequences, and there is a particular crisis in highly dense cities where large quantities of MSW are generated every day. The Hong Kong government has undertaken recycling initiatives and waste minimisation for the past two decades. Nonetheless, MSW has become a major environmental concern in the Hong Kong community. Waste management in Hong Kong has encountered two major problems: government implementation of environmental policy and the densely populated living environment. As far as the first problem is concerned, although the organisation that plays the leading role in public waste management services is the Hong Kong government, the manner in which it currently implements environmental protection policies has discouraged people from participating in recycling.

This chapter is divided into two sections. The first presents an overview of the research, examining the characteristics of Hong Kong waste management and the policies that have been introduced.. The second section illustrates the MSW situation in Hong Kong and the problems created by it.

5.2 Waste Management Policy

In Hong Kong, no waste management fees are charged for disposing of household and public waste. The major reason for this is that many people believe the responsibility for waste management should be shifted to the government and that all they should be required to do is dispose of their household waste correctly. This policy has the effect of lowering the contributions that individuals and households make to waste management.

From the early 1970s, when economic growth in Hong Kong began, waste has been a serious and difficult problem for the Hong Kong government (Environmental Protection Department, 1987, 1991, 1992). Many research and mass media reports, have noted that the situation seems to have become worse in recent years and the government seemingly has no way to improve it (e.g. Apple Daily, 2009; GovHK, 2010; Mingpao, 2005). The so-called promotional campaigns and legislative actions have had very little effect on conditions having to do with waste disposal in Hong Kong.

In Hong Kong, the government handles nearly all of the public waste collection, transportation and treatment. Over the past four decades, Hong Kong has developed rapidly. Millions of tonnes of solid waste, particularly municipal solid waste (MSW), are generated every year in the city (Environmental Protection Department, 2014). Indeed, Hong Kong has urban incinerators and a landfill waste management system. Nonetheless, its MSW production has been continuously increasing. In 1989, 12,500 tonnes of waste were disposed of by transfer to landfills. That increased to 14,000

tonnes in 1997 and 16,700 tonnes in 2001. According to the Environmental Protection Department (2008), the three existing available landfills: Ta Kwu Ling, Tseung Kwan O and Tuen Mun, are all expected to be full by 2019 if Hong Kong's MSW continues its rapid growth. However, the government predicts that the disposal rate of MWS will continue to increase and acknowledges that it is not likely to improve in the foreseeable future (see also Environmental Protection Department, 1987, 1992). That could amount to a waste management catastrophe for this tiny city.

Many researchers, environmentalists and designers have recognised that solid waste recycling, particularly household MSW recycling, is a key direction for environmental protection. Thus, in 1995, Hong Kong's Environmental Protection Department began to promote a domestic waste separation scheme. The campaign's (or programme's) purpose was to facilitate the separation of domestic solid waste for communities and households (i.e. residents) at its source, and to help property management companies provide waste separation facilities on the floors of every building.

Residents are now expected to separate their recyclable waste into three categories: paper, metal and plastic. From the beginning of the campaign, Hong Kong residents have made few negative comments about the scheme. To the contrary, over the past ten years their awareness of recycling has grown due to the government's promotion of it. However, this does not mean that the waste separation and recycling practice have been successfully implemented. To date, the result is still unsatisfactory. One of the reasons given is that waste separation and recycling is hindered by Hong Kong's densely populated living environment and the lifestyles of Hong Kong residents. The review and discussion in the following sections provide an in-depth exploration of this situation, focusing on living environments, social change and waste facilities.

5.3 MSW Problem

Based on 2004 statistics from the Environmental Protection Department (2008), every person in Hong Kong at that time generated 1.35 kg of waste a day. Of this, 1.0 kg (74%) had domestic sources. However, compared with commercial and industrial waste, only 14% of domestic waste was recovered,. In addition, 60% to 70% of the waste could have been recycled. It is thus easy to see how community and household participation in recycling has strong potential for generating a positive effect on waste accumulation and in turn the quality of the living environment (for the potential and merits of personal, community, and household participations in waste recycling, see also Schultz, Oskamp, and Mainieri, 1995; Switzer, 2004; Woollam, Emery, Griffiths, and Williams, 2000).

Studies have also shown that waste management can make the recycling process more effective (e.g. Baud, Post, and Furedy, 2004; Daven and Klein, 2008; Karousakis, 2009; Tam and Tam, 2006). However, as mentioned above, Hong Kong still relies heavily on land filling to handle its MSW, even though there is limited space for it and some practical constraints affecting the disposal of waste in it. For example, the main sources of MSW in Hong Kong are domestic households and the construction industry. Yet, because Hong Kong's recycling practices lag behind other countries in handling MSW, the current practice, is to dispose of most of it in landfills.

Many environmentalists and researchers have argued that there are other methods for managing MSW from domestic households and construction sites that are wiser and more environmentally friendly, including minimising, reusing, and recycling the waste (Mazzanti & Montini, 2009; Tam & Tam, 2006). These methods allow the

landfill site-life to be extended in addition to minimising the waste and transportation costs, reducing the resource needs, and generating resources to cover the cost of these alternative programmes (Kaseva & Gupta, 2001; Wesilind, Worrell & Reinhart, 2002).

Millions of dollars are spent on the disposal of waste by the Hong Kong government every year. This high cost does not include the potential value of restored landfills or the overall maintenance of the sites and other related systems and facilities such as those required for temporary waste storage and transportation. Specifically, the following costs are often overlooked (see also McBean, Rovers & Farquhar, 1995; Velinni, 2007):

- transportation cost of MSW from individual household units to communities waste collection points;
- removal cost generated by commercial and industrial concerns;
- capital cost and land value; and
- the land value of refuse collection points.

In Hong Kong as well as many other metropolitan cities, most of the costs incurred for MSW disposal are paid for out of public revenue. The costs are insignificant or non-existent for most waste producers. Thus, there is no economic incentive for public who participate to recycle or reuse the waste that they generate, or to reduce their volume of waste (including some 'still-useable' waste), because they are not being made to pay for their waste disposal (for additional information about the incentive of the 'recycler', see Vining and Ebreo, 1990). The free waste management service in Hong Kong, in fact, not only provides a disincentive for the general public to avoid waste, but also affects the growing cost of disposal.

All of the hidden costs paid for by taxpayers make it hard for the general public to appreciate the cost effectiveness and possibilities for recycling, and that in turn makes it difficult for the local recycling industry to survive. In addition, the lack of necessity for people to pay for the disposal of their waste leads to lack of development in the recycling industry (Blodgett, 2004).

Hong Kong's Environmental Protection Department has promoted the source separation of domestic waste since 1998. The campaign has been aimed at reducing the volume of domestic waste produced by households – the main source of domestic solid waste. The Department introduced coloured waste separation recycling bins and installed them in public spaces. These recycling bins came in three colours: yellow bins for aluminum cans (later changed to include metal); brown bins for plastic bottles; and blue bins for waste paper. Hong Kong had a total of 6,241 recycling collection points in 2011. Most recycling collection points are located in schools, parks, streets, shopping centres, and public transport interchanges. Their locations are determined on the basis of accessibility, public area density and the availability of space in the public areas. Although it is claimed that recycling collection points are now located throughout Hong Kong, the public recycling rate is very low compared with the rates in other Asian cities.

The other main waste management problem facing Hong Kong is its densely populated living environment (Lo & Siu, 2010). Households face constraints on participation in waste separation and maintaining their waste recycling habits. The recycling system is also limited in terms of the types of materials that can be recycled.

One prior study shows that householders are the key participants in efforts to boost the recycling rate (Perrin & Barton, 2001). However, of Hong Kong's approximately 2,300,000 households in 2002, only 51.9% habitually separated recyclable waste before disposing of their refuse (Census and Statistics Department, 2002; as cited in Chan & Lee, 2006). In short, although households have become more concerned about environmental protection in recent years, moves to transform this concern into action have not been particularly successful.

5.4 Increasing MSW Problem

In the 1980s, the Hong Kong government began to work on the monitoring of solid waste, in conjunction with the rapid growth in the population and economy. The main source of waste was from domestic households, and the commercial and industrial sectors.

To address the need to pair waste management system design with societal change, in 1981 the Environmental Protection Agency and Environmental Protection Department (EPD) began to a plan a waste monitoring programme to enhance the efficiency and results of waste disposal systems. The goal of this waste monitoring programme was to set up geographical distribution points for the disposal of solid waste and to identify the socioeconomic parameters that could be used to forecast future waste management needs in addition to planning for appropriate waste facilities and conducting waste monitoring annually.

In 1989, the Waste Disposal Plan was released to the public. Its disposal strategy for solid waste included the development of new cost-effective waste facilities meeting high environmental standards. In 1997, a new model for waste management facilities was introduced. It provided for a Chemical Waste Treatment Centre, three particular landfills and a cluster of five refuse transfer stations under the management of the EPD.

Waste monitoring is an important exercise because it maintains waste types and quantities and tracks relevant development. The existing database of fundamental waste information has been complied since 1981. EPD started to collect the latest waste disposal records each year from the waste monitoring programme. It allowed EPD to regulate waste forecasting and take account of the appropriate estimates for waste management planning and strategy such as:

- forecasting waste generation and its geographical distribution;
- forecasting the future utilisation of waste disposal facilities;
- planning for new waste disposal facilities;
- establishing waste management models for development of cost-effective waste management plans; and
- Identifying new waste management initiatives.

Since 1989, the Hong Kong government has suggested the region's strategy for waste management in its Waste Disposal Plan. The plan propose an extensive and effective waste management network of waste transfer stations to prevent the pollutant and shorten the transportation time on waste collection and large, rurally located landfill sites to serve expanding disposal needs. The following paragraphs provide a review of

the policies and designs, and expect to identify the possibilities and direction for this study on waste recycling.

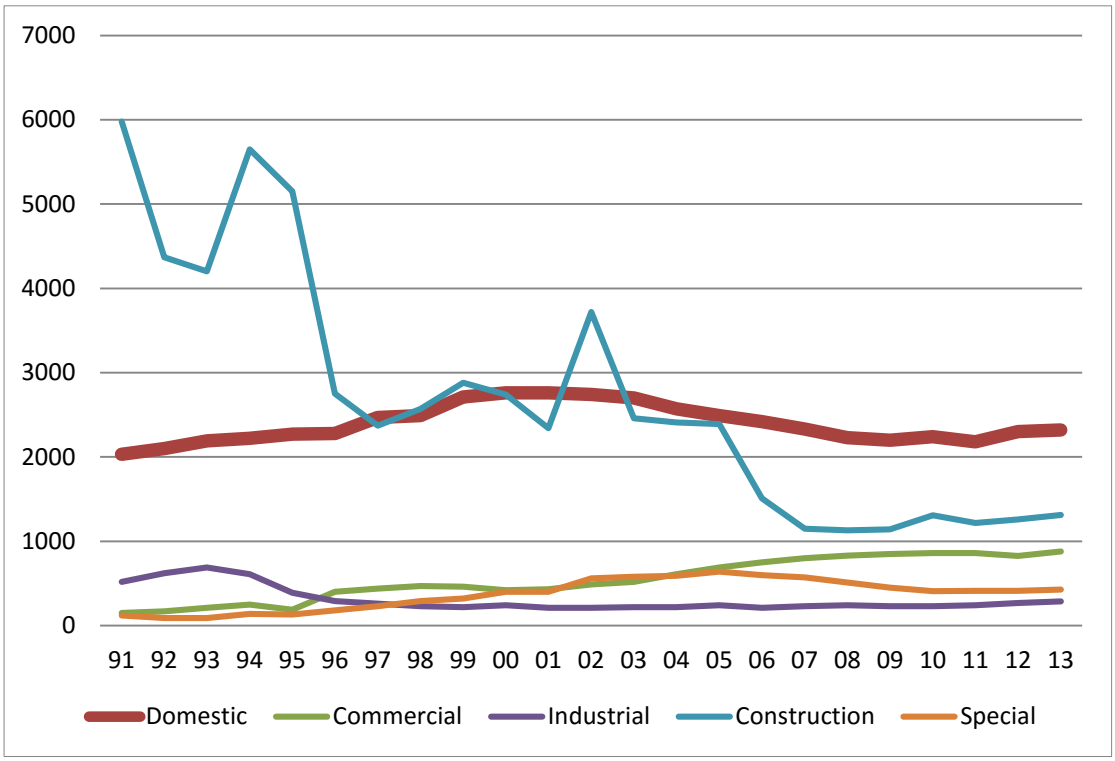


Figure 5.1 Volume of solid waste disposed in Hong Kong landfills, 1991-2013

Over the past three decades, Hong Kong has developed rapidly. Hong Kong is also facing a serious waste management problem. Millions of tonnes of MSW are produced every year in Hong Kong. Although Hong Kong has urban incinerators and a landfill system, its MSW production has been increasing continually. Landfill is highly relied on for waste management in Hong Kong compared with other Asian countries. (Fig 5.1). In 1989, there were 12,500 tonnes of disposable waste transferred to landfills; 14,000 tonnes in 1997; and 16,700 tonnes in 2001. According to the Environmental Protection Department's information (2008), Hong Kong's landfill system will soon be full if its MSW continues to grow. This will become a serious

problem for waste management in this tiny city, and the government predicts no improvement will be forthcoming in the near future.

The government needs to spend $435 million and $355 million on the cost of land and construction respectively to manage Hong Kong's future waste collection, transfer and disposal needs (Environmental Protection Department, 2008). It also acknowledges that for every 5.7 million tonnes of waste, 2.3 million tonnes (40%) of waste can be recovered and 3.4 million tonnes (60%) must still be disposed of in landfills (see Figure 5.1). Not including the land and construction costs, every year the Hong Kong government spends nearly one billion dollars to manage the collection, transfer and disposal of its waste (Environmental Protection Department, 2008). If people continue to produce waste at their current rate the government may need to find more than 400 hectares of land for new landfill sites (Environmental Protection Department, 2008). This is equal to one-third of the size of Hong Kong's International Airport, an area that could absorb half of Hong Kong's projected population growth for the next decade. However, as stated above, it is nearly impossible to find such a large area in Hong Kong on which to construct a landfill site. Accordingly, the government has been criticised by the Legislative Council and the public for proposing them.

Despite the steps taken by the Hong Kong government to promote environmental protection over the past one and a half decades, the problems surrounding landfills have not yet been resolved. The government has acknowledged that its existing landfill capacity will soon be exhausted (Environmental Protection Department, 2009). It has therefore suggested building new incinerators as a possible solution for

handling incremental increases in MSW and to meet future waste management requirements. Many members of the public, however, are strongly opposed to this. They are worried about and strongly object to the pollution incinerators would generate. To date, the government has been unable to persuade the public to accept their proposal despite its recent presentation and debates in the Legislative Council. Rather, people are convinced the construction of incinerators will adversely affect their health, and some are concerned property prices in their localities will fall if incinerators are built nearby. When people's personal interests are affected by environmental policies, they tend to minimise or even neglect environmental protection issues.

5.5 Problems Related to MSW

Solid waste can be classified into three different types based on their source and the institutional arrangements for their collection and disposal. These three types of solid waste are MSW, construction waste and special waste. The detailed descriptions are as the follows:

Municipal solid waste includes domestic waste, commercial waste and industrial waste. Domestic waste refers to household waste or urban waste, waste generated from daily activities and refuse collected from public cleaning services. Food residue is one of the most common substances in domestic waste, and it is biodegradable. It is not suitable for landfill disposal because methane gas leaks from it, leading to a greenhouse effect. In Hong Kong, cleaning waste is found in dirt and litter. The Food

and Environmental Hygiene Department (FEHD) collects this kind of waste. Marine refuse is collected by the Marine Department. The Agriculture, Fisheries and Conservation Department collects waste from country parks. Commercial waste is generated from commercial activities which taking place in hotels, markets, offices, restaurants and shops in private housing estates.. Private solid waste collectors primarily collect it. Part of commercial waste is also mixed with domestic waste and collected by the FEHD. Industrial waste is generated from industrial activities and does not include construction or chemical waste. Private waste collectors take care of most of the waste collection duties, but some industries deliver their waste directly to landfills. Industrial waste includes textiles, plastics, paints and dyes. It produces serious hazardous pollution if it is deposited into a landfill directly without first undergoing a pre-treatment process. Furniture and domestic appliances constitute common bulky waste. They cannot be transported in conventional compactor type collection vehicles and must usually be handled separately. This generates extra cost for the government.

The volume of construction waste is rising as a result of construction, excavation, site clearance, renovation, demolition and road works. Most construction waste is inert and includes rubble, soil, sand, and concrete. These materials are suitable for land reclamation and suitable for recycling in construction reuse. The remaining non-inert substances in construction waste include bamboo, packaging waste, timber, vegetation and other organic materials. These kinds of non-inert waste are not appropriate for land reclamation and are disposed of in landfills directly.

Special waste includes abattoir waste, animal carcasses, asbestos, chemical waste, clinical waste, and condemned goods, and requires particular disposal arrangements. Hong Kong's Chemical Waste Treatment Centre (CWTC) collects all special waste.

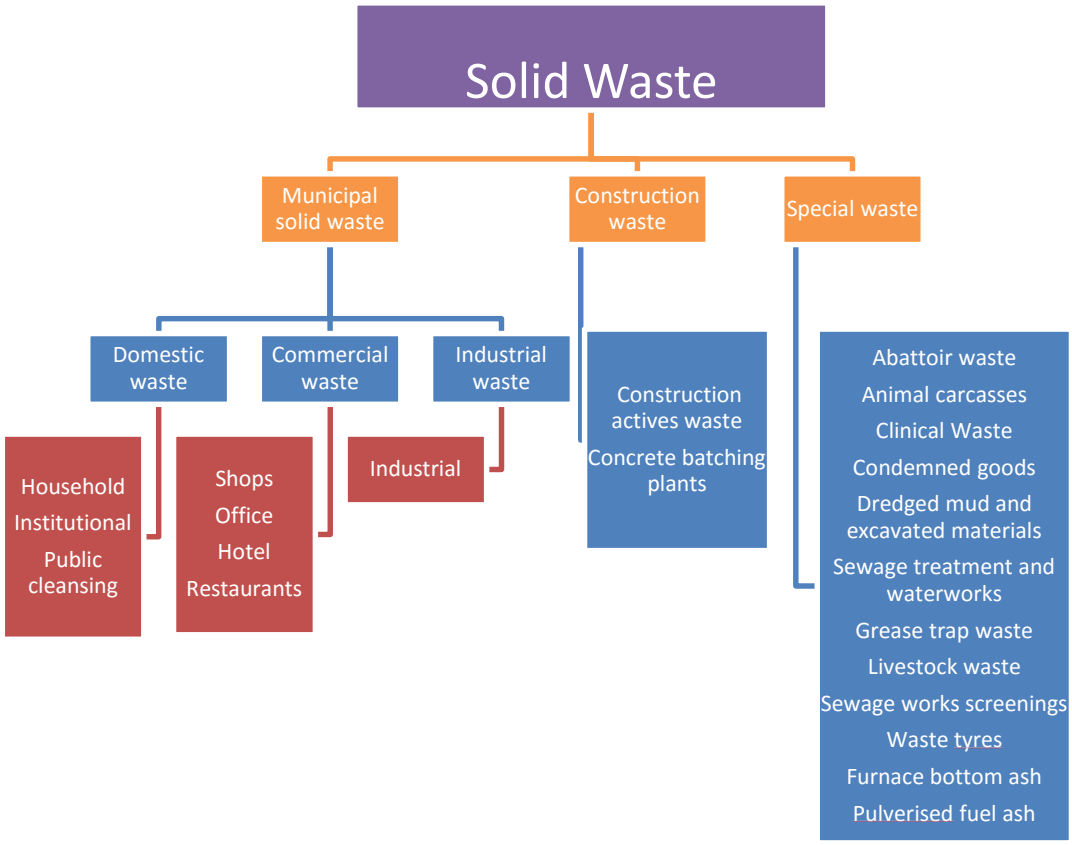


Figure 5.2 Solid waste classification

Figure 5.3 illustrates the complexity of waste management and waste transportation.. For the most part, over the past two decades, the responsibilities and actions illustrated in the figure have belonged to the Hong Kong government. This implies that most of the time the costs– money and manpower – are absorbed by the government, and all users – individuals and communities – can enjoy the free services provided for waste deposit and management. Consequently, the users (i.e., waste

disposers) may not consider their responsibility for waste reduction. As the policies and practices in other countries and cities are similar, such a situation appears to be quite common (Hailes, 2007).

This does not imply that the current approach is effective (Blodgett, 2004; Hailes, 2007; Hay, Stavins & Vietor, 2005; McCorquodale & Hanaor, 2006; see also ATV, 2001). Increasingly, researchers and environmentalists have suggested that communities can (and should) take up some of the roles to help the government implement a recycling policy in which the overall social cost can be significantly reduced.

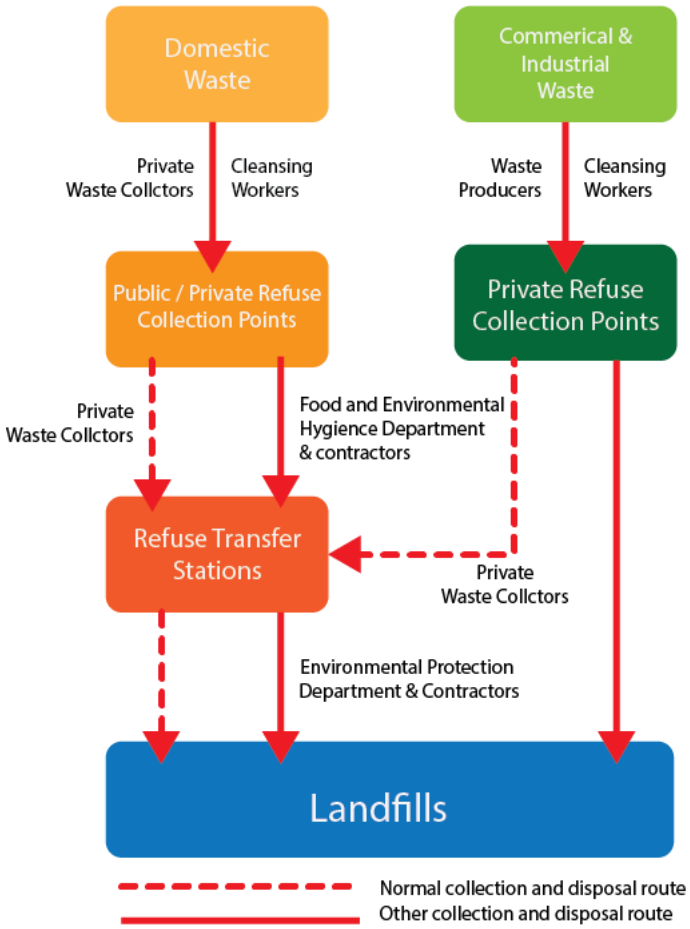


Figure 5.3 Waste management and waste flow chart in Hong Kong

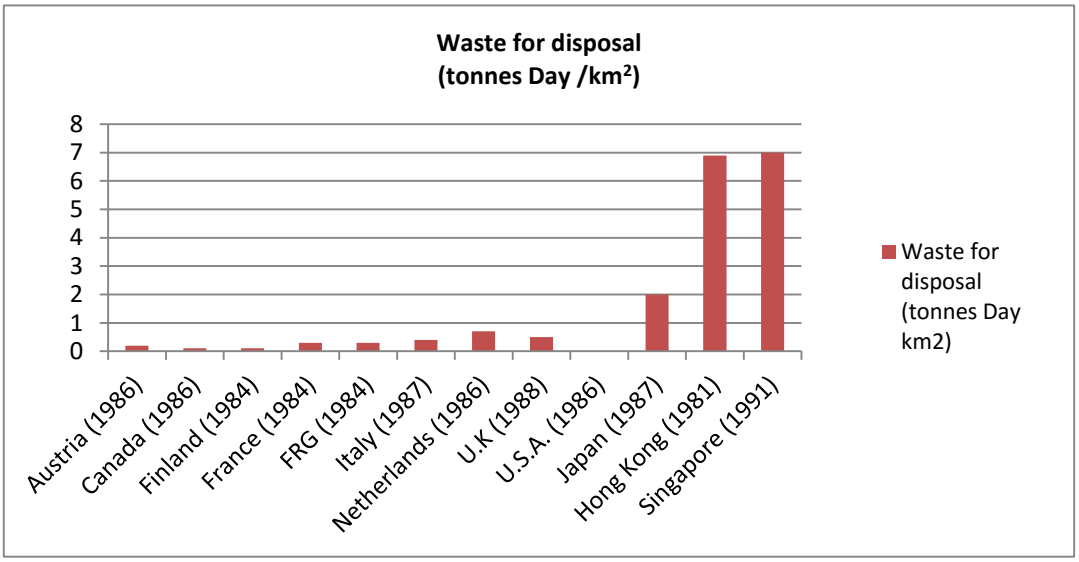


Figure 5.4 MSW disposed of by countries per land unit.

Figure 5.4 shows that Hong Kong is generating a remarkably high quantity of MSW per capita compared with other international cities. Given the small extent of its territory, the waste disposal required by Hong Kong is creating massive pressure on its waste disposal facilities compared with other international cities. As MSW incineration is an expensive and polluting waste management approach, so the main way to dispose of MSW for next twenty to thirty years is expected to be landfill. The existing 13 landfills in Hong Kong, 9 landfills site were completed and 4 are still to allow landfilling. The total amount of land designated for landfills occupies approximately 260 hectares (EPD 1991). Additionally, there is insufficient recycling of solid waste. The experience of waste recycling in Japan has proven that public recycling can be acts as an effective approach. It means of reducing the pressures associated with waste disposal. In 1987, Japan was disposed about 1 kg of waste per person on each day. The reason for this discrepancy is that the other 1kg of waste had recycled (Tanaka 1991). Accordingly, high and populated density living condition, the pressure on waste management facilities in Japan is far less compared with Hong Kong.

5.6 Lack of Community Concern over Waste Management Costs

Millions of dollars have been spent every year for waste disposal by the Hong Kong government. This does not include the opportunity costs for restored landfills and the overall maintenance of the sites and other related systems and facilities such as temporary waste storage and transportation facilities. The following detailed costs are often omitted from waste cost analyses (see McBean, Rovers & Farquhar. 1995; Velinni, 2007):

- cost of removing MSW from individual housing units to refuse collection points;
- removal costs incurred by commercial and industrial concerns;
- capital costs and land values; and
- the value of land used for refuse collection points.

Most of the costs associated with MSW disposal are paid out of the public revenue. These costs are insignificant or invisible to many waste producers. There are virtually no incentives for individuals to recycle or reuse the waste that they produce, or to reduce their volume of waste (including some 'still-useable' waste), because they are not being made to pay directly for what they are throwing away. The free waste management service in Hong Kong actually discourages waste prevention by the general public, which, in turn affects the growing cost of waste disposal. Moreover, people who are not required to pay for disposal of their waste are not predisposed to developing a recycling industry (Blodgett, 2004). All of the hidden costs paid for by the taxpayers make it difficult for the general public to appreciate the cost effectiveness of and possibilities for recycling.

Chapter 6 Recycling in Hong Kong

6.1 Hong Kong Recycling Policies

The increase in MSW over the past several decades more or less reflects the current consumption-led lifestyle in most developed countries, not only in Hong Kong. Although social researchers and environmentalists have seriously warned us, the situation has not seen much improvement. To the contrary, it has gotten worse (Farmer, 2007). As stated above, one of the critical points is that individuals and communities (or neighbourhoods) have not realised that the cost of waste is related to the high volume of MSW disposal (see also Timmeren & Roling, 2003). Thus, one way to reduce the government's responsibility for waste management cost and the quantity of MSW is to put the full cost back into the consumption equation (Bennett, Wang & Zhang, 2008; Hailes, 2007). If individuals and communities were to act responsibly towards MSW, they could reduce its disposal rate, or change the nature of MSW to non-MSW (that is, recycle). As the Environmental Protection Department (2008) and many environmentalists have pointed out, the last action for individuals and communities is the best option because it tackles the problem fundamentally (that is, by reducing MSW).

In sum, producing less waste and recycling more are two more sustainable ways of living (see Figure 6.1). The 'waste hierarchy' in Figure 6.1 is an effective principle for managing MSW. There are three approaches involved in the Waste Hierarchy:

- avoidance and minimisation;
- reuse, recovery and recycling; and
- bulk reduction and disposal.

As illustrated in Figure 6.1, the first priority in the waste hierarchy is ‘avoidance and minimisation’. This means that we (i.e., policymakers, professionals, communities and individuals), should locate the problem at its ‘source’ and encourage citizen to minimise the waste generation. If it is not feasible to avoid generating waste in the first location, the waste generated should be minimised as much as possible, through avenues such as appropriate product design or minimal packaging (AIMS, 1997).

We should also arouse public on the reuse, recovery and recycling of suitable recyclable materials (Environmental Protection Department, 2008; Hay, Stavins & Vietor, 2005). To make recycling work efficiently, robust sorting, collection and distribution systems must be in place. Equally important are the market outlets for recycled materials. Because of reuse, recovery and recycling, the recycling industry is a key element in a ‘circular economy’, consumption loop. Through this loop we could achieve the effective way to use of resources and materials, while manufacturing and producing as little waste as possible.

Once the possibilities of waste avoidance, minimisation and recycling have been exhausted, it is necessary to use appropriate technologies to reduce and treat the residual waste. It is a commonly accepted principle that all waste should be properly treated prior to disposal at landfills to prevent long-term environmental burden .The direct disposal of untreated MSW causes water pollution and landfill gas emissions, both of which are environmental liabilities (Bennett, Wang & Zhang 2008; Popov & Power, 1999).

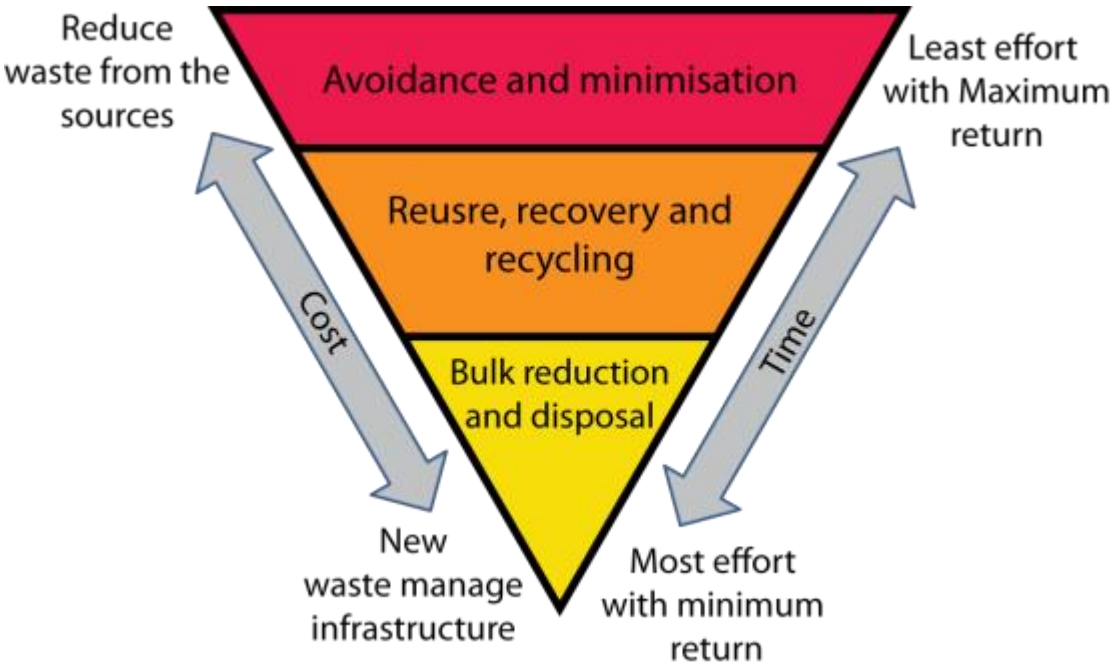


Figure 6.1 Waste hierarchy

6.2 Characteristics on Waste Recycling in Hong Kong

In Hong Kong, no restrictions, laws or regulations require the general public to separate domestic waste into recyclables. However, according to some studies, most people in Hong Kong support source separation of domestic waste. Householders prefer to sort their waste into recyclables and non-recyclables and place recycling facilities at their doorways for waste collection.

Binary recycling (recyclables and non-recyclables) is also acceptable to the Hong Kong public because it is convenient and involves less effort. People carry their waste short distances and sort it into as few categories as possible.

Housewives, in particular, tend to support source separation rather than binary recycling. One reason for this is that housewives accept the importance of waste separation more than other family members. They will search temporary storage space, and check for recyclables before leaving their waste for collection. Housewives are also affected by environmental charges resulting from environmental concerns. For example, due to product charges being imposed on plastic carrier bags, housewives are more motivated to bring their own shopping bags and less willing to request new plastic shopping bags from shops because of the cost.

Figure 6.2 Misuse of recycling bins

Most citizens in Hong Kong are supporting waste recycling and other resource conservation measures. Though, it has been found that housewives participate less in household waste separation programmes than the general public. The main reason given for his is that housewives expend more effort for source separation of waste at home than other family members.

Nowadays, waste management is a key issue for metropolitan development. The general public will be more likely to consume products if waste-recycling programmes are provided. The government should assume a leadership role in develop new waste management systems and educate the public in reducing waste and recycling. The waste collection charge policy will not be affect in reducing household solid waste for the general public and housewives in the short period. Changing housekeeping practices, however, can help to reduce the waste generation. In addition, economic incentives are a good way to encourage housewives to improve their habits and increase the separation of domestic waste.

6.3 Programme on Source Separation of Domestic Waste

As a high-density city, Hong Kong is running out of land to build waste management facilities. Thus, in January 2005 the government launched its programme on Source Separation of Domestic Waste. This provided a convenient way to encourage citizens to practice waste recovery. Each participating residential building was allowed to install a waste separation and recovery system based on their residential building conditions. The participants could expand the variety of their recyclables to include waste paper, aluminium cans, plastic bottles, plastic shopping bags and compact discs. As the interiors of residential buildings are complex, the campaign allowed property managers and owners to design their own recycling systems with applied findings. In 2006, 497 private and public housing estates were enrolled in this programme. This included 371 private housing estates, 64 public housing estates and 62 government

quarters. Twenty-nine per cent of the Hong Kong's population participated in source separation of domestic waste and recycling of a broader range of recyclables.

At the end of 2006, 120 housing estates reported that ground-level waste separation facilities had been installed and that their waste recovery rates had increased by an average of 36%. Seventy housing estates that installed waste separation facilities on each residential floor performed even better, with an average waste recovery rate of 54%. The overall domestic waste recovery rate in Hong Kong increased to 20%. Conversely, domestic waste decreased by 3% in 2006 compared to 2005.

Figure 6.3 Ground-level waste separation

TAs part of the programme, the Hong Kong government provided a guidebook, which helped property managers and residents overcome any obstacles they might have had to joining Source Separation of Waste in Residential Buildings. In addressing recycling concerns, the guidebook provided advice on how to practice source

separation of domestic waste in residential buildings. It also explained the waste recycling system installed in the building and reviewed fire safety regulations and laws.

6.4 Recycling Facilities in Hong Kong

The slogan, ‘blue (for paper), yellow (for aluminium), and brown (for plastics)’ has been widely promoted to identify recycling bins, since 1998, when recycling separation bins also started being located in public housing estates and residential blocks. These three coloured bins, which collect aluminium cans, waste plastic and waste paper are usually designated common areas of housing estates or located on the ground floor of buildings entrance. Though, some residents still find it is difficult to access the recycling bins. The recycling system also constrain the types of items that can be collected for recycling purpose.

Figure 6.4 Private-business-designed recycling bins

Figure 6.5 First types of recycling bins

Although the three coloured waste separation bins have been installed in the common areas of public housing estates and residential blocks since 1998, this type of recycling bin installation cannot satisfy user need. This is reflected in the recycle recovery rate, which is only about 16%, and much lower than the rates found in the commercial and industrial sectors. Because the recycling bins are placed on the ground floor or common areas, it is inconvenient for residents to dispose of their recyclable waste. Furthermore, the coloured bin recycling system limits the types of items that can be collected for recycling.

Due to the limited space and high-density population in Hong Kong, waste source separation is one of the most effective ways to reduce and collect waste. In 2004, the Hong Kong government tested source separation in the Eastern District. Recycling bins were installed in the following eight locations on each floor of selected buildings:

1. Floor refuse storage and material recovery room;
2. Floor refuse storage room and refuse chute room;
3. Floor cleaner room/water meter room;
4. Refuse chute;
5. Integration of lobby with floor refuses storage room;
6. Staircase landing;
7. Floor service lift lobby;
8. Floor passenger lift lobby.

6.4.1.1 Floor Refuse Storage and Material Recovery Room (MMR)

The floor has a single room provided for separation and sorting of waste and recyclable materials. This is only applicable where floors have an extra room or a built-in room for separation purpose. This design allows to facilitating large volume of recycling bins for resident to sorting recyclables.

6.4.1.2 Floor Refuse Storage Room and Refuse Chute Room

An enclosed room is used for waste and recyclable material being stored. It allows resident for separation of refuse, sorting of recyclables and storing of related material. It allows facilitating small volume recycle bins for residents to put waste and recyclable. Cleaner request empty the refuse bin and recyclables frequently as the volume of container were limited in small size

6.4.1.3 Floor Cleaner Room/Water Meter Room

Cleaners use the floor cleaner room (FCR) to store cleaning stuff and to prepare for cleaning duties such as floor mopping and waste management. Proper water supply and drainage outlet points are common provisions. The design is different between the floor cleaner rooms and material recovery rooms in order to government regulations. It must be met before they can be used for collecting recyclables. The water meter room contains water meter piping so that relevant personnel from the Water Supplies Department can come periodically to record water usage.

6.4.1.4 Refuse Chute

A refuse chute is an inclined facility used for throwing waste from the opening tunnel on each floor to the ground floor refuse central room of a building.

There are several common designs for refuse disposal that may include the following.

- Separate recycling bins
- Single large recycling bin design:
- Shelf and bin design:
- Floor divider design:

Three separate recycling bins: Residents bring their recyclables and dispose of them in corresponding waste separation bins. The three separate recycling bins require a large space for their installation, and their volume is limited. Cleaners need another room to store some recyclables until the recycle company collects them.	
Single large recycling bin design: Residents need to dump their recyclables on specific days. A limited space is suitable for use of the single recycling bin design. Furthermore, this design allows cleaners to collect a large quantity of recyclables and they do not need to sort the recyclables each time. However, residents need to store all of their recyclables in their flat until their specified day.	
Shelf and bin design: The wall-mounted shelf is for paper disposal. Recycling bins can be setup for plastics and metals collection. The installation is easy and it is suitable for some small rooms. The limitation is the wall-mounted shelf, which cannot store a large quantity of recyclables.	

Floor divider design: The painted colour is marked on the floor to indicate the regions for different kinds of recyclables. Residents deposit their recyclables in the corresponding regions. This is the cheapest method of recycling system installation and it is suitable for any place. The limitation is that residents need to pack all recyclables before depositing them.	

6.4.1.5 Integration of Lobby with Floor Refuse Storage Room

Figure 6.6 Integrated triangle bin

A building's lobby, adjacent to its ground floor refuse storage room in much of Hong Kong, is the standard means of ingress and egress to both the building's staircase and its exit. Where refuse storage rooms exist, the lobby also acts as a fire and smoke barrier between it and the adjacent staircase or exit. Storage rooms are enclosed by walls and have a door. Nonetheless, it is common to call the lobby area the 'smoke lobby' because it has specific requirements for fire safety. Due to the limited space in

most buildings, the lobby and recycling bin design are usually combined into one. This minimises the space needed for waste and makes it collection easier.

6.4.1.6 Staircase Landing

In this configuration, the recycling bin is located at the corner of the staircase. For safety, it is made of metal, a non-combustible or fire resistant material with a self-closing lid to prevent fire from spreading if the recyclables are ignited.

Figure 6.7 Bi-recycling bin

6.4.1.7 Floor Service Lift Lobby (SLL)/Floor Passenger Lift Lobby

In this arrangement, the recycling bin is installed on the floor next to the entrance to the lift. It must be fixed and secured (e.g., floor- or wall-mounted) to prevent toppling or displacement in the event of an emergency. This is the most common plan in Hong Kong's private residential buildings. The recycling bin cannot be installed beside the fireman's lift lobby because it cannot block the means of escape. Furthermore, this space is needed for natural ventilation.

Figure 6.8 integrated triangle bin 2

6.5 Attitudes and Behaviour Associated With Waste Recycling in the Community

Household waste separation has been welcomed in Hong Kong over the past few years. The primary reason is that many families have more than one member (sometime, all family members) with a full time job. This includes married women. The increasing number of full time working women is one of the key factors driving household waste separation in a positive direction. The attitudinal differences between housewives and the general public with respect to waste have been discussed above. Most housewives in Hong Kong favour waste recycling and reduction. In addition economic incentives are a more powerful motivation for housewives than for the general public in terms of enhancing waste recycling and reduction.

In Hong Kong, the number of housewives with full time jobs is increasing. Because housewives are also primarily responsible for domestic household work, the success of source separation of household waste greatly depends on them as a social group.

The attitudinal differences between housewives and the general public lie in perceptions of the level of avoidable waste and the green premium, and support for source separation.

6.5.1 Level of a Green Premium

In general, green products are more costly than ordinary products. Market research has found that environmentally friendly products are 5% to 15% more expensive than ordinary products. The general public are not usually willing to pay this extra expense. Housewives, in particular, tend not to pay for green products because of their relatively higher cost. Because they are responsible for their family's expenditures, housewives are more concerned about the prices of the products they buy. They are not willing to incur the expense of the green premium or buying a 'green life'.

6.6 Summary

Although the general public's awareness of Hong Kong's waste management problem and the need for recycling has increased in recent years, many people are still not quite willing to actively participate in waste recycling, particularly if there is a cost implication. Hence, for the past ten years, the most significant action the Hong Kong government has taken in furtherance of waste recycling at the community and neighbourhood levels has been the installation of recycling bins in public areas. However, Hong Kong is crowded and geographically restricted. Home spaces are very small, and most of the public spaces in residential buildings cannot accommodate recycling bins. Many corridors and staircases are not suited to the existing recycling bins because of fire regulations. Furthermore, many public and open spaces are not conducive to recycling because interior and exterior built-environments restrict waste recycling activities. In addition, many property

management companies only install waste recycling facilities as a low-grade option for residents, and are discouraged from installing the unpleasant, locally designed recycling bins. As stated above, many imported recycling facilities do not fit the needs of Hong Kong's local communities, and most of the time the cost of imported facilities is very high. Overall, the recycling facilities in Hong Kong are extremely limited and not user-friendly. All of this acts as a disincentive for communities as well as individuals to participate in the waste recycling process.

Figure 6.3 isleading and mixed recycling bin design

From another perspective, most of the time the recycling bins in Hong Kong are misused, that is, they are used as a kind of general rubbish bin. Additionally, the types of recyclable materials are very limited in the communities. In contrast to other countries, such as Japan and the Netherlands, only three broad categories of waste are designated for recycling in Hong Kong. In addition, without education and adequately designed facilities, the public sometime finds it very difficult to classify the waste, whether recycling it or not. Recycling facilities (e.g., recycling bins) in Hong Kong

are also frequently damaged from misuse and even by intention. For example, some homeless people have broken into locked recycling bins to collect valuable waste from inside of them. Due to safety and hygiene issues, the government and property management companies face a dilemma as to whether or not to allow the waste inside the recycling bins to be accessed by the public.

Finally, community participation is an enormous potential for successful in recycling. Hong Kong government launched recycling campaign on Source Separation of Domestic Waste in 2005. Community had confident to understand the important of recycling. Government and NGOs should arouse their motivation on participating in waste reduction. Progressive waste on public policies and infrastructure are properly aligned with community. It helps to secure the public confidence on waste deduction. As the public distrust on recycling programme was launch a decade but the generation rates per capita was remaining in large volume compared with nearby Asian countries. Low public participation was showed as they questioned whether the recycling from waste separation are helping to increase waste recovery. Also, public concerning about recycling facilities of the locations, varies of recyclable and quantities. There are also public doubts about whether recyclables can be manage correctly rather some collectors lump with waste together to landfill. Government should provide a comprehensive and convenient waste collection system. The waste collection system and waste separation of recyclables should be strengthen and improve the front-end of waste chain.

Figure 6.9 Homeless people can damage locked recycling bins

It is important and it is time to reconsider the waste recycling practices in Hong Kong, in particular, at the community level. As indicated above, the focus of research in design practice should be directed to an all-round approach with a wider perspective instead of the conventional way of look into the issues only from the governmental policy point of view. The ways in which communities can ‘actively’ participate in the recycling process through the aid of ‘design’ is very important.

Chapter 7 Hong Kong Households' Waste Management

Many researchers reported environmental awareness is driven by the demographical background of publics. High education background and income publics contains with active environmental awareness. They are will to participate on recycling and concern for the living environment. In contrast, 46% of Hong Kong population are living in public housing estates. Public housing estate which provided affordable housing for lower socioeconomic stratum. The resident's income is below the median monthly wage. According the data (Hong Kong Statistics, 2014), the median monthly wage of male HK$ 16,500 and female HK$12,700 respectively. In public housing estate which provided and subsidised by Hong Kong government. Income and total net assets constrained for the resident. Maximum income for individual is HK$ 10,970 (2016) which below the median monthly wage. Also, Hong Kong public housing estate is designed in effective and high complex living environment to match with high demand of living condition and populated exploration. High density living condition will affect resident's behaviour on environmental awareness. As the public housing estate is the pioneer for launching government recycling campaign for past decade, recycling facilities and environmental education were promoted continuously. The result of recycling is not significantly improve. In this chapter will discuss about the condition of public housing estate on recycling. Also, investigation on the public housing estate resident of recycling behaviour and the mechanism on recycling will be analysis.

7.1 Characteristics of Hong Kong Public Housing Estates

The most popular and characteristic living environment in Hong Kong are its public housing estates, which provide affordable housing for lower income residents. The housing programme started after the 1953 fire disaster in Shek Kip Mei, which destroyed thousands of shanty homes. The first public housing estate was built to settle the fire disaster victims. Today, about 47% of the Hong Kong population live in public housing estates (Hong Kong Housing Authority, 2010a, 2010b, 2010c). The estates are primarily built and managed by the Hong Kong Housing Authority and the Hong Kong Housing Society (Hong Kong Housing Authority, 2001a; Hong Kong Housing Society, 2009). The main characteristic of the public housing estates is that rent is subsidised by the Hong Kong government, making it significantly less than private housing. Public housing buildings are generally high-rise and almost all of the new buildings contain more than 40 storeys (Hong Kong Housing Authority, 2010c) (The government claims that public housing facilities can fulfil the residents' daily needs, because they contain residential flats, supermarkets, car parks, public libraries and transportation systems.

Figure 7.1 New design of public housing estate

Shau Kei Wan is an old district in the eastern part of Hong Kong Island. Approximately 587,800 people lived in Shau Kei Wan in 2006. In the 18th century, Shau Kei Wan was a fishing village for 1,200 people in what was then a squatter area. Generally, there were problems with poor hygiene until the 1960s when the government began to implement a large infrastructure construction project in the district that included land reclamation and road construction. A high volume of public subsided housing was provided at the same time. According to the Census and Statistics Department, in 2006, 27% of Shau Kei Wan residents lived in public housing and 16% lived in private residential buildings. Twenty-one per cent of the population had less than a secondary education and 49.5% had no primary education. Today, the average domestic household size is three, and the median monthly domestic household income is HK$21,705.

Almost 47.5% of Hong Kong's population live in public housing estates (Census and Statistics Department, 2006; Hong Kong Housing Authority, 2010a, 2010b), which include both public rental housing and subsidised sale flats. Hong Kong has a total of over 300 public housing estates, which provide a high-density living environment and are the epitome of a small community. Within this small community, households can find recreation facilities, shopping centres, schools, public transport hubs and simple waste management facilities. Although public housing estates satisfy their residents' basic living needs, the facilities are inadequate to accommodate the wider requirements of a densely populated community, especially when it comes to waste management and recycling facilities.

7.2 Environmental Factors – Internal

The average size of domestic households in Hong Kong is 2.9 people (Census and Statistics Department, 2006). In general, small households generate little in the way of refuse and recyclables each day. Most households adopt the practice of disposing of all their waste after finishing supper, a routine that makes it difficult for recyclables to accumulate. People who are willing to participate in recycling and facilitate source separation need to accumulate recyclables over a longer period (such as overnight), leading to sanitation problems if they are stored inside the house for very long.

Figure 7.2 Public housing estate kitchen

This is a serious concern, especially in the constricted living environment of Hong Kong's public housing estates. Studies show that 46.5% of public housing flats are between 30 and 39.9 square metres (Census and Statistics Department, 2011). This congested area is insufficient to store a large amount of refuse. Further, small domestic kitchens only allow each household to use one trash bin (Lo & Siu, 2010).,

It would be difficult, if not impossible, to find space for extra containers to store different types of recyclables. Moreover, the particular dietary habits, food preparation and cooking methods of Hong Kong people, such as those related to fresh meat and live fish, create unpleasant waste odours. All of these factors combined suggest that public housing residents are forced to clear all of their waste and recyclables at the same time every day, even when such waste is produced in small quantities.

7.3 Environmental Factors – External

The accessibility of recycling infrastructure affects household participation in the recycling process. The distance to recycling facilities, for example, is a key factor influencing household interest in recycling (Belton, Crowe, Matthews & Scott, 1994). Households are also less motivated to use recycling facilities when they are located in inappropriate places. In nearly all modern public housing estates in Hong Kong, the residential buildings are 37 to 40 storeys high with 20 to 24 flats on each floor. Although each floor has a waste storage room, that room is not only small but often misused for purposes such as storing personal furniture. Housing property management staffs are therefore obliged to lock waste storage rooms and place a large trash container next to the lift entrance on each floor. Although residents have easy access to such trash containers, the containers are not large enough to meet the needs of all residents wanting to dispose of their waste. This leads to illegal fly tipping and hence more serious hygiene problems.

Figure 7.3 Public housing estate lift lobby

Most recycling facilities in public housing estates are located in the entrance lobbies of residential buildings. The major reason for this is to make the collection of recyclables more convenient for the collection service, particularly where no charge is levied. Recyclable collection companies are only able to earn a profit from the recyclables they collect and sell. However, the prices of many recyclable materials have recently fallen. The resulting cost pressures faced by such companies have a flow-on effect on the location of recycling facilities that inconveniences residents. Interviews conducted with residents of public housing estates from 2009 to 2011

show that many of them considered recycling to be a very time-consuming process because they had to carry recyclables from their flats to ground floor recyclable collection points. According to observations made in five selected public housing estates located in different districts of Hong Kong, many residents preferred to leave their recyclables beside the trash container on their floor because the closest recycling bins and collection points were too far away (Lo & Siu, 2010). Residents even disposed of recyclables and refuse together to avoid this time-consuming transfer process. The inconvenient location of recycling bins is therefore one reason why households are unmotivated to support recycling.

Figure 7.4 Recycling bin located on ground floor

7.4 Cultural Factors

Despite its status as an international city, traditional Chinese social values prevail in Hong Kong. For example, men still play an important role in family life and are the key breadwinners. Many women stay at home to prepare meals and do housework

unless they have a domestic assistant who can help them. Even though the family roles of men and women have changed since the late 1980s, women still do most of the housework even if they have full-time jobs during the day. Thus, women are generally responsible for dealing with domestic waste and disposing of recyclable waste materials in recycling bins. As noted earlier, the recycling process is quite a time-consuming chore in public housing estates, especially given the busy lifestyle and long working hours in Hong Kong (working from 9 am to 7 pm is quite normal).

Residents are required to dispose of their waste in trash containers and to sort recyclables into the appropriate recycling categories before depositing them in lobby bins. Other procedures must also be followed, such as rinsing out bottles with water and de-labelling both magazines and plastic bottles. On top of the extra time spent on recycling before disposing of household waste, this extra work tends to discourage residents from participating in it.

7.5 Public Housing Households' Attitudes and Behaviour

Another factor to consider in recycling conduct is that like the majority of Chinese people, Hong Kong residents prefer to buy their daily necessities from wet markets because they like fresh food (Kumar, 2003) and also need the ability to purchase in small quantities. Wet markets satisfy both of these conditions and additionally provide different options within the same category of goods, enabling housewives to compare the quality and prices in different shops. Unlike wet markets, supermarkets are often conveniently located near people's flats. However, many housewives still regard food

bought from supermarkets as not being fresh enough (Lo & Siu, 2010 and, the retail price of supermarket food can be much higher than similar items sold in wet markets. As most items are packaged in advance and frozen, shoppers are unable to compare the quality of different food products and may also have to purchase more food than they wish. Given the small size of the typical Hong Kong flat and the limitations on storage, most food purchased by housing estate residents needs to be bought and consumed on the same day. Thus, although supermarkets provide one-stop service and a better shopping environment, wet markets are favoured. Waste created from the wet and dirty packaging of wet market food is difficult to clean, store and categorise for recycling. For example, a fresh fish bought at a wet market is packed in a small plastic bag that eventually becomes waste including water, blood and other matter, whereas a frozen fish bought from a supermarket is packed in a plastic box that is much cleaner and can more easily be disposed of in recycling bins.

7.6 Economic Factors

Apart from lifestyle, some researchers have proposed that economic incentives are a key factor influencing household participation in recycling. In some Asian cities, despite congested flats many housewives store recyclables because they consider them to be valuable items that can be resold. A recent investigation carried out in Hong Kong showed that 421 recycling companies had been set up in residential areas in the territory (Environmental Protection Department, 2011). Most of these companies do not provide a collection service, but allow people to deliver recyclables directly to the company. Ideally, although recycling companies are located farther

away than recycling bins in the lobbies of residential buildings, paid for recycling should provide a greater economic incentive to participate in recycling programmes. Drop off recyclers, however, only receive HK$1.2 per kg of paper and HK$1.5 per kg of aluminium cans. (Fig. 7.1) Comments made by the housewives interviewed for this study indicated they did not consider these amounts worthwhile. Additionally, the distance between their homes and the nearest recycling companies meant they had to travel for approximately 15 to 30 minutes each time they wanted to recycle. Just to cover their travel expenses, these women needed to take 30 to 50 kg of recyclables to the recycle company. Thus, it is not difficult to see why households lack the motivation to sort, store and deliver recyclables to recycling companies.

Figure 7.5 Recyclables price list in private recycling shop

7.7 Physical Factors － Recycling Facilities

Overall policy, detailed policy implementation and the on-going management of recycling facilities are important to the success of recycling. For example, good planning by a service network and a sound implementation plan can make urban investment in public facilities effective (Wan, Siu & Justice, 2007). A well-designed and installed recycling facility that takes careful account of a comprehensive range of physical, psychological, social and ideological considerations gives people a high level of motivation to participate in the recycling process and provides them with sufficient support for their participation (Kellenberg, 2004; Siu, 2007). A well-managed range of recyclables and a good recycling service can enhance the rate of recycling (Tucker, 2000; Woodard, 2001). The interviews conducted and observations made in this study show that the above arguments can be validly applied to local household participation in recycling. For example, although many residents interviewed for this study indicated that they saw the value of recycling and were willing to participate in it, they were willing to do so only on the condition that they also maintained a hygienic home environment. If this were not possible, then their original good intentions would easily fade, as they also mentioned that Hong Kong people, like many people living in modern cities, are very practical.

As discussed above, the small and congested household living spaces in which Hong Kong residents reside make it difficult to participate in recycling. Above all, the space available for storing recyclables is critical. In a programme subsidised by the Environmental Protection Department, the Hong Kong Housing Authority has, over the past few years, distributed about 5,700 sets of recycling bins to the lobbies of

public housing estate buildings. These bins, originally designed by the Environmental Protection Department, come in three models (with three different colours and a 240-litre capacity) for waste paper, aluminium cans and plastic bottles, and are now easily found in nearly every public housing estate block.

Figure 7.6 Common recycling bins located outside public housing estate building entrances.

However, all high-rise buildings on public housing estates accommodate a large number of households, in some instances more than 1,500. The large volume of waste produced by the residents of each building means the recycling bins are inadequate to meet the recycling needs. Some residents noted that their recycling bins were always full, giving them no choice other than to leave their recyclables beside the bins or place them in general trash-cans. Observations revealed that recyclables were collected from recycling bins infrequently.

Figure 7.7 Poorly designed recycling bins are easily damaged

Recycling bins are poorly designed and often made with unsuitable materials. For example, they are not manufactured from biodegradable materials, making them harmful to the environment when they are dumped after use. Recycling bins are also lacking in their function and appearance. For instance, the information pertaining to the categories of recyclables is not always clear enough. Moreover, some of the stickers on the bins have even disappeared. People are often confused by the wording on recycling bins and in some cases are only able to distinguish between bins by memorising the government slogan: yellow for aluminium, brown for plastic bottles, blue for waste paper. However, as the colours of the some recycling bins do not match

Figure 7.8 Recycling bin from different design periods

their recycling categories or designated shape, it can be difficult for people to determine which recycling bin belongs to which category of waste (Figure 7.3). Additionally, recycling bins are often fixed in too high of a position, making it difficult for housewives and children to reach the opening on the lid. The bin lid openings are also too small, forcing residents to lift up the entire lid to dispose of large items or large quantities of recyclables. The original thinking of the Environmental Protection Department was that having a small opening with the lid locked would prevent people from removing recyclables, thereby avoiding hygiene and security problems. However, the small openings have created another problem. In order to fit their items into the bins recyclers are obliged to unpack and separate their recyclables into small quantities after first packing and carrying them in larger containers over what could be a considerable distance from home.

The poor bin design is also related to the potential for theft. As discussed above, the lock-up feature on the bins was designed to prevent people from digging out recyclables to avoid hygiene and security problems. However, the good intentions behind these features have had the opposite result as many of the bins have been broken into and destroyed. Because recycling bins are located outside lobby entrances, recyclable collectors (including some residents, non-residents from other estates, and homeless people) easily access and remove recyclables from the bins to resell them. This type of situation is particularly serious in some of the old public housing estates where low-income residents reside. In sum, the recycling bin system does not meet the needs of the diverse groups of users (including non-residents) in public housing estates in terms of its planning, implementation and management.

Figure 7.9 Misused recycling bins

Chapter 8 Findings of the Empirical Study

According the above chapter understanding, particular living condition in public housing estate, passive recycling facilities, accessibility and design of recycling bins, simple waste management provided by property management. These negative impression were generated the public misgiving on recycling in communities. Public question their recycling participation and effort are not helping to protect environment. They also doubts about the cleaner dispose all the recyclables with general waste together. Therefore, waste management and recycling mechanism should need to involve a new element to arouse the public concern. Waste separation of recyclables and the waste collection system must strengthen. It helps to create a positive image on recycling and believes in order to reinforce the public trust on recycling. The following chapter would like to figure out the solution of improvement on recycling through a design experiment. The experiment will investigate on the household believes on recycling, user practices on waste management, recycling facilities design and the relationship between recycling attitude and behaviour.

8.1 Investigation of Household Behaviour in Hong Kong

Quantitative and qualitative data were collected to understand the recycling attitudes among households in four public housing estates in Hong Kong. The results of the recycling experiment showed how household members changed their recycling attitudes at each stage of the investigation. Additionally, many comments indicated that the respondents had observed the changes in their own attitudes towards recycling and their recycling behaviour after joining the research study.

8.2 Pre-assessment Survey

The pre-assessment survey was conducted in January 2010. It is important to illustrate the participants' behaviour regarding conservation and recycling.

In Figure 8.1, the age distribution of the respondents is shown. In Aldrich Bay ages ranged from 25-44, and in Sai Wan Ho, Shaukeiwan and Yiu Tung ages ranged from 45-46. The data indicated that the older respondents had more positive recycling attitudes. The majority of the respondents (78.5%) were female (Figure 8.2). This suggested that females were more likely to take care of cleaning and waste management in their families. In the Chinese traditional family, females are the key people responsible for the household. Although females today need to work for a living, they are also expected to maintain the upkeep of their households. Data concerning income and education levels were also collected. In educational attainment, 40.5% of the respondents had attended secondary school or the Primary-six level, 29% had attended primary school level and below, and 30.5% had achieved a post-secondary education. Figure 8.3 shows that 41% of the respondents had income less than HK$5,000 per month. Another 20.5% of the participants reported that their income was below HK$8,000 and the income of 29% of the respondents was between HK$10,000 and HK$12,999.

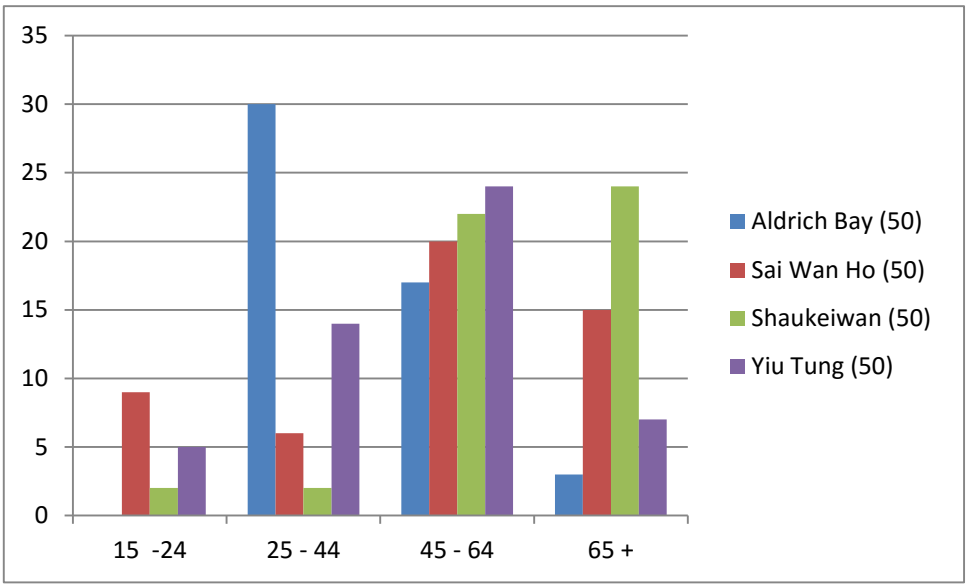


Figure 8.1 Age group in sampled public housing

According the data of income and education levels, majority of the respondents (85%) were over 64 years old from Shaukeiwan. Shaukeiwan is an old district. Insufficient recycling facilities were provided in communities. Respondents collected recyclables from outside daily. Because collecting recyclables could increase their income and quality of life. They traded recyclables to private recycling shop for earing money to maintain their daily necessities. Based on field studies, private recycling shops were located beside to respondent's residential area. This is the reason why elderlies were in high recycling rate compared with other sample area.

In Yiu Tung and Sai Wan Ho, respondents were equally disturbed from 4 age groups. These two districts were sufficient installed recycling facilities. Every public housing lobby were located with 5 types of recycling bins. Respondents reached and disposed recyclables frequently. They suggested recyclables keep for two days and disposed to lobby's recycling bin. Moreover, none of private recycling shop was located beside to Yiu Tung and Sai Wan Ho. Respondents reported recyclables should not be

accumulate more than 2 days, hygienic problems could be occurred. Also, respondents reported their living space was not allowed for storing large amount of recyclables.

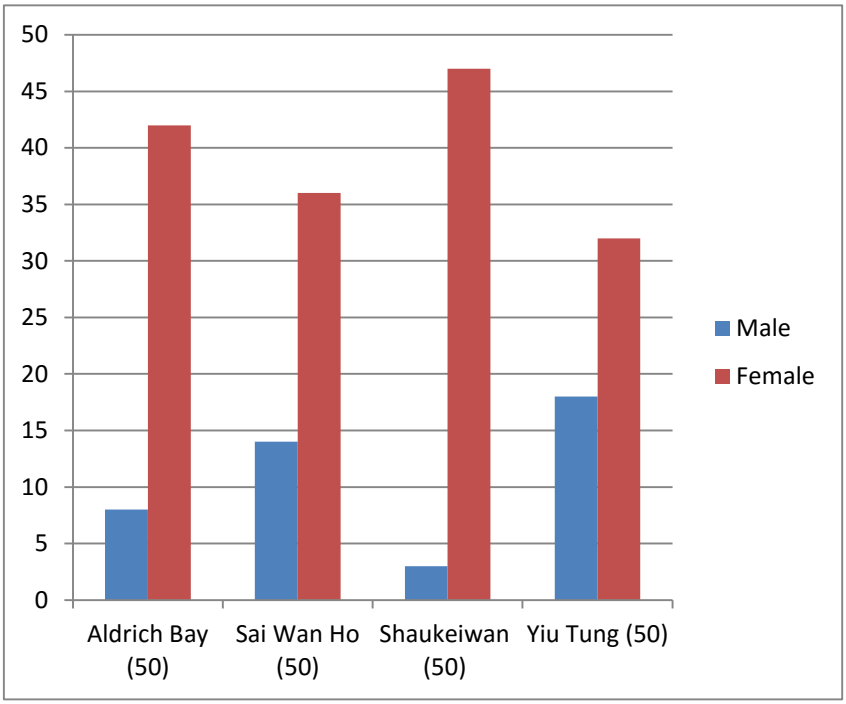


Figure 8.2 Gender in sampled public housing

In Aldrich Bay, the location was the latest developed on 2000. The majority of the respondents (62%) were from age group 25-44. The respondents reported environmental awareness was important for communities. They considered recycling was one the key attitude for environmental protection. It was good for community's development and next generation. Aldrich Bay public housing was designed in harmony block. Harmony block interior was in flexible design. It provided more public common space for resident. Therefore, recycling bins could be installed in every stories floor. Respondents could dispose recyclables in high frequent. Even the limited living space, convenient disposal allow respondent for manage recyclables. It was appreciated by respondents and arouse residential of environmental intension.

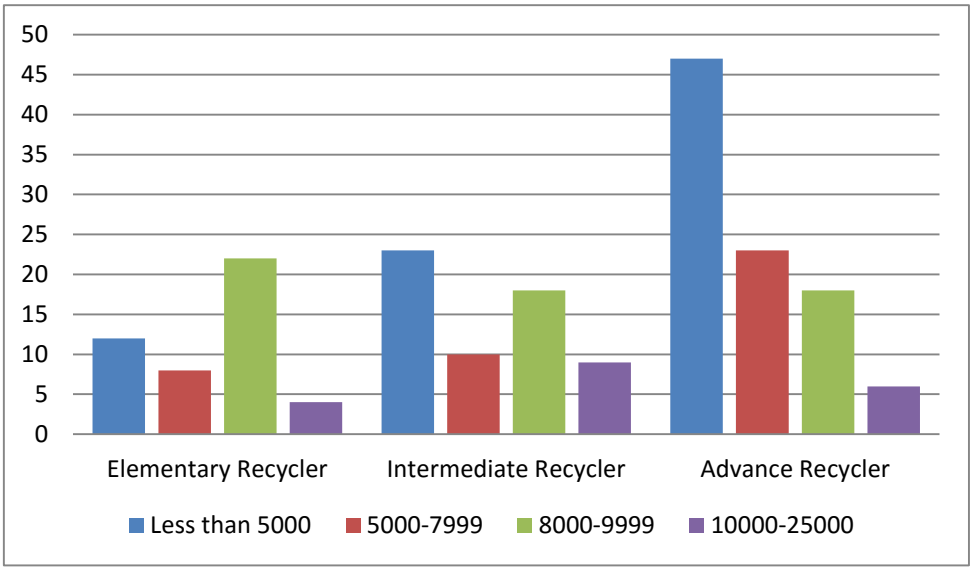


Figure 8.3 Income in sampled public housing

8.3 Understanding the Recyclers

Based on the results of the pre-assessment survey, respondents were classified by a recycling standard mechanism. It based on respondents' attitude on recycling, behaviour of recycling practices, condition of living environment, demographic properties and understanding of environmental awareness. It helps to figure out the respondents characteristics on recycling.

Respondents who will classify into three groups: elementary recyclers (passive in recycling), intermediate recyclers (imitative in recycling) and advanced recyclers (active in recycling) based on the internal and external aspects. An internal aspect is including the respondents' attitude and behaviour of recycling. It will base on the respondents how to manage the recyclables, condition of recycling approach and understanding of recycling management. On the other hand, external aspect is

measuring on recycling mechanism and hardware supporting on respondents recycling behaviour.

According the survey, the majority of households (49.2%) were categorised as intermediate recyclers, 32.2% as elementary recyclers and 18.6% as advanced recyclers.

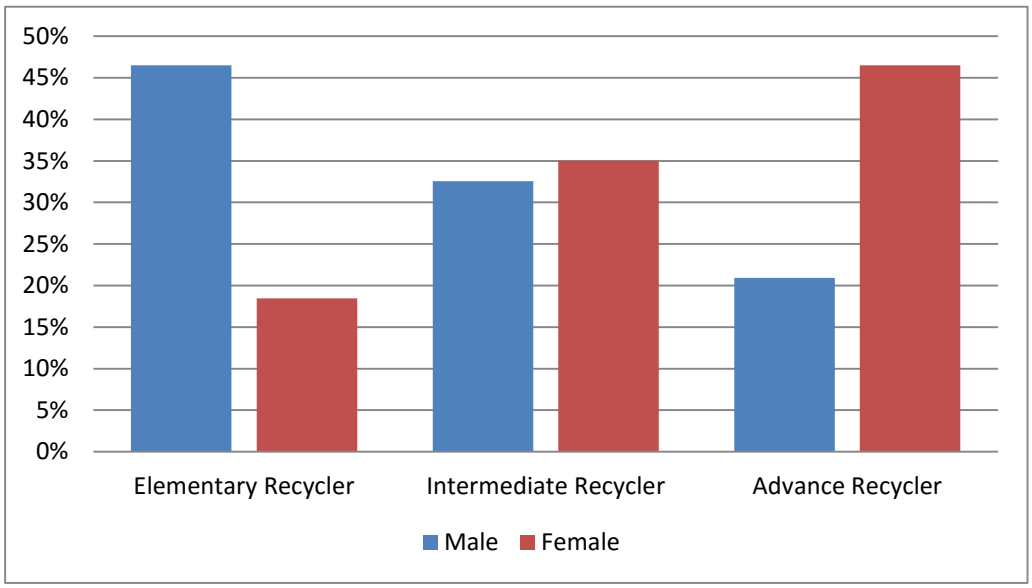


Figure 8.4 Gender of recyclers by type

The majority of advanced recyclers (46% or 157 respondents) were female and 21% (43 respondents) were male (Figure 8.4). Among intermediate recyclers, 35% were female and 33% were male. Among elementary recyclers, 18 % were female and 47% were male.

As seen in Figure 8.5, the majority of the respondents (60%) in the advanced recycler group received at least a primary education. Among them, 52% received a secondary or secondary sixth education and 33% had post-secondary education qualification. In

the intermediate recycler group, the percentage of respondents from primary and post-secondary backgrounds was 34% and from secondary education backgrounds 34%.

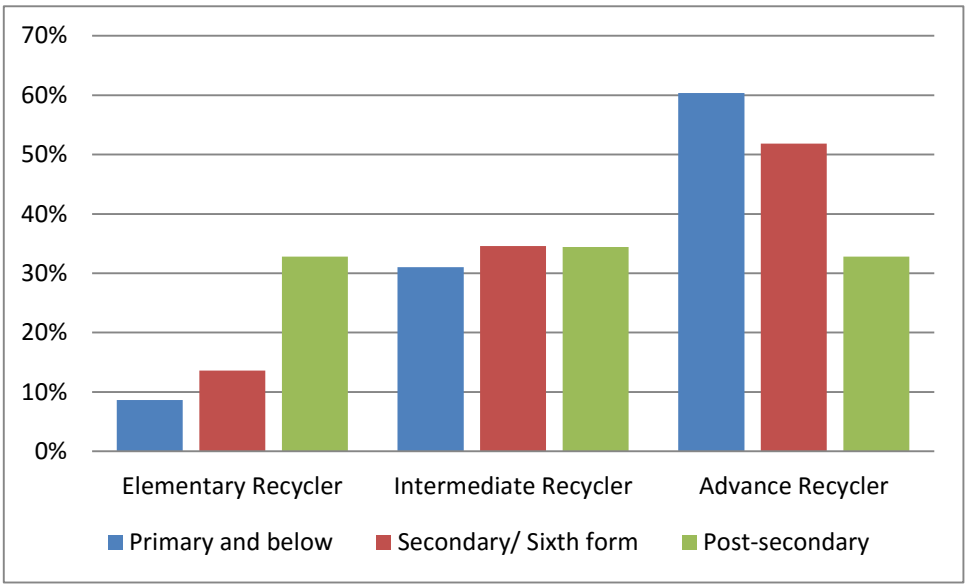


Figure 8.5 Educational attainment of recyclers by type

Ninety-three respondents were classified in the advanced recycler group (Figure 8.6). The majority of these respondents (74%) were older (age 45-64 and 56+ groups). Respondents in the younger age groups (age 15-24 and 25-44 groups) accounted for 26% of all respondents in the advanced recycler group.

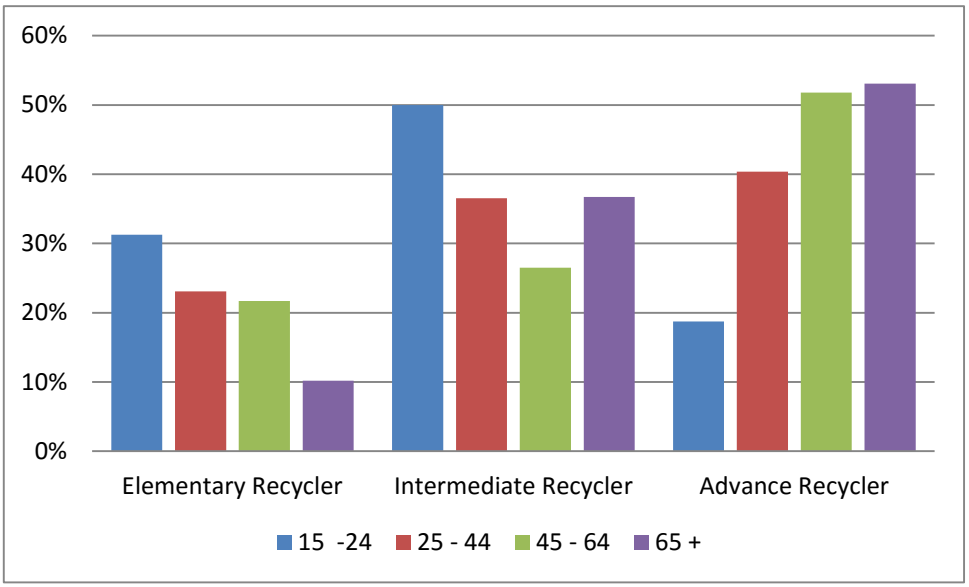


Figure 8.6 Age groups of recyclers by type

Figure 8.7 shows that half (50%) of the advanced recyclers had income less than HK$ 5000 per month. Most of the respondents in the intermediate recycler group also had a lower income. In the elementary recycler group, most of the respondents had an income of HK$8,000-HK$9,999.

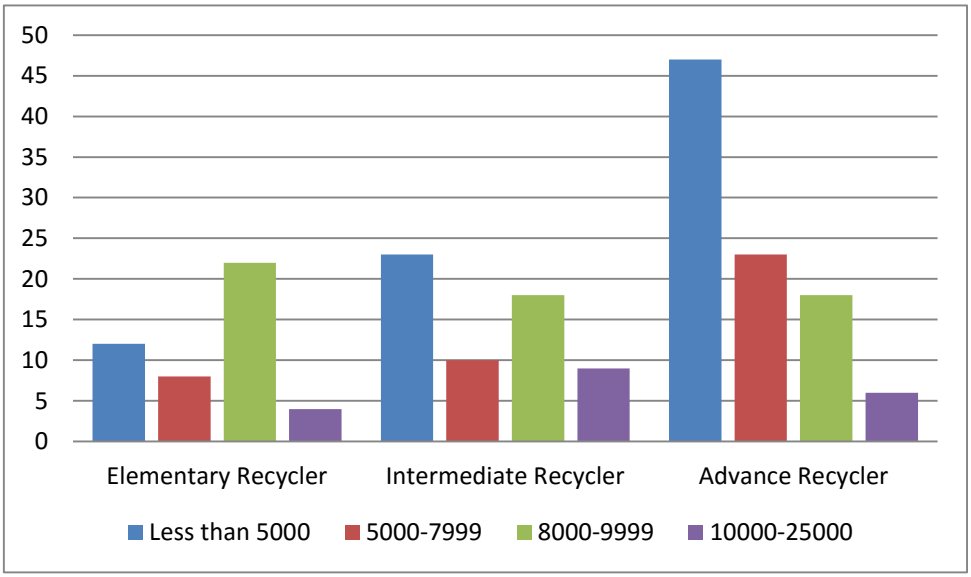


Figure 8.7 Income of recyclers by type

Households were divided into different groups according to their reported recycling behaviour. These groups included the elementary, intermediate and advanced recyclers. Households who had greater awareness of recycling appeared to be older and have lower educational levels. About 74% of the advanced recyclers were over 45 years of age. Only 33% of the respondents had received a post-secondary education, compared to 60% who had attained an educational level of primary or below. A pattern can be found in that the advanced recycling households tended to have the lowest income. Fifty per cent of the households had an income below HK$5,000 a month.

When examining the role of gender, a significant relationship was found between the gender of the respondents and the recycling behaviour of the households. Females were notably more likely to do the household recycling, and most of them were intermediate to advanced recyclers.

8.4 Design experiment

After understanding the characteristic of household in public housing estate, a design experiment was delivered to above four public housing estates. The purpose of the experiment is to see how the household attitudes and behaviour changing when different recycling conditions and approach is apply in different experiment stages. The design experiment was conducted for a year. It was divided into four main stages and the duration of experiment in each stage was in 3 months.

The first stage was a recycling beginning stage. Printed Assessment form was delivered to 200 households who was conducted pre-assessment survey. It would like to give a channel to arouse households on recycling attitudes. Assessment form used for recording their recyclables in a month. The details of recyclables which include the government suggested recyclables of metal, paper and plastics. Household allowed adding the extra varies of recyclables on the assessment form. This recording activity aimed to maintain the household recycling participation. Also, it could allow the household to review their recycling practice clearly. The assessment form helped the household to cultivate a recycling behaviour and understand the waste management attitude. After 3 months experiment was finished. Recycling Feedback form was sent to respondent to understand their changes on recycling attitude with contains with 10 questions. The questions were concerning the individual recycling attitude to community environmental awareness. Respondents allowed to answer form strongly agree to disagree after they finished each stage of assessment.

Second design experiment stage purpose was a development of recycling behaviour to households. Printed assessment form was delivered to targeted households and recycling report attached. Household was requested to record their quantities of recyclables monthly. Also, a comparison recycling report was generated according the first design experiment stage recycling data. The recycling report include the household recycling data which is the recyclables quantities, comparison data between the similar household and the best recycling household performance. Also, a simple data calculation was included to allowing the household understand their recycling performance. A grading was given according to their recycling performance from poor to excellent. The comparison report aimed to share the recycling experience from similar household and allowed household to exam their performance. Also, the report provided a map of private recycling trade-in shop. It provided the alternative for managing of recyclables. As household allowed household sold the collected recyclables to trade-in shop. Economic incentive can be increase their interest on recycling beside the environmental concern. Finally, review survey conducted at the end of second design experiment stage. It attempt to define the changing of recycling attitudes when the peer assessment in recycling performance and provide a motivation to reinforce their recycling behaviour.

The third stage of design experiment attempt to determine attitudes toward the behaviour of recycling. Recyclables assessment form and recycling comparison report were given to household continually. A physical recycling bag was provided to each household. The bag allowed household to keep the recyclables and easy for disposal. As mentioned, accessibility of recycling is one of driven element on the recycling campaign (Torre 2005). The designed recycling bag was allowed household for storing amount of recyclables and dispose. Also, they allowed selling collected

recyclables through this recycling bag. Household reported estate recycling bin was far away from their living place. Although the recycling bin located at the ground floor entrance, no container to keep the recyclables and allows them for carrying to public recycling point. It attempted to create a convenient way for the household to increase their recycling intension. Also, they could choose to use the bag for carrying to private recycling trade-in shop for selling recyclables. Review recycling attitude survey also given at the end of third stage to exam the household recycling change between their behaviour and attitude. This stage provided three activities in recycling to household from individual self-assessment, communities recycling intention and economic incentive. It helped to understand the design concern on physical design elements.

Finally, the fourth design experiment was conducted with 3 months. It attempted to conclude the recycling behaviour can be establish through a certain time of recycling activities. The households' recyclables recording and recycling comparison reports were maintaining to each participate. Recycling bag released to household to store recyclable in their living place. These continue activities attempted to embed the recycling behaviour in their daily life. Also, it facilitated the household intention on environmental awareness in order to those are in the elementary recycler category.

Chapter 9 Analysis and Discussion

The design experiment result indicated that several factors were influence to community recycling in high populated density area. The demographic factor from the household shown that lower socioeconomic stratum is an active recycler compare with high income and well educated respondent. Economics incentive is other variables influence to recycling attitude. According to different recycling activities in each design experiment stage result, recycler attitude and behaviour will shift to active action. The accessibility of recycling facilities is help to arouse the household motivation and participation. In this chapter will determine the failure and importance on recycling attitude and behaviour.

9.1 Failure of Household Recycling

According to empirical studies, there are several reasons why household recycling is unsuccessful in Hong Kong. One is the lifestyles and habits of Hong Kong residents. (Regarding how behaviour relates to household waste recycling, see Chu & Chiu, 2006; Darby & Obara, 2005; Williams & Kelly, 2003.) Another is the particular living environment of Hong Kong, including the lack of appropriate facilities to help residents recycle.

Hong Kong is a city in which most of the residents are Chinese and traditional Chinese cultural practices prevail. For example, although both men and women work, most married women do the housework unless they hire domestic help. The preferences and practices of housewives as well as their domestic assistants are therefore important to the success of waste recycling. Today, most housewives in Hong Kong buy their daily necessities, including food, from wet markets or

supermarkets. Unlike in many Western countries, nearly all of the fresh food in Hong Kong's wet markets is sold unpacked. Shoppers carry home 'wet food' such as fish, meat and vegetables in plastic bags. This is different from food sold in supermarkets, which in general is frozen and packed in plastic and coated-paper boxes.

Figure 9.1 Unpacked vegetables in a wet market

Figure 9.2 Unpacked meat in a wet market

When housewives or their domestic helpers are able to go to market everyday, wet markets (Fig. 9.3) are their preferred choice even though supermarkets may be more convenient.

This is because many consider ‘freshness’ as their main selection criterion in terms of quality and believe supermarket food, unlike wet market food, is not fresh. Furthermore, unlike wet markets, supermarket food is often packaged in large quantities and the prices are high. Thus, families are more likely to purchase fresh food from wet markets with loose packaging such as plastic bags, which will later have to be separated and cleaned if they are to be recycled. The Hong government and environmentally concerned groups have encouraged household members to spend the extra time pre-cleaning waste, because without pre-cleaning before disposal, recyclable materials can create hygiene problems. However, neither housewives nor

domestic helpers are likely to take time for waste separation and recycling that they consider to be both time-consuming and troublesome.

Figure 9.3 Hong Kong wet market in Yuen Long

In conjunction with the cultural ethos, high land costs and congested residential living environments affect recycling behaviour in Hong Kong. On Hong Kong Island, for example, the price of a common residential flat (not including the more expensive flats) can be HK$6,000 to HK$18,000 per square foot. Because of this, flats are small. Size combined with normative change has also resulted in a reduction in the number of occupants of residential flats. Most Hong Kong households now consist of only three to four individuals (Census and Statistics Department, 2009a; 2009b). So few people are unlikely to generate a large amount of daily waste, and even if they did, there would be no place to put it. A domestic kitchen may be no more than two square metres (Lo & Siu, 2010). This is inadequate for storing recyclables, and unlike other countries Hong Kong residential flats do not have backyards or other areas for storage.

Therefore, households are more inclined to consume all of the food they buy each day, leaving very little for recycling.

Apart from congested interior living environments, Hong Kong residential buildings lack convenient public or communal recycling facilities. As noted above, waste rooms and chutes built on the individual floors of public housing high-rises are often locked and inaccessible to the residents. To compensate for this, one large container for general refuse is placed next to the elevator on each floor. Frequently, the only recycling facilities are located in the lobbies of these residential buildings. There are very few recycling collection points on the streets or elsewhere. (For the relationship of distance on the frequency and motivation of household recycling, see also Gonzalez-Torre & Adenso-Diaz, 2005).

Taken together, the low volume of daily waste generated in the average Hong Kong household, the difficulty and time required separating waste, the lack of interior household storage, and the inconvenient location of recycling facilities, it is not difficult to understand why there is little motivation to manage recyclables. The most common waste management behaviour in Hong Kong is to dispose of waste, including that which has recycling potential, as soon as possible and as far as possible from one's residence, before going to bed. However, it is far easier to throw a few items into a general waste bin located on the same floor as one's flat than to descend to the street in a 40-storey high-rise and perhaps even then be required to walk a long distance to dispose of recyclables.

In light of Hong Kong's high land prices, the reluctance of property developers to incur the expense for providing residential buildings with adequate, conveniently

located spaces for waste disposal and recycling is understandable. Nonetheless, the government has begun to pressure large property developers to consider their responsibility for doing just this.

9.2 Understanding Households Recycling Attitudes and Behaviour

Among Chinese societies, Hong Kong has a rather low level of environmental awareness (Chung, 2001). Household and commercial waste are both collected by the government's Food and Environmental Hygiene Department (FEHD), and the public are not asked to pay waste management handling fees. The FEHD is now providing 157 permanent off-street public refuse-collection points (RCPs) without charge. The public is only asked to dispose of household waste at these official locations (RCPs). However, this policy is causing public environmental awareness to become even lower. As addressed in the previous chapter, this is consistent with other studies indicating that the public are not interested in recycling unless economic incentives are provided. The results of the pre-assessment survey in this study have categorised the recycling respondents into three different types. This categorisation can help recyclers easily understand their recycling attitudes and behaviour, and can also help them assess their environmental awareness based on their recycling practices.

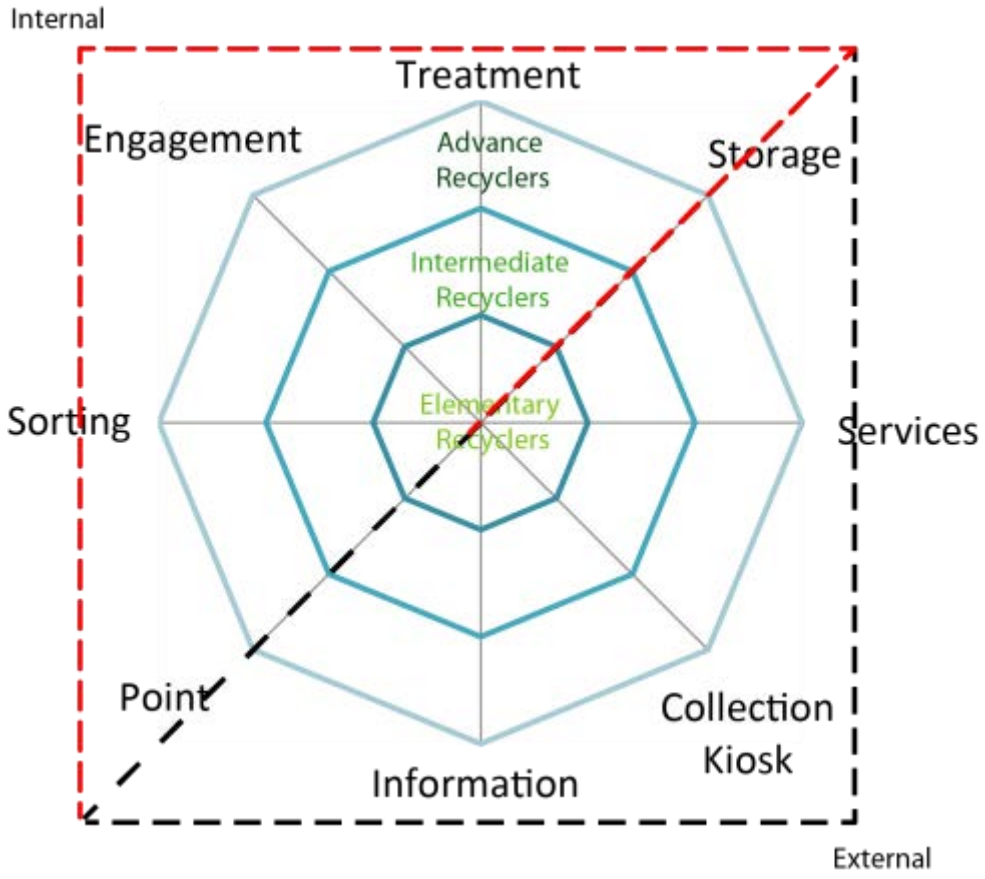


Figure 9.4 Characteristics of recyclers

9.2.1 Internal Aspects

The internal aspect includes four elements: sorting, engagement, treatment, and storage (SETS) that illustrate recyclers' attitudes, awareness and knowledge of recycling in their living areas. Many researchers and environmentalists have stressed that the fundamental difficulties in recycling concern internal factors, including confusion, ignorance, inconvenience, misunderstanding and time-consumption. They have also pointed out that recyclers are more knowledgeable than non-recyclers regarding the general need for recycling in the community (De Young, 1986). This suggests that there is a need for more recycling education aimed at generating greater

motivation to participate in recycling activities. In this way, more households could be helped to initiate recycling practices and to develop recycling habits (Jablonowski, 1987).

9.2.1.1 Sorting

'Sorting' scores can be determinative of a respondent's attitudes. According to the data collected from the pre-assessment survey, the respondents in this study only considered sorting if it involved valuable recyclables (e.g., papers and metal cans) that could be taken to recycler stalls to be traded for money or bartered for daily necessities. As observed in site investigations, the recycle stalls only accept paper, metals, used clothing and home appliances. The value of used paper is measured by its weight. Thus, large volumes of it must be collected from different places to make any money. In recycling, sorting is also a time consuming process. For example, different types of plastic can be integrated into a single product such as a plastic bottle. Moreover, recyclers are asked to clean and separate their own recyclables. In this study, 95% of non-recycling respondents reported that recycle sorting was one of the major factors affecting their environmental awareness. In addition, as previously noted, the limited living conditions in Hong Kong discourage sorting and recycling. Therefore, sorting may reflect the recycling respondents' attitudes regarding the recycling campaign.

Figure 9.5 Plastic sorting process at the Yan Oi Tong plastic recycle centre.

9.2.1.2 Engagement

Engagement refers to the intention of family members to recycle. According to the survey results, 75% of the female respondents said they were the only members of their families who performed recycling activities. Approximately 20% of the respondents indicated that two to three family members were involved in recycling. The remaining 5% reported that four to five family members recycled. The latter group had the highest recycling rate compared with the families with fewer members. The results thus showed that the number of family members who participated in recycling activities affected recycling rates, and engagement reflected the attitudes of household members regarding recycling.

9.2.1.3 Treatment

There is evidence to support the proposition that recycling attitudes are distinct from recycling behaviour (Liska, 1984). Recyclers should nonetheless have a basic understanding of how to separate recyclables. In this study respondents were asked to pre-treat recyclables by, for example, washing and tearing off the packaging from plastic bottles, disassembling batteries from electronic products and wrapping the tips of re-chargeable batteries. These time-consuming activities acted as negative incentives to household recycling. The results of the pre-assessment survey also found that households characterised recyclables as trash if they had no monetary or barter value. Hence, the pre-treatment process is considered one of measurements for determining a household's recycling attitudes.

Figure 9.6 Post recycling in plastic at the Yan Oi Tong plastic recycle centre

9.2.1.4 Storage

The convenience of recycling is correlated with recycling behaviour (Schultz and Oskamp 2003). The respondents in this study reported that compact living conditions limited their recycling activities, because the space for installing recycle trays was inadequate. In Hong Kong's public housing estates, the average of household size is 13 square metres (HKHA, 2014). This small living space does not allow residents to install extra recycling bins. As seen in this study, the space for storing recyclables can affect a household's recycling motivation. Approximately 55% of the respondents reported that they only had one tray to store recyclables. Another 20% reported they had two recycling trays. Twenty-five per cent of the respondents had no trays for recycling. Indeed, 90% of the households surveyed described valueless recyclables such as compact fluorescent lamps and rechargeable batteries as trash because they could not be sold to recycle shops. Hence, the space for storing recyclables can determine the motivation to recycle.

Figure 9.7 Metals can storage bag from an elderly recycler

9.2.2 External Aspects

External aspects have four elements: points, information, collection kiosks, and services (PICKS). Point is the relationship between recyclers and recycling facilities and the personal resources, including money, space and time that recyclers expend in furtherance of their recycling activities. In this study, the respondents reported that recycling was time consuming, as they needed time to prepare, sort and transport their recyclables. The respondents were also asked to dispose of their recyclables every two or three days for a week. However, their limited living spaces did not allow them accumulates a large quantity of recyclables. Furthermore, the respondents' were discouraged from recycling when the recycling bins and facilities were far away from their homes. Waste management services positively affected the respondents' recycling motivation. In particular, recycling rates increased among the elderly and female respondents when NGOs offered recyclable trade-in services. Hong Kong is reported to have the second highest cost of living in Asia. Although the government provides the elderly with an old age allowance (fruit money) of HK$1,135 monthly, this is often insufficient to support them (Mercer, 2015). Elderly respondents reported that collecting and recycling was a major way for them to supplement their income, and they could exchange recyclables for their daily necessities. The survey results from the female respondents suggested that greater accessibility to recycling facilities could increase their interest in recycling. The old design of public housing estates did not allow recycling bins to be located on each floor. Instead, the bins were placed at the entrance to the building (Fig.9.7). The respondents also reported that recycling information affected their motivation for recycling. Wallpaper, public announcements and recycling activities inspired frequent participation by the female

respondents. Therefore, PICKS can help to enhance the living environment and information can influence recycling participation.

Figure 9.8 Bins were placed at the entrance to the building

9.2.2.1 Point

Point refers to how recyclers understand the recycling facilities. Some researchers have observed that the convenience of facilities affects interest in recycling (Scott, 1999). Motivation declines when recycling facilities are difficult to reach. In Hong Kong public housing estates, four recycling bins are provided in the lobby of each building. The containers are designated for paper, metal, plastic, second hand clothing and glass respectively. About 85% of the respondents reported that they only knew the location of the lobby recycling bins. Approximately 10% said that other types of recycling bins (for used clothing and rechargeable batteries) were located in their

residential areas. The remaining 5% of respondents were only aware of the recycling facilities provided by individual NGOs. Respondents acknowledged that they deposited recyclables even when no recycling facilities were provided. They found recycling to be dirty and particularly time consuming when they had to search for recycling bin locations. The cramped living space in public housing estates did not allow the respondents to accumulate a large amount of recyclables. Additionally, there were hygiene issues, as public housing estates only provide 75 square feet of space per person. In these high-density living conditions it is not possible to provide a suitable storage space for recyclables. Accordingly, respondents were asked to clear out their recyclables two or three times per week.

Figure 9.9 Public housing estate recycling bins.

Some respondents indicated they did not store recyclables if their building did not provide a corresponding type of recycling bin. For example, small home appliances,

batteries and compact fluorescent lamps were disposed of in the general waste bin. Searching for related recycling bins was considered to be time consuming and the respondents did not always know the exact location of them. Eighty-five per cent of the respondents said they were willing to do source separation when the recycling location list was shown in the public area or lobby. Therefore, understanding of the logistics of recycling facilities is important to recycling behaviour.

Figure 9.10 Recycling bins with locking systems

9.2.2.2 Information

Recycling information can positively influence the public's recycling attitudes. Moreover, recycling campaigns are efficient and inexpensive.. Researchers have found that clear recycling information can stimulate change to recycling attitudes and behaviour (Schultz, 1998). In this study, approximately 85% of the respondents

reported that recycling leaflets and information left in public areas was useful, reminding them to practice their recycling habits. About 15% of the respondents did not comment on this question, but indicated their recycling practice had not changed even when the information was readily available. Sixty per cent of the respondents welcomed the information that was provided. They reported that their interest in recycling increased when they received relevant recycling information. In this study, a comparison report was also provided to all of the respondent families between the second and fourth stages. There was an obvious increase in the recycling rate from 5% to 20% when they received the report compared with the previous stage. The respondents were concerned with the recycling behaviour of other similar families compared to themselves. Additionally, the recycling data sheet provided was a significant and efficient tool for arousing the respondents' interest in recycling. The discipline and routine prompted by the information encouraged the respondents to maintain their recycling behaviour until it became a habit. Hence, information is a key factor in generating public interest in recycling.

Figure 9.11 Recycling information notice in a common lobby

9.2.2.3 Collection Kiosk

Collection kiosks located close to the public housing estates could affect household participation in recycling. A collection kiosk is a kind of business that provides recyclable trade-in services. Recyclers could sell their recyclables to the shop to earn money. The elderly in public housing estates, for example, would collect recyclables and sell them to collection kiosks. Furthermore, 90% of the respondents indicated that they preferred to sell their valuable recyclables to collection kiosks to earn money rather than to dispose of them in public recycling bins. One demographic survey found that the majority of the respondents (41%) in public housing estates had low salaries. Selling recyclables to collection kiosks could be one way to supplement their income. Therefore, the operation of collection kiosks can affect motivation for recycling in the community. It can also determine a household's recycling behaviour.

Figure 9.12 Measuring recyclables' value

In addition to stationary collection kiosks, some private businesses provide trucks for mobile recycling collection. This is a flexible approach to the recyclable trade-in

service and convenient for public housing estate residents. Mobile recycling services can provide a higher price for trade-ins than the local trade-in stalls because they do not have the overhead associated with a physical fixed stall. Residents also appreciate this service as it accepts various types of the recyclables. Mobile collection services welcome home appliance, personal computers, used furniture and clothing. Payment is based on the weight, type and value of the recyclables. The operation of collection kiosks can thus affect the motives for recycling in the community, and can also influence a household's recycling behaviour.

Figure 9.13 Private mobile trade-in service

9.2.2.4 Service

Social norms can influence individual behaviour. Social pressure can affect recycling behaviour and change a household's attitudes (Hopper and Nielsen, 1991). According to the results of this study, recycling attitudes were changed when the management company of the respondents' housing estates launched recycling campaigns or private recycling trade-in services so that households could exchange their recyclables for daily necessities. In this study, five recycling campaigns were initiated by NGOs. The results showed that 85% of the respondents increased their recycling rates. Although the location of the recycling service was a 20-minute walk from the respondents' residential area, they were still highly appreciative of the campaign.

Figure 9.14 Glass recycling campaign booth

Recycling campaigns are different from private recycling stalls and trucks because NGOs do not provide cash for exchanged recyclables. NGO recycling campaigns only allow participants to exchange their recyclables for daily necessities, based on the collected recyclables' weight. The allowed daily necessities include cooking oil, tissues, canned food and domestic cleaning products. Twenty five per cent of the male respondents reported that they joined two campaigns. Sixty-nine per cent of the male respondents and 100% of the female respondents said they joined all five recycling campaigns. Most of the recyclables collected by females came from daily domestic waste and cleaning, not from their day-time jobs.

Joining a recycling campaign can save money for a family. Additionally, it can help people enhance the quality of their lives through the extra income or products they receive. Recycling services thus comprise one of the elements intrinsic to understanding recycling behaviour, and they can also transform short-term recycling actions into long-term recycling behaviour.

Figure 9.15 Recycling trade-in campaign by NGOs

Chapter 10 Conclusion

10.1 Conclusion

Not only in Hong Kong, but also all around the world, rapid economic development, high daily consumption and the excessive use of resources have caused a tremendous increase in solid waste generation. This large volume of waste has become a serious problem that affects the living environment everywhere. Because the public does not welcome incineration, and many cities have limited space for waste disposal, there is a need to conserve our limited landfill capacity for the future. Recycling is thus a good way, and probably the best way, to maintain environmental sustainability. Successful recycling can provide an entire city, and the communities and individual households within it, with a better living environment. However, because the residential waste disposal rate is critically high, and it has an extreme effect on environmental quality, household participation in recycling is vital. As the preceding discussion has indicated, the overall policy and planning and the design of living environments are essential, especially in the initial stages. A good start can greatly contribute to the implementation and management of recycling programmes. Of course, good public design is also crucial, because only a user-fit design that has carefully considered the particular nature of the living environment, together with the lifestyles, preferences and needs of the residents can finally make a recycling practice successful, and result in a more sustainable living environment.

10.2 Overview of the research

An increasing number of public housing estates in Hong Kong provide waste management facilities for their residents. These include waste collection rooms, recycling bins, centralised refuse-chutes and daily cleaning services (Lo & Siu, 2010; see also Chung & Poon, 2001; Yeung, 2001). However, public housing estates are still not hygienic living environments. Because the residential flats are small, it is inconvenient and even unhealthful for the residents to retain large quantities of daily waste and recyclables, particularly in the summer when most public housing estates have high indoor temperatures. As a result of these conditions, most households dispose of their mixed waste once a day in a single large bin on their floors without separating the waste from the possible recyclables, and recyclables are not stored for later processing.

Besides the physical limitations on interior space, there is a question of whether existing waste facilities within public housing estates are sufficiently convenient or even adequate for recycling. When the public housing estates were designed, recycling facilities were not taken into account or considered to be necessary (Lo & Siu, 2010). This situation has a ripple effect, as recycling facilities are difficult to install and manage once buildings are constructed. Moreover, similar to the cases presented above, some new public housing estates are still without recycling facilities on individual floors (or at some location convenient to the residents). Instead, a few recycling bins are located at the ground floor next to the building entrance and residents are expected to carry recyclables from their flats to the lobby. Although a small number of residents have been observed using the recycle bins when they go out to work, school or shopping, overall, the recycling practice is unsatisfactory. Most of the waste and possible recyclables are generated after meals in the late evening, which means that every night residents wanting to recycle must first dispose of their general waste in the bins on their floors and then take their recyclables to the recycling bins located on the ground floor. Clearly, this is not suitable for Hong Kong's hurried and tense urban lifestyle. In addition, some of the residents have been seen leaving their buildings without passing through the lobby on the ground floor. Instead, they use other exits such as those located at the podium level. All of these factors further discourage people from recycling.

10.3 Design Recommendations for Recycling

Waste generation and disposal are influenced by economic development, lifestyle and human attitudes and behaviour. The high demand for products and services, a disposable lifestyle, increasing income and an improved living standard increase the amount of waste generated. In a dense and highly populated city like Hong Kong, the traditional waste management strategies of landfilling and incineration cannot fulfil the large daily demand for waste disposal. Coordination and simultaneous action are required in the waste management chain.

Community mobilisation, waste management policies and legislation and the infrastructure of waste management (Fig. 10.1) can help to strengthen the insufficient waste management framework to minimise waste generation.

Figure 10.1 Design recommendations for recycling

As a result, Hong Kong's environmental development should be divided into three parts.

Community Mobilisation

- Collaboration with district non-governmental organisations for ecological activities
- Funding for small-scale recycling facilities
- Expand the variety of recyclable collection
- Educate for public environmental awareness
- Strengthen recycling support for communities
- Thorough community green point to enhance environmental education

Policy and Legislation

- Charging for MSW
- New waste charging schemes for industrial and domestic waste
- Legislation for green specification consumer products
- Increase the classification of sources of recyclables

- Bill on Producer Responsibility Schemes for all consumer products

Infrastructure exploration

- Expand the community green point for recyclables collection
- Redesign the waste separation and collection system
- Set up integrated waste management facilities
- Set up waste recycling and recovery facilities

Hong Kong citizens are willing to practice recycling and waste separation, but the support is not well developed, which can diminish the attitude and efforts of people who are willing to participate. Because community participation is an important element in driving waste minimisation, communities must have a comprehensive and convenient waste management consideration. Government should collaborate with district non-governmental organisations to promote ecological activates to arouse the local citizens to understand green living and ecological waste management.

Recyclables are valuable materials, even though they cannot be sold at high prices in Hong Kong. Nevertheless, in public housing estates, some people with very low incomes or no income at all (such as older persons) break into recycling bins to retrieve recyclables for resale to recycling companies. In the process, many of the recycling bins are destroyed. To prevent this, and in further consideration of hygiene and management issues, governments and most property management companies and waste cleaning services prefer to lock these bins to prevent easy access. However, this approach often backfires, because the damage done to the bins is even worse. This is also one of the reasons that recycling bins are usually installed on the ground floor, where property management companies have staff on duty most of the time. Therefore, recycling facilities need to be enhanced with proper design for communities. Funding can be provided by government for the production of small-scale recycling facilities and to expand the variety of recyclables collected. Recycling activities should also involve interactive information.

On occasion, the poor design, conditions and arrangement of recycling facilities discourages residents and causes problems when they attempt to dispose of their recyclables. In addition

to being locked, some recycling bins have only small openings on their lids to access the inside, so some objects such as large plastic bottles cannot be accommodated. Moreover, although there are three types of recycling bins (yellow for metal, blue for paper, and brown for plastic), they are all the same size. According to observations, the bin for paper collection is not big enough, so it is always full. When residents are unable to place their paper in the correct bin, some may dump large quantities of it (often including other waste) beside the bin, causing hygiene problems.

Outdoor bins have their own design problems. The design of Hong Kong's existing recycling bins is not appropriate for outdoor conditions. For example, the bins are easily damaged and are inconvenient for people to use. The covers and openings of the recycling bins are not strong enough, and the bodies of the bins are made of brittle materials. These factors lead to a high degree of deterioration, which forces the government to spend millions of dollars to replace them. In addition, the lids of the bins are usually dirty, which is repugnant to potential users. In fact, many people do not want have any contact with the recycling bins. The existing lids should be replaced with new ones that are better designed. Furthermore, to accommodate Hong Kong's small living spaces, bins with waste-compression functions, such as those used in other countries (e.g., the 'Big Belly' solar trash compactor used in Boston, USA), should be introduced to help save recyclable storage space and transportation costs. The size and design of the bins should also be distinct and based on the nature and volume of the recyclables for which they are intended. In addition, recycling bins should be made of environmentally friendly materials. Currently most are not, which has an ironic and negative effect in light of the government's desire to promote recycling in Hong Kong.

Strong recycling collection in communities is important to build confidence and to allow citizens to be active recyclers. Community green centres provide a collection point for community recyclable disposal and management and can provide an economic incentive for recyclers. In addition, the community green centre can educate the public on environmental awareness via visiting and barter activities. Good design and management are the answer to many of these problems. To motivate residents and facilitate household participation in recycling, a well-planned and continuous review of public waste management is important for the high-density buildings in Hong Kong's public housing estates. Good design of public environments and facilities is also critical to waste management success, because only user-fit designs can be paired with the lifestyles of local residents to satisfy their preferences and

needs. For example, recently constructed public housing estates include large public areas and waste collection rooms with centralised refuse chutes. Instead of locking these up and wasting the resource, as they do now, facility management companies should educate their residents and promote the use of these waste disposal facilities. If they still have concerns, safety locks and protective covers could be installed on the centralised refuse chutes to prevent accidents or misuse. This type of arrangement would allow people to use the waste disposal facilities for the purpose for which they were intended. In addition to the waste collection rooms and centralised refuse chutes, different-sized recycling bins designated for specific purposes should be placed on each floor. If the distance between the residential flats and the recycling bins was shortened, the arrangement would better accommodate the needs of Hong Kong residents who are unable to store large volumes of recyclables at home. Such an arrangement would promote recycling and motivate people to learn and maintain good recycling habits.

Infrastructure exploration can help to strengthen the efficiency of waste management. The significant waste reduction and recycling in the community require the support of complete waste management facilities. The accessibility of the facility can increase public belief in recycling efforts, help to build a green image and arouse more people into recycling. Also, waste recycling and recovery facility support is required in the waste chain. All collected recyclables depend greatly on export value recyclables (metals and wasted paper) in Hong Kong. Success in recycling depends on the cost of collection, sorting and transportation. The government should implement initiatives to support local recycling industries, including promotion of separating waste sources to increase the quantities of recyclables, such as clothing and electrical and electronic equipment. The government should also developing an advanced eco-industrial park for long-term, affordable high-technology recycling approach for the recycling industry. The recycling industry should be allowed to manage waste with advance technology and decrease recycling costs. The implementation of MSW charging will provide a much greater incentive for people and businesses to separate all kinds of waste, which will in turn provide more recyclable materials for trade.

10.4 Policy Recommendations for Recycling

Public environmental awareness must grow, and the lack of a comprehensive waste management infrastructure and system in Hong Kong must be addressed with up-to-date waste management policies and legislation to help the public to embrace a daily culture of environmental awareness. Multiple and concurrent actions must be undertaken to drive attitudinal and behavioural change and to minimise the sources of waste through policies and legislation. An MSW volume charging scheme should be executed for community and industrial waste. According to the Taiwan waste management experience, the generation of waste progressively decreased after the waste charging system was implemented in the community. The system provides an economic incentive to arouse public participation in waste minimisation and recycling. The government should provide an efficient waste transportation and recycling system. Establishing recycling centres in the community will allow the public to understand the importance of environmental protection for their living space and allow the government to promote related environmental information, such as the waste charging scheme, recycling information and environmental education and activities. A recycling centre also acts as a recycling transfer point for storing recyclables from the community. The cost and time required to clean recyclables can be minimised because the cleaning staff can collect a large volume of recyclables in a single location.

Indeed, Hong Kong is a high-consumption city. The Bill on Producer Responsibility Schemes is important to reduce consumable products. In 2010, wastes electrical and electronic equipment (WEEE) increased significantly with 70,000 tonnes annually (EDP 2010), and most of these wastes were exported overseas for reuse and recycling as the need for second-hand products diminished and trading control of WEEE was tightened in most countries. Hence, the practice of exporting WEEE is not an appropriate waste treatment solution. Because WEEE is a harmful and polluted waste, disposal and disassembly is not a suitable solution. Minimisation of WEEE is a proper approach for long-term environmental development. Consumers and producers share the responsibility for the cost of waste generation and disposal. The producers and consumers are obligated to manage certain consumer products, as well as schemes that should support the producers in the design of products that generate less waste and less packaging material for their used product from consumers. Also, thought the schemes to levy from producer and consumer and help to

establish a fund for support recycling and recycling industry. The recycling industry can be maintained with continued support to expand and develop with advanced technology because most of the local recycling businesses are primitive and small scale. Support for local recycling businesses is an effective approach for waste management and recycling and also helps to develop a healthy and positive image for the recycling industry.

Furthermore, the scale of the existing waste source separation programme must be expanded. According to the EPD, a source separation programme will be launched in two decades. Recycling practices are already embraced in daily life; however, the waste generation and recycling rates from the community are worse than those of nearby Asian countries because recycling is voluntary in Hong Kong. The public does not have the responsibility for waste separation. The environmental attitudes and behaviour of the public must be strengthened. According to the results of a design experiment, a large quantity of domestic waste can be recycled. Households will use recyclables that cannot be classified (used clothes, electronic and electrical equipment) to trade-in with mobile recycling activities for income or non-governmental organisations for commodities. Therefore, expanding the scale of community separation can motivate public and attitudes on waste dumping. In Japan, the strategy of environmental policy focuses on community recycling. The government provides support for recycling activities and industry to help minimise the consumption of resources and waste disposal. A large-scale waste source separation programme was also promoted by the government. Recyclables can be classified into more than 20 types, which allows households to separate the recycling as much as they can before waste disposal. Therefore, waste generation and landfill loading are decreasing as a result of the community's efforts in waste source separation. Intensive recycling from the community is an opportunity for the development of a can recycling industry. The expansion of recycling classification provides an economic incentive to allow recycling business and allows a stable source of recyclables for recycling businesses. Therefore, waste source separation in the household should play an important role in Hong Kong's environmental development to decreasing waste management costs and the need for of landfilling.

10.5 Motivation Needed

Finally, in promoting recycling it is important to motivate people (Lo & Siu, 2010; see also Yau, 2010). Because modern citizens enjoy consumption and convenient lifestyles, it is not easy to know how to motivate them to recycle without exploring economic considerations.

In Hong Kong, asking individual households to sell their recyclables to earn money is not a good solution because the financial return is extremely small. In fact, ten pounds of waste paper today is only worth HK$5. Some countries and cities have also indicated that they do not want to receive recyclables, as the management cost is much higher than the return. In some countries (e.g., Japan, South Korea and Germany), ‘reward systems’ have been used to encourage household recycling. Rewards can be either a monetary return or a physical benefit. For example, residents can exchange recyclables for goods that meet their daily necessities such as detergents. Rewards can also be derived from resident satisfaction, such as that found in some cities (e.g., Seoul and Hokkaido) where their recycling proceeds are donated to the less fortunate.

10.6 Future Work

As discussed in the previous chapter, there were some limitations to the study that may have affected the findings. Had it been possible to offer residents recycling for at least a year it might have yielded more wholesale changes in their attitudes. Three months might not have been enough time to expose the respondents to recycling at each stage of the study and to document the changes to their attitudes. Indeed, the respondents who were already recyclers strengthened their pre-existing attitudes, whereas those who had not previously recycled underwent the least amount of change. With more time, the attitudes of the respondents who had not previously recycled might have shown greater change.

In addition, it would have been interesting to conduct a follow-up survey of the same respondents approximately a year later to see how many more of them had become willing to recycle and to investigate the long-term effects of engaging in recycling attitudes and behaviour. Future research could also investigate the respondents' understanding of the concepts and knowledge pertaining to waste reduction and reuse. This could include bringing your own bag when shopping, upcycling recyclables and joining consumer product exchange campaigns. All of these measures could help to reduce waste through the reuse of products rather than recycling.

Further studies that capture human behaviour and attitudes on recycling are also needed to help address the waste problems that plague our earth. Including the concept of waste reduction while researching waste behaviour and attitudes could help bring greater understanding to the recyclers' approach to consumption in different cultures. This could be beneficial to waste management authorities and groups. A comparative study could also be conducted to look at people who are already involved in universal and mandatory recycling exercises or campaigns.

Finally, future research could focus on examining the problem of recycling from an economic perspective. An experimental design could be constructed to determine the costs to consumers that attach to the various information and convenience factors. The economic incentives that are necessary to overcome inconvenience and lack of information could also be investigated. Additionally, more research should be conducted on the demand for

recyclable materials. As supply and demand are linked together, a decrease in demand could result in a corresponding decrease in the prices paid for recyclables, which in turn could result in a further decrease in supply. Local or private firms need to have a steady demand for recyclables, and at the same time manufacturers need to have a steady supply of materials so that recycling can be maintained.

Appendix A
Demographic Characteristics of Responses from the Four Hong Kong Public Housing Estates

Area		Aldrich Bay (n = 50)	Sai Wan Ho (n = 50)	Shaukeiwan (n = 50)	Yiu Tung (n = 50)
Age group	0 - 14	0	0	0	0
	15 -24	0	9	2	5
	25 - 44	30	6	2	14
	45 - 64	17	20	22	24
	65 +	3	15	24	7
Gender	Male	8	14	3	18
	Female	42	36	47	32
Marital Status	Never married	2	8	1	4
	Now married	46	42	47	43
	Widowed/Divorced / Separated	2	0	2	3

Area		Aldrich Bay (n = 50)	Sai Wan Ho (n = 50)	Shaukeiwan (n = 50)	Yiu Tung (n = 50)
Educational Attainment	Primary and below	1	5	41	11
	Secondary/ Sixth form	22	36	5	18
	Post-secondary	27	9	4	21
Economic Activity Status	Employees	12	2	6	6
	Person not in working				
	Home-makers	34	43	25	38
	Retired person	4	5	19	6

Area		Aldrich Bay (50)	Sai Wan Ho (50)	Shaukeiwan (50)	Yiu Tung (50)
Household size	1	0	2	0	0
	2	2	18	15	6
	3	9	21	10	32
	4	39	9	2	6
	5	0	0	18	6
	6+	0	0	5	0
Income	Less than 5000	20	15	25	22
	5000-7999	15	6	11	9
	8000-9999	9	24	11	14
	10000-12999	4	1	0	2
	13000-14999	0	0	0	1
	15000-19999	1	2	2	1
	20000-24999	1	2	1	1
	25000 and over	0	0	0	0

Appendix B
Households' Changes in Attitudes and Behaviour

Recycling data	Stage 1			Stage 2		
	Elementary Recycler	Intermediate Recycler	Advanced Recycler	Elementary Recycler	Intermediate Recycler	Advanced Recycler
Plastic	50	25	25	57	32	32
Paper	10	13	77	17	20	84
Metal	5	12	83	12	19	90
Glass	26	38	36	33	45	43

Recycling data	Stage 3			Stage 4		
	Elementary Recycler	Intermediate Recycler	Advanced Recycler	Elementary Recycler	Intermediate Recycler	Advanced Recycler
Plastic	60	35	35	80	24	30
Paper	20	23	87	91	16	78
Metal	15	22	93	25	15	92
Glass	36	48	46	35	40	65

Appendix C
Households' Recycling Attitudes Questionnaire

針對家居廢物分類及回收問卷調查

1.　性別?

□男　□女

2.　你的年齡?

□15-19　□20-29　□30-39

□40-49　□50-59　□>59

3.　你的家庭成員人數

□1　□2　□3　□4　□5　□≧6

4.　你的教育程度?

□未受教育/小學　□中學　□專上教育

5.　你在家中有回收再造廢料分類的習慣?

□有　□沒有（請轉答問題 12）

6.　參與回收家庭成員人數

□1　□2　□3　□4　□≧5

7.　你家中有回收再造廢料分類的設備?

□有　□沒有

8. 什麼原因影響你在家中回收再造廢料分類的習慣?

□保護環境

□透過回收活動換取獎賞 (食物/日用品)

□透過回收活動換取金錢

□方便清潔工人

□廢料分類回收箱位置方便

9. 你家中回儲存再造廢料分類的方法是?

□膠桶 □膠袋 □紙箱 □紙袋 □其他

10. 你在家中回收再造廢料分類前，有進行清洗/分類嗎?

□有 □沒有

11. 請依次排出你最常回收再造廢料的類別（5 最多，1 最少）

□紙

□鋁罐

□塑膠樽

□玻璃樽

□電池

□其他 (請註明:_____)

12. 在家中回收再造廢料時,你有進行以下程序?

□再造廢料篩選/分類

□膠樽/鋁罐清洗

□膠樽去除招紙和樽蓋

□去除雜誌封面

13. 什麼原因影響你在家中沒有回收再造廢料分類的習慣?

□沒有回收再造廢料的習慣

□家中只有少量垃圾

□回收再造廢料分類十分麻煩 (浪費時間)

□回收再造廢料的分類設施不足

□家中沒有空間儲存可回收的再造廢料

□居住的地方沒有回收設施

□不認識可回收再造廢料的分類

14. 曾到回收店轉售到回收物?

□有 □沒有

15. 回收物料價錢會影響你回收迫意欲?

□有 □沒有

16. 除居所外,可以而子列出居所附近地方 (15 分鐘行各程) 的回收設施?

17. 請列出居住大廈大堂提供的環保資訊

□海報 □傳單 □展板 □視訊廣告宣傳 □回收再造廢料分類的設備

18. 近 1 個月,社區機構有否提供以下環保活動

□派傳單 □攤位遊戲日 □以物換物活動 □環保講座

□派發回收用品

Appendix D
Households' Recyclable Assessment Form

回收物品	日期	1	2	3	4	5	6	7
膠								
紙								
金屬								
玻璃								
回收物品	日期	8	9	10	11	12	13	14
膠								
紙								
金屬								
玻璃								
回收物品	日期	15	16	17	18	19	20	21
膠								
紙								
金屬								
玻璃								
回收物品	日期	22	23	24	25	26	27	28
膠								
紙								
金屬								
玻璃								
回收物品	日期	22	23	24	25	26	27	28
膠								
紙								
金屬								
玻璃								

Appendix E
Statistics of Hong Kong Municipal Solid Waste Recovered in 2001-2014

Statistics of Hong Kong Municipal Solid Waste Recovered in 2001-2014

Year	**01**	**02**	**03**	**04**	**05**	**06**	**07**	**08**	**09**	**10**	**11**	**12**	**13**	**14**
Paper	800	763	782	883	908	1003	1102	1091	1027	1195	1278.4	1162.3	1034.6	947.9
Plastics	214	166	207	265	644	646	820	1023	1211	1577	843.2	316.6	242.7	98.7
Wood	10	18	25	22	14	19	21	18	17	17	17.7	9	6.1	6.3
Ferrous metals	803	859	1202	956	829	923	594	793	733	566	667.3	499.8	523.1	845.1
Non-ferrous metals	77	53	80	99	108	140	187	140	101	155	115.1	78.2	78.6	75.5
Glass	4	1.5	2	2	2	3	1	1	3	5	4.8	18.3	10.2	8.4
Textiles	20	18	26	18	15	26	15	10	16	20	10.8	3.8	7.2	4.2
Rubber tyres	10	12.5	20	21	21	22	13	7	9	10	14.8	12	21.7	4.6
Electrical & Electronic Equipment		68	33	37	53	58	59	59	64	61	66.7	56	55.8	55.5
Food Waste											0.6	6.7	28.6	6.9
Quantity (x 1 000 tonnes)	1938.6	1959	2377	2303	2594	2840	2812	3142	3181	3606	3019.4	2162.7	2008.7	2053.2

Appendix F
Recycling Feedback Form

Recycling Feedback Form

	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	Too much spacing for recycling					
2	Recycling require much time					
3	Responsibility for environment					
4	Recycling can save waste management cost					
5	Make family be closer					
6	Educational activities					
7	Recycling I think I should do					
8	Recycling is a personl decision					
9	I am enjoy recycling					
10	Citizen should do recycling					

Appendix G
Experiment Timeline

Structure of experiment in public housings household recycling and attitudes and behavior

Time	*January*	*February*	*March*	*April*	*May*	*June*	*July*	*August*	*September*	*October*	*November*	*December*
Stage	*Stage 1*			*Stage 2*			*Stage 3*			*Stage 4*		
Activity	*Assessment Form*			*Assessment Form*			*Assessment Form*			*Assessment Form*		
				Recycling Report			*Recycling Report*			*Recycling Report*		
							Recycling Bag			*Recycling Bag*		

Survey	*Understanding*	*Assessment*	*Assurance*	*Conclusion*
Attitudes	*Arousal*	*Built*	*Continuous*	*Determined*
Behaviour	*Begin*	*Carry-on*	*Develop*	*Embed*

Appendix H
Household Recycling Performance Report

家居回收率表現報告

Flat 123
Ming Wah Dai Ha
Shau Kei Wan

Sample: A002

你的回收率：05月01日-05月31日
過去一個月，你與同類家庭回收量：+10%

良好

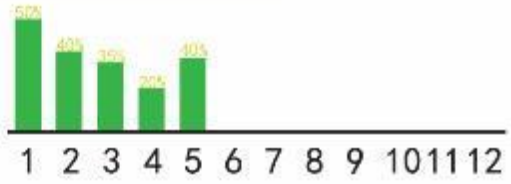
一般

留意

你的家表現：

同類家居

回收率最多的家居



過去一年記錄

最近你家的回收店

回收小貼示

回收物宜先清理，務求乾淨清潔，才放入三色回收箱中進行回收。

廢紙

清除去污染物，撕去塑膠封面及拆除大件的金屬或塑膠釘裝,放入藍色的回收箱。

膠樽

先移除樽蓋,清空樽,除去樽身的招紙,放入啡色的塑膠回收箱。

金屬

清空金屬容器，鋁罐,鋁罐應壓扁，增加運送效率,妥當地放入黃色的金屬回收箱。

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