GUIDELINES FOR WASTE SEGREGATION MANAGEMENT AND AWARENESS BUILDING AMONG URBAN RESIDENTS

BY

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ABSTRACT

Today, solid waste and urban waste are a common problem in many areas of the country due to the rapid development and growth of Thailand's economy and tourism. Increased household waste creates a burden on city governors, leads to higher costs for collecting waste and waste management. Moreover, landfills fill up in a short period. Without adequate waste segregation, illegal landfills remain high. From the past to the present, garbage is still a major contributor to the disorder of the country due to ineffective waste management, lack of longterm planning and cooperation from the public sector. Garbage is the cause of many pollutants that cause direct and indirect effects on people and environment. It is urgent that everyone has to cooperate in managing waste starting from the household level, expanding to urban communities and countries, resulting in overall waste volume of Thailand decreased and the amount of waste that is recycled increased significantly. Thailand has no serious penalties for those who throw garbage in the wrong place and those who dispose it the inappropriate way, causing most Thais to ignore waste problem. Moreover, the separation of garbage has not been cultivated until it has become a Thai norm. Garbage segregation also reduce contamination on waste resulting in higher reuse and recycle rate. Research approach includes a comprehensive study of waste management system from prototype countries, which are Japan and Singapore to analyze models of waste management and

raise awareness of urban residents in waste separation taking into account the suitability of the country's context.

Keywords: Waste Segregation, Waste Management, Urban Waste, Illegal Landfills, Recycling, Public Cooperation, Environmental Pollution

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CHAPTER 1

INTRODUCTION

Rapid industrial development, including tourism and service promotion to stimulate the country's economy causing natural resources to be used for many benefits resulting in the deterioration of natural resources and environmental pollution such as water pollution, air pollution (Office of Natural Resources and Environmental Policy and Planning, 2007) and the increasing amount of waste, which is a major problem that many countries around the world are currently face nowadays including Thailand (Department of Environmental Quality Promotion, 2005). The increasing amount of community waste is caused by increasing population (Chiemchaisri, et al., 2007), economic expansion and changes in consumer behavior (Department of Pollution Control, 2013). Increasing amount of waste leads to a lack of potential in pollution management of local administrative organizations in terms of budget, human resources, and understanding of community waste management (พีรยุตม์ วรรณพฤกษ์, 2558) including the provision of services for collection, transportation and disposal of community waste (Office of Natural Resources Policy and Planning And environment, 2007). These restrictions cause residual community waste in various areas and are not disposed correctly affecting public health concerns (Giusti, 2009).

According to the Waste Generation and Recycling Indices 2019 reported by Verisk Maplecroft Environment Dataset, which studied and explored over 52 indicators of waste production and recycling of waste in various countries around the world found that the waste situation is concerning globally. Each year more than 2.1 billion tons of municipal solid waste are produced, but only 16%, or around 323 million tons will be taken into the recycling process. In Thailand, most waste from the community was dumped in the system without being managed. The Pollution Control Department Report of residual waste in Bangkok in 2017 demonstrated that there are 4.2 million tons of waste, which averaged 1.5 kilograms per person per day. The whole country has accumulated 74,073 tons of waste. Therefore, there are 27.04 million tons of waste left behind in Thailand within 1 year. Although Thailand is ranked 61st in the world for overall waste generation, it is one of the sixth largest marine waste in the world,

with 1.55 million tons in 2017 and is likely to increase significantly every year (Verisk Maplecroft, 2017).

To be consistent between the 12th National Economic and Social Development Plan and the development of the national strategy which has the same concept of focusing on preserving and restoring natural resources, creating good environmental quality, reducing pollution and reducing impact on public health and the ecosystem. In addition, the government's plan also focuses on increasing the efficiency of management to reduce the risk of disaster and reduce the loss of life and property caused by disaster by focusing on methods to solve the environmental crisis, promote production and consumption that are environmentally friendly and develop the management mechanism for resolving conflicts about natural resources and the environment (Office of the Department of National Economic and Social Development, 2017). Both the 12th National Development Plan and the development of the national strategy emphasize on environmental problems and try to define sustainable solutions for municipal solid waste. In addition, the waste disposal program is in line with the 20-year national strategy, which was written under the 2017 constitution. The aim is to set the framework and development guidelines for all government agencies to follow to achieve the vision of Thailand becomes a developed country, with mandatory execution duration up to 20 years from 2017 – 2036. The strategy is divided into 6 areas: 1)Strategy for security 2) Strategies for creating competitiveness at the international level 3) Strategies for development and capacity building 4) Strategies for creating equal opportunities and social equality 5) Strategies for creating quality of life that is environmentally friendly and 6) Strategies for balancing and developing government management systems.

From the above problems, the researcher found that there are two important problems in waste separation in Bangkok as follows

1.) Government

The guidelines and the management of the responsible agencies are not effective, which is Bangkok Metropolitan itself. There has not been a series campaign to create understanding and participation in waste management, whether it

is educational public relations, requesting cooperation in sorting waste from the source, fiscal incentive as well as educating people about waste collection and disposal process.

2) Residents

People should be aware of the occurrence of waste, waste separation method and waste disposal method. It is possible that most people do not aware of the problems and impacts of not separating waste or not recognizing the importance of waste separation. This issue is a very problem and obstacle to urban development.

Therefore, the importance of studying waste management practices and raising the consciousness of urban people in waste separation is not only to indicate the problems and obstacles in waste separation of the urban people. In addition, the importance of this research is to focus on finding the following two main points.

i What appropriate management approach should be for the agency responsible for Thailand's waste management? And what are the future directions for the improvement of concepts and approaches to manage waste problems in Thailand?

ii How should the process and guidelines for creating public awareness on waste separation be in Thailand?

In this research, the researcher will conduct a comparative study between Japan and Singapore, which are Asian countries with similar social systems as Thailand. Both model countries have been strictly practiced systematic waste management in national level. This comparative study shows the problems, obstacles, concepts, including ways to manage and create the consciousness of urban people in waste separation to reach sustainable municipal solid waste management.

1.1 Purpose of study

This research seeks to investigate waste management methods and government policies of prototype countries which are Japan and Singapore by studying waste management approach of the agency responsible for waste management. Case studies are investigated to seek opportunities of mutual learning across regions and countries and to understand the implication of waste management in each country as

well as the obstacle to achieve sustainable waste management in Thailand. Currently, practice of waste management has fundamentally focused on short-term impact for example, government expenditures and environmental pollution but less address to long-term impact such as, post-disposal planning, regional self-reliance in managing waste, uncertainties in current practice and national waste management and control policies. This research investigated how government and urban residents can cooperate in promoting sustainable waste management.

1.2 Methodology

In this research, a case study-based approach is proposed to develop research solutions including information from published materials, government official statistic announcement and news. The researcher studies prototype countries regarding the method of raising awareness of people in municipal solid waste management. The method will also consist of interpreting, comparing and contrasting secondary resources in order to find mutual learning of municipal solid waste management from prototype countries that are Japan and Singapore to be a model case study and to improve and develop Thai waste management system. Qualitative data will be presented to support the research findings. This study focused on municipal solid waste management of studied countries by emphasizing on the adequate waste management method and how their government support sustainable solid waste management. The researcher focuses on the planning of waste infrastructure and waste management site that the municipality and the government provide to the city to improve solid waste management. The scope of study will be different waste collection methods and urban planning for improving waste collection and waste management of each study country. Following case will be then identified for example, Waste Management process of foreign countries and Thailand, Guidelines for managing and raising the awareness of urban people in waste separation in Thailand, landfill site location and innovative systems to collect waste. The challenges to reach sustainable urban design for waste management will also be discussed to understand what the constraints of incorporating sustainable planning strategies are in waste control and management policy.

1.3 Significance of study

This research promotes contribution and cooperation between government and public sectors towards sustainable waste management planning as well as raises government awareness to include integrating facilities and long-term waste management approaches into mainstream planning. The government and private sectors who are involved with the waste management process from the beginning to the end need to firstly understand that a single method cannot be applied to every country. Therefore, the study of policy and methods from different countries that have similar and different geographical characteristics is required to build sustainable waste management planning that is suitable for each city.

CHAPTER 2
REVIEW OF LITERATURE

The research on Guidelines for Waste Segregation Management and Awareness Building among Urban Residents is a qualitative research in which the researcher reviews literature, theories, articles, academic documents, official government announcements and related previous research in order to use as guidelines for determining the conceptual framework in accordance with the research objectives. The issues in the literature review are following topics.

1) Waste Management Theory
2) The Concept of Waste Separation
3) Participation in Waste Separation

2.1 Waste Management Theory

The Office of Natural Resources and Environmental Policy and Planning (2004) has defined the definition of waste means solid waste and sewage, which are caused by human activities and animal, from consumption, production, and excretion. Similar to the aforementioned concept, the Department of Local Administration (2005), the Pollution Control Department (2009) has defined the definition of waste as waste paper, waste textile, food scraps, packaging waste, plastic bags, food containers, glass, animal feces, carcasses or any other things that are collected from roads, markets, livestock or other places. Moreover, solid waste includes infectious waste, toxic waste from communities or households except the materials that are wasted from the factory which has the specified characteristics and qualifications provided in accordance with the Factory Act.

The definition of waste may vary depending on the definition of each person or organization. In the study solid waste means objects that are disposed from the household, including public places, markets, roads and water courses in the community which can be both decomposed, such as food scraps, leaf litter, or cannot be able to decompose such as foam boxes and plastic bags. Moreover, waste that can be reused or a toxic waste from households and communities. However, type of waste

is different according to the origin of where it is generated. This definition is therefore similar to Visakha Phuchinda's (2005) point of view regarding the meaning of solid waste. Waste sources that are different affect the difference in the amount and type of waste (Phuket Provincial Administrative Organization, 2008)

2.2 Types of solid waste

According to Udomsak Sinthiphong (2004), solid waste can be divided into three major categories which are compostable waste, non-compostable waste, and toxic waste

2.2.1 Composable waste

Compostable is the most common waste that is found up to sixty-four percent of the total waste. It is high humidity waste that is difficult to ignite. It can be rotten and degradable, often includes organic matter, such as food scraps, plant debris, vegetables, fruit skins and remains of plants and animals. Due to this type of waste has a high humidity, when decomposed, there will be a foul odor that may create odor pollution to nearby communities. Composable waste is commonly known as "wet waste". It is originally from communities, residences, fresh markets, restaurants as well as from agriculture.

2.2.2 Non-compostable waste

Non-degradable waste has low moisture or without moisture, therefore it is easily ignited, such as paper, grass, rubber, except metal and glass scraps. This type of waste is difficult to rot or decompose or some types may not rot and can also be reused, such as foams, plastics, bottles, or tires. It is commonly known as "dry waste". It is originally from from residences, communities, and industrial areas.

2.2.3 Toxic waste

Toxic waste means waste that contains chemical components or toxic, corrosive waste such as chemicals from factories, batteries, medicine and deteriorated chemicals, pesticides including infectious waste from hospitals such as chemicals, contaminated waste, radioactive waste, and syringes. Special control and disposal methods is required to prevent the spread of germs and

toxins into the environment. sources of toxic waste or important hazardous waste. Source of toxic or hazardous waste Including industrial factories, hospitals, and research sites of Pollution Control Department Ministry of Natural Resources and Environment (National Geographic, 2016).

2.3 Physical Characteristics of Waste

In addition, waste can be classified according to physical characteristics into four types as follows.

2.3.1 Organic waste (Compostable Waste) is a waste that degrade quickly. This type of waste can be used to make fertilizer, such as vegetable scraps, fruit peels, food scraps, leaves, meat scraps, etc., but does not include carcasses or remnants of vegetables, fruits, or animals resulting from laboratory experiments. The degradable waste is the most common waste, which accounts for 64% of the total waste.

2.3.2 Recyclable Waste or waste that can be reused, such as glass, paper, plastic scraps, beverage cans, metal scraps, aluminum, and automotive tire. This recycling waste is the second most common waste in the waste, that is, about 30% of the total waste.

2.3.3 Hazardous Waste is waste that contains or contaminated with a variety of dangerous substances, including explosives, flammable substances, oxidizing substances, poisonous substances, pathogenic substances, radioactive materials, other objects, whether chemicals or other things that may cause harm to people, animals, or the environment. This hazardous waste is often found the least, which is approximately 3% of the total waste.

2.3.4 General waste is other types of waste, other than biodegradable, recyclable and hazardous waste. It is difficult to degrade and is not worthwhile for reuse, for example, plastic wrap for food, plastic bags containing detergent or instant noodle sachets. General waste has approximately the same amount as hazardous waste, that is, about 3% of the total waste.

2.4 Concept of Waste Separation

Waste management requires a system for sorting waste into various types according to the composition of waste. The primary objective of solid waste management is to reuse waste as much as possible. People should practice solid waste separation in their household by placing waste into appropriate container. The local governor also needs to establish adequate solid waste collection system as well as considers the necessity of the waste transfer station and the waste transportation system.

2.4.1 Standard rules for garbage container (Pollution Control Department, 2004)

2.4.1.1 Garbage container

1) Trash bin - to efficiently collect waste and reduce contamination of waste that has the potential to be reused. The municipality must set up garbage collection points and separate the types of waste bins in different colors by having plastic bags in the bin to conveniently and prevent the waste from falling or spreading. In case that there is limited space to place a container or it is in populated area, such as in the airport, convention center or attraction area, there should be one bin that can support all four types. It is the bin that is divided into four compartments and it should be made of stainless steel. Each type of waste will be disposed into different bin due to its colour.

i. **The green lid** supports degradable waste.
ii. **The yellow lid** supports waste that can be recycled or sold.
iii. **The red lid** supports hazardous waste
iv. **Blue lid** supports non-biodegradable and non-toxic waste

2.4.1.2 Garbage bags

Garbage bags for household waste separation in various colors as follows

1) Green bags are for collecting degradable waste and organic waste that can be decomposed to fertilizer such as vegetables, fruits, food scraps and leaves.

2) Yellow bags are for collecting waste that can be recycled or sold, such as glass, paper, plastic, metal, and aluminum.

3) Red bags are for collecting hazardous waste such as fluorescent lamps, medical waste, batteries, spray bottle, insecticide spray bottle including containers for various dangerous substances.

4) Blue bags are for collecting non-biodegradable waste and non-toxic waste

Figure 2-1 Waste containers in Thailand

2.4.1.3 Waste collection arrangement

The municipality must set up a collection point for waste in the community for the convenience of waste collection. The waste collection points will be specified in various locations by local municipality. For example, in the housing village, there is one collection point per 50-80 households. It is normally located at the entrance of the housing village. For the apartment, it will be located at the parking lot. Each household is responsible to separate the waste by sorting each type of waste into different colour of plastic bag and dispose it at waste collection point.

2.4.1.4 Waste collection arrangement

Solid waste disposal technology can be divided into three major systems (Pollution Control Department Ministry of Natural Resources and Environment, 2004) as follows;

1) Composting system is the decomposition of organic matter by biological processes. Microbes allow waste to transform into minerals that are black, dry and can be used to improve soil quality. The process of composting can be divided into 2 processes (1) Aerobic Decomposition which is the creation of a condition in which microbes use oxygen to digest nutrients and grow rapidly and turn

into minerals. This process does not cause foul odors. (2) Anaerobic Decomposition which is the creation of a condition in which microbes use oxygen to digest nutrients and turn into minerals. This process often produces foul-smelling gases such as Hydrogen Sulfide (H24S) as well as Methane gas, which can be utilized as fuel.

2) Incinerator system is the destruction of waste by burning in incineration plant that has been designed appropriately to prevent leakage of toxic substances. The incinerator must have a burning temperature of 850-1,200 degrees Celsius to complete the destruction. On the other hand, waste combustion often causes air pollution such as small dust, toxic gases such as Sulfur Dioxide (SO2). In addition, Dioxins, which are carcinogens and substances that are now in the public interest. Therefore, it is necessary to have an air pollution control system in incineration plant to prevent pollution passing through the chimney to the atmosphere.

3) Sanitary Landfill is the disposal of solid waste in the area provided and approved by the government. This area has been chosen according to academic principles in terms of economy, society, environment, engineering, and architecture. The Environmental Assessment has been conducted before building the landfill. Most importantly, landfill site must have consent from the community around the site. Design and construction of landfill must have measures to prevent negative impacts that may occur in the future such as water contamination from solid waste known as leachate. If there is a leakage of wastewater, the quality of groundwater will deteriorate which will affect people who use water for consumption and agriculture. In addition, there must be measures to prevent flooding, foul odors, and effect on the landscape.

2.5 Participation in Waste Separation

Public participation is an important foundation of sustainable development. It is an opportunity for people to participate in determining the direction of development and cause the integration of participation in many areas, including the environment, poverty, career development, education, religion, politics, and equality creation. Concepts and theories about public participation have been compiled.

2.5.1 The definition of participation

The participation of people or communities is one of the important foundations for national development. Therefore, the participation of people or communities is a concept that has been widely discussed. Many scholars have defined the definition of public participation as follows.

Participation is to participate in activities and share responsibility with others, whether by making decisions or expressing opinions. When a person is involved directly or indirectly in some issue as well as one person is interest in one matter is considered as participation. Therefore, it can be said that there are many forms and means of participation which is relevant in the psychological and emotional aspects of a person. The activities of the group motivate them to accomplish their goals. Participation is related to involvement, contribution, and responsibility (Devis and Newatrom, 1989).

Chuchat Phuangsomchit (1997) stated that participation is an opportunity for people to make the decisions on what affects themselves directly.

In addition, Jutharat Chompan (2012) states that participation is a social process that allows the people to know the information, analyze problems, monitor the impact of the operation as well as participation in the implementation of any matter which lead to a solution or improvement of community or locality. In addition, the author mentioned about the participation in Thai context which mean public participation. The authority must listen to the people at public hearing and allow people to participate in projects or development activities.

While Cohen and Uphoff (1997) described participation in rural development as a local co-operation under any condition or situation to reach the development goals.

The above research demonstrates the participation is involved many parties and stakeholders, including community representatives, government, local authorities as well as everybody in the society. However, one thing that must be considered to contribute to the success of participation is the ability to connect the concept of participation with management as well as decentralization and sharing of

benefits in an appropriate proportion. The participation will be success or fail depends on the ability to organize and management processes within the community.

2.5.2. Participation in waste management

According to the statistic from Pollution Control Department, the amount of waste increases every year and Thailand still lacks efficiency in waste management. In 2017, the amount of waste generated nationwide was approximately 27.60 million tons, an increase from the year 2016 with a volume of 27.40 million tons. This is due to the increase in population and the expansion of urban communities, which is an urgent problem to be solved (Pollution Control Department, 2018). Participation in solid waste management is therefore an important factor for the proper disposal of community waste without causing environmental impacts. The concept of participation in waste management under the paradigm of sustainable development consisting of 6 principles (Costanza et al., 2000) as follows.

2.5.2.1 Access to environmental resources requires awareness of responsibility for sustainable use of resources. Responsibility of businesses and individuals, along with the passion for the conservation of environmental resources under ecological goals is significant.

2.5.2.2 Appropriate management in making decision on environmental resources should have the following criteria:

1) Decisions should be made at the institutional level, which will place ecological factors as the highest priority for the decision.

2) The decision must ensure the distribution of environmental information between relevant institutions.

3) The decision must be given to the ownership and those who get involved.

4) The decision must have the analysis of costs and benefits within the environmental system.

2.5.2.3 Prepare for the uncertain situations about the environmental impact that cannot be reversed. Therefore, decisions about the use of environmental resources should be based on precaution.

2.5.2.4 Adaptive Management under the uncertainty of environmental resource management is required. Decision makers should have to consolidate and integrate economically, socially, and environmentally to meet flexible adjustment goals.

2.5.2.5 Full cost allocation in making decisions on the use of environmental resources, all costs and benefits should be identified in the entire environmental system. Appropriate allocation must be at the level that the market is fully adjusted to reflect the costs.

2.5.2.6 All stakeholders should be involved in the decision to use environmental resources including get involved in the process of drafting and implementing the policy. The stakeholders who are fully aware of their roles will lead to the creation of rules that are accepted and trusted. These rules will help to determine the responsibilities of each party appropriately.

However, participation in waste management requires cooperation from all stakeholders. Therefore, it is necessary for local authority to specify the direction of operation and budget allocation to create a long-term waste management system with efficiency.

CHAPTER 3
WASTE MANAGEMENT PROCESSES OF FOREIGN COUNTRIES AND THAILAND

This section demonstrates the methods of waste disposal in Japan and Singapore which are prototype countries with efficient waste management. The researcher studied waste management methods of prototype countries to find suitable methods that can be adapted to improve waste management system in Thailand. The study also demonstrates problems, obstacles, and ways to raise people's consciousness in waste separation by studying five major areas 1) Source reduction 2) Waste disposal sites 3) Waste collection and storage 4) Waste disposal center and 5) Final stage of waste management.

The concept of waste management is to study the entire process of waste management, starting from source reduction which depends on the intention of a person who originally generates waste. Municipal solid waste can be divided into two types according to their origin 1) household waste and 2) public waste. After that, solid waste will be transferred to waste disposal center, which is the connection between the waste producer and persons who are responsible for further management. The collection and final disposal methods will also be studied.

3.1 Japan: Waste management in Japan

Japan is one of the top tourist destinations in Asia which is the main reason for increasing the amount of waste. However, Japan has a systematic waste management. Japanese waste management methods begin at the household level. There is a clear law regarding littering and segregation. In addition, Japan also has a large waste factory that brings waste into the combustion process so that those wastes cause as little pollution as possible. Plus, burning waste is not wasteful because it also generates electricity to make money for the waste plant. The ash from incineration can be used to build bricks for construction use or to fill the sea to change that space to a recreation space as well.

3.1.1 Source Reduction

3.1.1.1 Household waste

Local waste reduction and segregation in each district of Tokyo has implemented activities or projects to reduce the amount of waste at homes, shops, and companies. The country enforces the law to promote a sustainable society including the specific laws for managing each type of waste. In addition, Japanese must separate the waste before disposing at the specific collection point which is divided into 4 types of waste.

1) Combustible waste such as food scraps, plastic, and paper.

2) Non-Combustible waste such as metals, electrical equipment, glass, ceramics.

3) Oversized garbage such as furniture, cabinets, beds, tables.

4) Waste that can be reused or recycled such as paper, plastic, and glass.

Local Municipality in Japan provides a living guide for residents. In this guideline, there is information about a way to separate the waste before discarding including scheduled date and time of waste collection according to the type of waste. This living guideline is something that every household in Japan treats strictly and seriously to become a normal way of life.

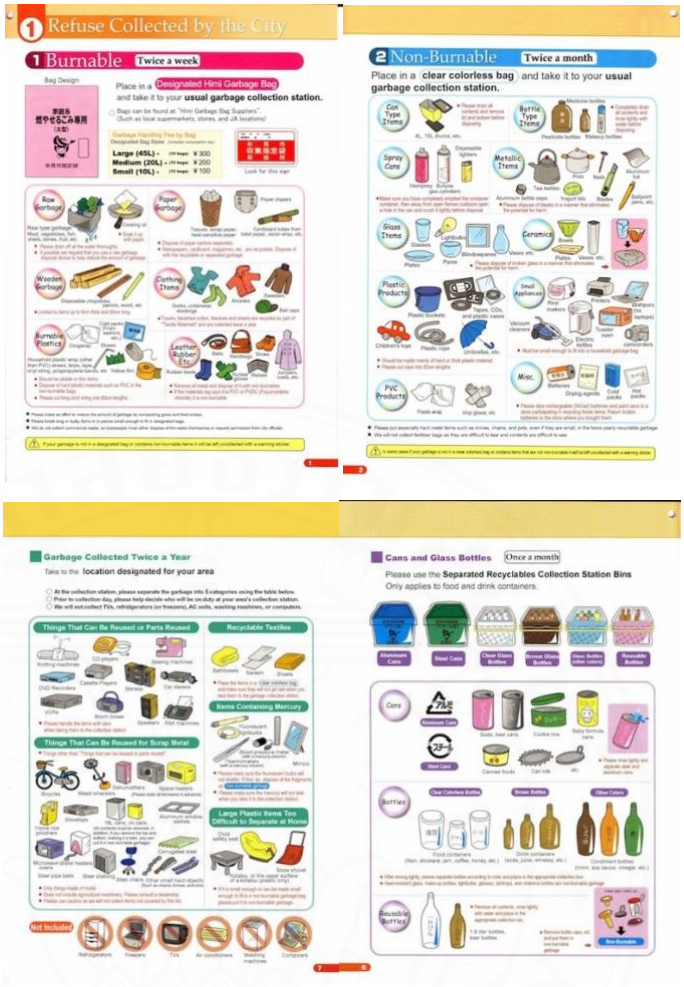

Figure 3-1 Japanese Waste Separation Guidebook

3.1.2 Waste Disposal Site

The residents can dispose waste that has been separated from their household in the garbage that the government provided for the locality. The bins are arranged according to types of waste. The local municipality normally place the bin where it is easy to access to for example close to residential building, in the park, near supermarket, near automatic vending machine and train stations. The local municipality and city planner will consider placing different types of bin to suit the location and type of waste in specific area.

Figure 3-2 Waste disposal site in Japan

3.1.3 Waste Collection System in Japan

Japan has set dates, time and points for waste collection depending on the type of waste and operation plan. In addition, the operational plan depends on the change of seasons and trends of local garbage volumes. There is no collection fee for waste management from households unless there is a requirement from the resident to collect large amount of waste or big piece of waste including waste from the business sector. Waste from residences will be collected by the local municipality, which has set the frequency of collection. Combustible waste is collected 2 times per week. The dumpers must place the garbage before 8:00 am on the day of garbage collection. Non-combustible waste is collected 1 time per week and large waste will be collected depending on the requirement of the residents. Recyclable waste is collected 1 time per week and waste from the office, shop and other business sectors will be collected by an authorized waste collection truck which is get the permission from local authorities to collect waste and dispose at the disposal site. The garbage bags will be covered by the net or will be placed behind the bar to prevent waste from the animals such as bird and dog.

Garbage collection systematically divided in about 1,500 garbage trucks that will circulate around 340,000 garbage collection points throughout Tokyo. Collection routes were planned to not affect car circulation around the city. Japan also provide door-to-door garbage collection for the elderly or the disabled who are inconvenient to leave the garbage at the set points. In addition, Ministry of the Environment consider the expansion of garbage collection zone and garbage disposal

points to increase the efficiency of collection and transport operation in each city. There is a compactor inside seventy percent of collection trucks which will reduce the size of waste into small pieces before going to the incinerator. Waste that cannot be burnt like electrical appliances, ceramic will finally be moved to non-combustible waste management center to be sorted.

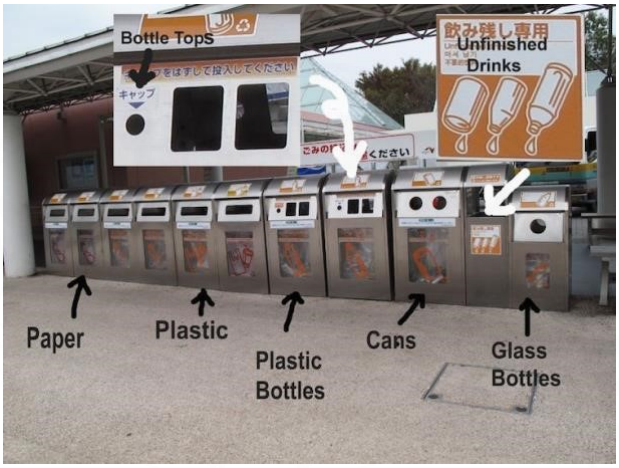

Figure 3-3 Waste container in Japan

Figure 3-4 Waste collection in Japan

3.1.4 Urban Development Project: Japan's Town Planning System

The city planning system in Japan has three important components 1) land use, 2) urban infrastructure 3) urban development project. This urban development project must comply with land use plan and the city development project. This systematic planning makes the Japanese town planning system successful.

Integration of elements of urban development projects in the city planning system supports housing needs and the rapid expansion of urban areas causing the urban development to be in the right direction, meet the needs of people and truly meets the policies of national development. The urban development project in Japan's urban planning system includes the Land Readjustment Project, the Urban Readjustment Project, the New Resident Area Development Project.

3.1.5 New Land from Waste

Japan is a country with an area of only 377,944 square kilometers, which is 2 in 3 of Thailand but has a population of 126 million (Thailand has an area of 513,115 square kilometers). Japan does not have enough space for living. The Japanese government therefore considers ways to increase the land area of the country to meet the needs of the residents of the country. The Japanese government has put waste into the sea to build a fake land before creating a city called "Odaiba" and the island for "Kansai Airport", which has a total area of approximately 1,900 square kilometers, approximately 20% larger than Bangkok.

Figure 3-5 A bird’s-eye view of the Central Breakwater landfill sites (left, middle) and the

New Sea Surface Disposal Site (TMG Bureau of Environment)

3.1.6 Redevelopment of Former Landfill Sites

It is a long-term plan of the local government organization collaborate with city planners to exploit the former landfill sites and repurpose them into a community facility that is in line with the needs of the people in the area (Alexandra et al, 2020). Most importantly, this must be the use of land reflecting the original plan when the planner selected the area for constructing disposal sites. After repurposing the landfill site, there are some concern that the planner needs to take into account such as the size and duration of land subsidence, flammable gas, odors, the risk of underground water pollution including the impact on durability and vegetation. 1) Land use as a park Imazu health park is redeveloped from the original waste disposal site. Most of the area is public parks, green spaces, recreation areas, gyms, and tennis courts. 2) Land use as a farm Imazu refresh farm is an agricultural area. The government divide the space for public to planting trees as a hobby. 3) Land use as the Biotope

On an area of 41 hectares lies Japan's biggest biotope, Hibikinada biotope, originally the waste landfill. This has become the habitat for endangered species. What are seen are rare birds, seasonal birds, various plants, dragonflies, insects, amphibians, fish, and mammals.

Figure 3-6 Hibikinada Biotope

3.1.7 The Incineration Plant in The Middle of Tokyo

There are 20 incineration plant facilities in 23 cities of Tokyo (Clean Authority of Tokyo, 2019). Incineration of waste is considered the most efficient waste disposal which will help reducing waste volume by up to ninety-five percent. Although the incinerator works continuously for 24 hours and located in the middle of residential and business zone, there is no complain from Japanese since strict pollution prevention standards have been established.

The number of dioxins, lead, mercury, hydrogen chloride, sulfur oxide, nitrogen oxide is controlled. The gases from the combustion will be sent to process of eliminating harmful substances and release clean gas through the chimney. Also, the water will be treated before releasing into the sea. Through this whole process, the public sector can track the procedure and pollution level at any time.

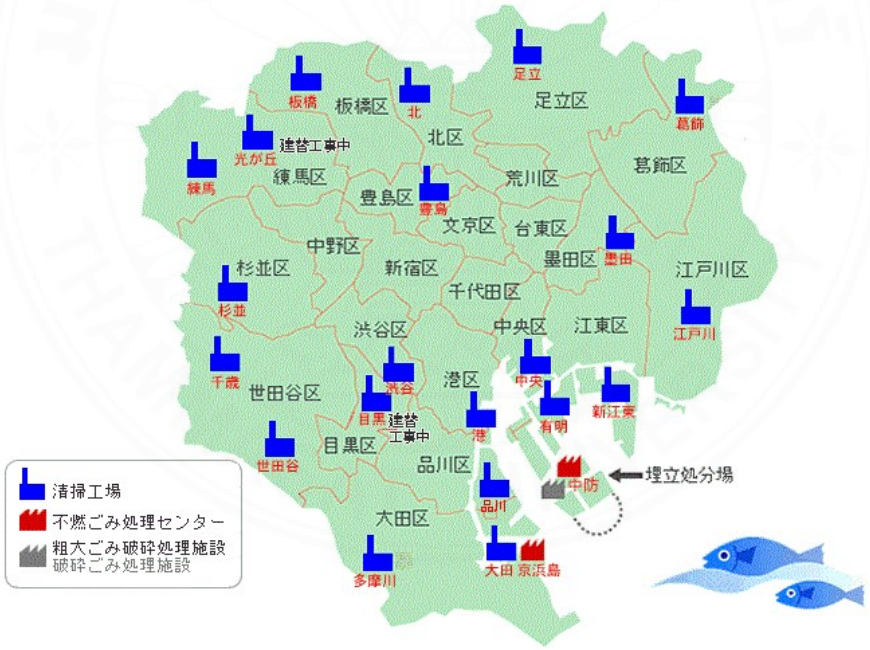

Figure 3-7 Waste Incineration Factory

- Non-burnable refuse processing center
- Facility for crushing oversized garbage
- Figure Location of incineration plants in Tokyo, Japan

Figure 3-8 Waste incineration plant in the middle of Tokyo business area

3.2 Singapore: Waste Management in Singapore

Singapore has an area of 721 square kilometers, with a population of 5.8 million in 2020. With limited land area and high population density, it is not surprising that the disposal of municipal solid waste poses a major challenge to Singapore (Lee Yuen Hee, 2008). The Republic of Singapore therefore places importance on a systematic city planning to build the foundation for the development of infrastructure and land management for maximum benefit by designing land use and building that lead to sustainable development and environmentally friendly. The Republic of Singapore has established the "Urban Redevelopment Authority "or " URA " that is one department in the Ministry of Land Development and Environment. URA oversees planning a systemic and sustainable urban system. URA has set up a concept plan by brainstorming ideological needs from people in all sectors and careers including children, youth, labour and elderly for creating a short-term and long-term master plan of 40-50 years by focusing concurrently on the balance between economic growth and quality of life of the people. In this regard, the city plan will be reviewed every ten years according to the country's economic conditions and national restrictions. One of the most important agenda of the URA is sustainable waste management. The URA also works with National Environment Agency (NEA), which is directly responsible

for managing community waste. According to the NEA, Singapore has four main strategies for increasing the efficiency of sustainable waste management 1) waste reduction strategy 2) recycle strategy 3) increase the use of waste-toenergy plant and waste management infrastructure 4) reduce amount of waste to landfill. Singapore was ranked the world's cleanest cities and is also the most environmentally friendly city in Asia. The idea of former Prime Minister Lee Kuan Yew since 1968, required the environmentally friendly development since the country declared independence. Due to the increase in population along with economic growth resulting in an increase in waste, Singapore hires a private waste management agency to deal with all waste management process. However, the agency is required to follow the government roadmap. Since the strategy has been well established, Singapore has an efficient waste management system. With the goal of Singapore being a waste-free city, the government has requested cooperation from the public sector in collecting and separating waste from household. The goal is to cut daily waste sent to landfill by 30% within 2030 by proceeding as follows.

- Request cooperation from the people in the waste collection and separation.
- Campaign to use recyclable materials
- Request cooperation from the private sector to produce all recyclable materials.

Singapore Solid Waste Management Policy covers waste generation, recycling, and disposal by focusing on reducing the amount of waste and maximizing recycling. Singapore wants to increase the total waste recycling rate to sixty percent. Any type of waste that cannot be recycled will be burnt to ashes at the Waste to Energy (WTE) disposal plant that has efficient pollution control system.

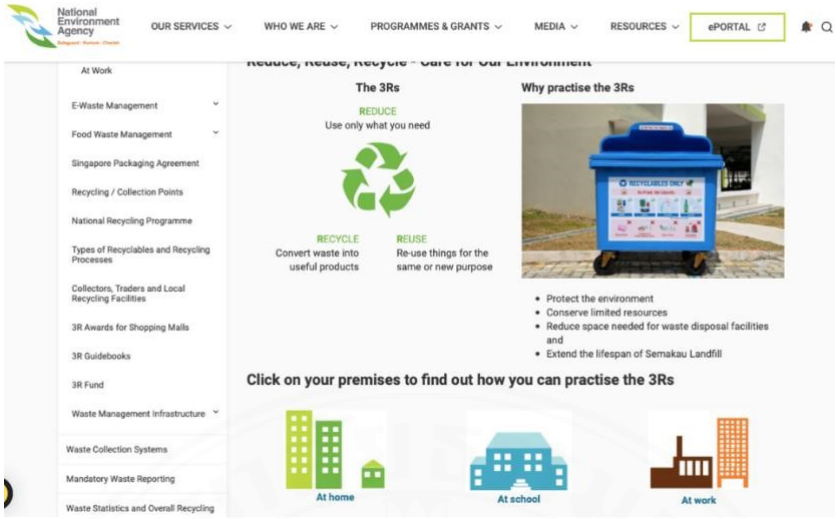

Figure 3-9 Singapore National Environment Agency website educates people about waste management

3.2.1 Waste Disposal Site

Singapore focuses on recycling. The municipality provides the recycle bins with a clear description and photo of the garbage that can be littered in each type of bin for the effectiveness in waste separation, especially in popular tourist areas. Different countries sometimes have different methods of waste segregation. Therefore, a clear direction on how to separate waste in Singapore facilitate the tourists from all over the world as well. Although the bins sometimes have the same colour, Singapore municipality uses large letters indicating the type of waste material with the symbol “Reuse Reduce Recycle”. In addition, they use the cartoon characters such as: plastic bottle cartoon characters, canned cartoon characters and the paper cartoon character said on the side of the bin, "Don’t throw away my future, recycle me", to stimulate people's consciousness in separating waste correctly.

Figure 3-10 Waste container in Singapore

3.2.2 Semakau Island: New Land from Waste

Semakau Island is located eight kilometers away from the southern island of Singapore. It is well-known for a new island built from landfill. Semakau is also home to a large oil refinery, a harbor and a mangrove forest and home of four waste separation plants. Waste will be burnt with high heat until all the garbage became ashes. These asheh will be tested to have no toxic residues in the amount that is harmful to the environment. Most of the toxins are eliminated during the process of burning at high heat and before going to landfill. Singapore's last mangrove forest is also located at Semakau island, it is still highly diverse in biology although the land of Semakau is filled by waste. The reason that the waste incineration plant is located near the reclamation area is because it saves traveling time, reduce travel pollution, and reduce the risk of contamination. The Singapore government estimates that Singapore will have about twenty-five percent of the landfill space available from the original island area.

Figure 3-11 Landfill site in Singapore

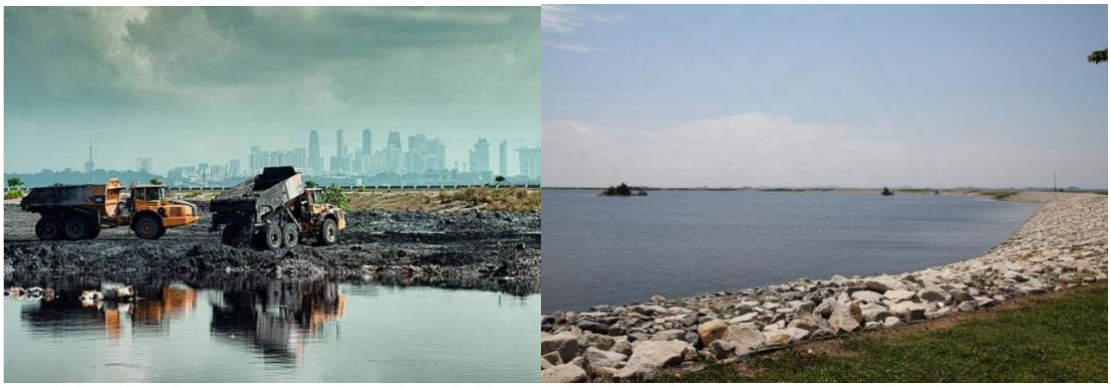

Figure 3-12 Semakau Island

3.3 Thailand: Waste Management in Thailand

Although there is a law enforcing the people to separate the waste in the household, but, the public does not comply with the law as it should do. Thailand ranks fifth in the country that has the most leaks to the sea in the world. More than 8 million tons of waste flowing into the ocean and more than half are plastic waste which is considered as a challenge in the waste management of Thai society. According to a report from the Ministry of Natural Resources and Environment in 2017, the amount of waste in 23 coastal provinces with more than 11 million tons is managed properly by 6.8 million tons and is reused for 3 million tons while there are more than 1.5 million tons incorrectly eliminated. When compared with the amount of waste generated in Thailand, it is even found that the amount of waste created by Thai society are over

27.93 million tons per year which are properly disposed of only 10.85 million tons or about 26% only.

3.3.1 Waste Segregation in Household

Although the law requires people to separate the waste in the household, but in actual practice, people still do not comply with the law as they should. Most of the people throw away household waste within the same bag without separating each type of waste.

3.3.2 Waste Disposal Bin and Challenges

There are four types of waste bins provided by government agencies which are 1) wet garbage 2) general waste 3) hazardous waste 4) recyclable waste. In practice, people are not separating waste as they should. Therefore, there are several wastes that cannot be reused or recycled since they are contaminated. Although the waste bins are divided according to the type of waste, the condition of the bin is poor. Whether the tank is broken, no lid and water from wet garbage flowing into the road. Moreover, the nine-point bombing event on New Year's Eve 2006 shocked Bangkokian and local governor and brought more serious security measures. Nikom Waiyaratpanit, Director of the Bureau of Environment Bangkok at that time ordered local municipality governors to quickly collect large trash from the areas of fifty districts with fear that it would be a risk of repeated bombings. Until 2017, under the command of Pol Gen Aswin Kwanmuang, more than one million colored bins were collected throughout Bangkok due to the incident of bombing on 5 April 2017 in front of the old Government Lottery Office that the criminal hid the bomb in the bin. Therefore, a new design of bin with a steel frame covered with clear plastic were installed. Due to lack of bin, most people still take out their garbage bags to put on the footpath or around the electric pole close to where they live, resulting in a dog or cat rummage food scraps from the garbage bag causing the scenery of some districts to be full of garbage.

Figure 3-13 Undermaintenance of waste containers in Bangkok

3.3.3 Waste Collection Schedule

The government has announced a roadmap for the management of hazardous waste and waste in the country. Short-term solid waste management master plan for the country (20162021) and action plan "Thailand without waste" from the annual action plan 2020 by the Bureau of Environment states that "Bangkok" has been established guideline for waste collection and management in the Bangkok Development Plan 20 years (2013-2032) with the vision to focus on waste management at source of waste. With all sectors get involved in the concept of Zero waste management. The local authorities raise awareness of community to reduce household waste in accordance with the 3R principles: Reduce, Reuse and Recycle and minimize waste and residue with effective technology.

Chatree Watthanakhachon (2019), Director of the Environment Agency Bangkok, stated that Bangkok Metropolis is trying to improve Bangkok's waste management to be more efficient to keep up with urban growth and the amount of waste increasing every year. Currently, there are 2,140 garbage collection trucks. There are 495 trucks belonging to Bangkok Metropolis, 1,571 trucks are hired from private waste collection agency, 111 waste collection vessels and a total of 10,454 waste collectors for 50 districts in Bangkok. Bangkok provides solid waste collection services with two main methods as follows;

3.3.3.1 Direct collection of waste is a door-to-door collection. The garbage collection

truck will collect waste from household garbage that the residents set out and from various places that the truck or boat can access.

3.3.3.2 Indirect waste collection is the ability to collect waste from waste container that Bangkok governor has set up along the roadside, waste collection points and areas of high amounts of waste where Bangkok arrange the truck to collect waste every day.

Bangkok Metropolis has set up the schedule for waste collection as follow;

1) General waste must be collected on a regular basis so that there is no garbage left over in the area. The municipality specifies the disposal points and set the date and time schedule. The garbage along the main street area and secondary road are collected every day. According to the setout rule, people must bring the garbage out between 8p.m.3a.m. allowing the collectors to complete collection before 05.30 a.m. to avoid traffic.

Regarding to waste collection service for the community in the small alley, Bangkok Metropolis will collect the garbage 2-3 times per week by using various types of solid waste collection trucks, both two tons and five tons, in order to access to small area. All the waste that has been collect will be then transfer to one of Waste Disposal Center in Saimai, Nong Khaem or Onnut.

2) Organic waste is collected on date and time specified by each district office. From there, organic waste will be composted in the area, or sent to an organic fertilizer compost factory at Onnut and Nong Khaem Waste Disposal Center.
3) Hazardous waste is collected once every fifteen days or as designated by the district office. It will be delivered to all three waste disposal centers in Bangkok to be hygienically disposed.
4) Infectious waste comes from hospitals, universities, or laboratory. In Bangkok, infectious waste will be collected on the appointed date and time. The local governor arranges temperature control vehicles to collect infectious waste and sends them to incineration plant in Nong Khaem and On Nut Waste Disposal Center.

There are many slum communities that the garbage truck is not able to access due to a narrow street. Therefore, the District Office recruits volunteers within the community to collect waste from whole community and gather them at the arranged point. The communities in Bangkok where the garbage collection trucks are not able to access are Ban Somdej Community, Wat Pradittharam Community, Samre community, Kudeejeen community including riverside communities. However, according to a survey conducted by the Pollution Control Department in 2018, garbage problem still receives a call for resolution as same as traffic and flooding problems. Bangkok Governor has attempted to reduce waste by promoting the campaign for the people to separate waste at home, reduce using single use plastic, compost food waste to reduce the amount of household waste. Nonetheless, there are still complaints from people in the communities that there is several garbage left behind and garbage collectors do not come on the specified date and time. Moreover, sometimes not all the garbage can be collected but if it is a valuable waste such as furniture or electronic waste, it will be collected regardless of whether it is large or small. Many people are wondering whether the rules for Bangkok's garbage collection in all fifty districts are different, what the type of waste that will not be collected are or exact dates and times for garbage set out in their area.

Figure 3-14 Waste collection truck in Bangkok

Figure 3-15 Waste collection boat in Bangkok

3.3.4 Waste management process

The document published on the website of the Bangkok Environment Office reported the current waste disposal in Bangkok as follows:

3.3.4.1 General solid waste

1) Onnut Waste Disposal Center has two methods of waste disposal. Waste that is transported to Onnut transfer station will be compressed and wrapped in plastic then are transported to hygienic landfill in Chachoengsao province. Onnut waste disposal center can handle waste to landfill not less than 1,800 tons / day. Garbage will be processed through composting to produce organic fertilizer. Then the remaining will be buried in a hygienic landfill. Onnut waste disposal center has the capacity to compost waste no more than 1,200 tons per day.

2) Nong Khaem Waste Disposal Center. Nong Khaem can receive waste to landfill not less than 2,000 tons per day. Waste will be transferred to be landfilled in Nakhon Pathom province.

3) Sai Mai Waste Disposal Center (Tha Raeng). Sai mai can receive waste to landfill not less than 2,000 tons per day. Waste will be transferred to be landfilled in Nakhon Pathom province.

3.3.4.2 Infectious waste

1) At present, there is an infectious waste that can be collected at an average of 18 tons per day, which Bangkok has hired Bangkok

Thanakom to collect and dispose of infectious waste by burning in incineration plant 15 tons per day divided in 2 times a day.

3.3.4.3 Hazardous waste

1) Bangkok has encouraged people to separate dangerous waste from general waste. Bangkok Metropolis collects an average of 141.45 kilograms of hazardous waste per day and collects it at a temporary storage at On-Nut Waste Nong Khaem and Sai Mai waste disposal center in order to gather enough quantity, then hires a private waste disposal company to dispose hazardous waste with a specific method.

Figure 3-16 Waste Disposal Center in Bangkok

3.3.5 Constraint of Waste Management Project in Thailand

In recent years, the government has carried out various waste disposal projects, such as the construction of waste power plants, waste separation plants, and the construction of landfill sites, but the communities nearby the area of the project protested against waste disposal project almost every day. The government must therefore stop or revise a plan. From news reports, villagers stated that the cause of the protests was largely due to concerns about the impact on the community, including smells, dust, air pollution, water pollution, flies, even the impact on their livelihood. The selection of waste disposal sites is based on academic principles and must comply with the Town Planning Act, such as the distance from houses, water sources, historical sites or airports to prevent the impact on the community and the environment. In addition, the project owner must use trustworthy and scientific

information to answer people's concerns. Back in 1977-1987, it was the first time that the government organized budget for sanitary landfill sites in all 4 major regions. Although there were some opposition from the community, but the government can clarify various concerns of people. At that time, there were not many obstacles in the project because landfill area was far from the community and the amount of waste that has been landfilled was still small. On the other hand, the city is expanding rapidly. The amount of waste has increased at the same time, but the landfill area has decreased and located closer to the community. This is one reason that the construction of the future waste disposal plants began to experience more opposition along with the failure to manage the local landfill system. In addition, the cause of the protest comes from the failure of the government in communication with the community. The local government avoids communicating with the community since they have been receiving negative feedback. Therefore, the abolition of the EIA report for the project that must get the community involved is considered by the government.

After the government raised the problem of waste into national agenda and announced the Waste and Hazardous Waste Management Roadmap in August 2014, Code of Practice (CoP) was used instead of the EIA report, also known as EIA for waste incinerator or waste power plant project without involvement of community and public hearing. January 2016, the government has exempted from enforcing the Town Planning Act for the incinerator project or the waste power plant to reinforce the CoP's rules regarding the project location. Under the CoP rules, waste management plant can be set up anywhere except five areas which are basin level 1 and 2, environmental protection area, conservation forest area and wetland of an international importance. This means that from now on, incinerators or waste power plants can be set up even in the community area, area near the water resource for agriculture or even water sources for tap water production. CoP's guidelines seem to be good for the private sector wishing to invest in waste power plant projects in accordance with the guidelines for encouraging the private sector to participate in the investment and management of the waste management roadmap. On the other hand, the community is not allowed to participate in environmental assessment or monitor the project.

After the exemption of Town Planning Act for waste power plant and waste disposal center, environmental impacts on many communities throughout the country are more severe. After issuing the said order, the number of factories type 105 (The factory engages in the business of segregation or landfill) and 106 (The factory engages in the business of using unused industrial products or waste from the factory to produce new raw materials or products through industrial production processes) is significantly higher. There is also a Factory Act (No. 2) B.E. 2562, which causes many factories to not be under the supervision of the Factory Act, especially the waste separation factory and waste recycling plants. They are now subjected to Local Ordinances or under the Public Health Act B.E. 2535 instead. Such activities may cause environmental impacts. There is a high risk of health and severe effects on nearby communities.

Figure 3-17 Illegal landfill in Thailand

Figure 3-18 Opposition group against waste incineration plants

CHAPTER 4
GUIDELINES FOR MANAGING AND RAISING THE AWARENESS OF URBAN PEOPLE IN WASTE SEPARATION IN THAILAND

This chapter is an analysis and comparison of waste management in Japan, Singapore and Thailand, which the researcher has reviewed in chapter above as well as summarizing the management guidelines for municipal solid waste management and the method to raise awareness about urban waste separation.

4.1 Comparative Analysis

Analysis and comparison of waste management in Japan, Singapore, and Thailand.

4.1.1 Waste Reduction and Separation

From the study of waste reduction and separation, the researcher found that waste separation in Japan requires deep understanding in sorting each type of waste into different Japan emphasizes the separation of within people's home before disposing at the garbage collection points provided by the government. If the garbage is left in the wrong day or wrong time, the garbage collection truck will refuse to collect that waste. Singapore focus on separating household waste together with the use of the 3R policy (reduce, reuse, recycle). When examining the reduction and separation of waste in Thailand, the researcher found that Thais do not separate household waste. Moreover, the government does not provide a clear information on collection policy and schedule. The collector also dumps the garbage into the same truck without separation. As a result, people do not see the need of separating household waste as well. In summary, prototype countries promote household waste reduction as it is a major place of waste generation. In addition, the government agency in prototype counties provides information on waste separation and communicate with the residents closely to create a social norm of waste separation within the country.

4.1.2 Waste Disposal Site

From the study of waste disposal site, Japanese government arranges many disposal points and different types of bin at the same place to encourage people to separate waste immediately. Some littering sites have nets or fences to prevent animals from digging into the garbage and destroy the scenery and cleanliness of the road. In Singapore, the residents will bring the garbage out according to the collection schedule of the municipality. Recyclable waste that does not contain food must be washed and disposed at the recycling bin provided by the municipality. In Thailand, the researcher found that Thais dispose the household garbage in their own waste bins in front of their house. Public bins are provided by the local municipality dividing into four types which are wet waste bin, general waste bin, hazardous waste bin and recycling bin. However, there remains illegal dumping all over Thailand.

In summary, prototype countries have set appropriate disposal site separated by type of waste and dispose the garbage into the right bin or right place is everyone's responsibility, while Thailand still lacks adequate waste management plan including no law enforcement or fiscal incentive on waste management.

4.1.3 Waste Collection

From the study of waste collection, the researcher found that in Japan the government provides waste collection schedule for every household as well as a guidebook for waste disposal. There is flexibility date and time for waste collection depending on weather and the trend of local waste, but if there will be any time schedule change, the municipality will inform the residents in advance. Household waste collection in Japan is free of charge unless it is a specific garbage that the residents must make the appointment for pick up, such as an oversized garbage. In Singapore, all garbage trucks are hired by the government to collect waste by following the schedule that each municipality provided. The collectors collect waste every day or every other day according to the type waste. The schedule can be divided into 1. General waste and food waste are collected every day 2. Recyclable waste is collected only on Sundays and 3. Hazardous waste is collected every 1st and 15th of the month. Lastly in Thailand, the municipality arranges the collection of household waste to collect waste every day depending on the areas. There is hardly waste separation before

waste is disposed in the garbage collection truck. There is no fix schedule for waste collection. Therefore, people put every type of waste in the same bin and wait for the collector to collect the garbage away.

In summary, prototype countries have a clear schedule of waste collection. People are responsible to take the right type of garbage out by the time and date given in advance otherwise waste collector will refuse to collect their waste. On the other hand, the municipality has never informed people regarding waste collection schedule. Most of the time people in each area know date and time of collection by observing by themselves. However, the main problem is Thais do not separate waste. As a result, there are little amount of waste that can be reused or recycled due to the dirt.

4.1.4 Waste Disposal and Separation Center

Regarding waste disposal and separation stations in Japan and Singapore, the researcher found that there are separation of wet waste, recyclable waste, and dangerous waste. Also, the manufacturer, importer and industrial sector are responsible to separate waste from their source before waste has been transferred to disposal and separation center. In Thailand, the researcher found that there are many illegal dumping sites remaining all over country especially outside Bangkok or urban areas. It was found that electronic waste was not disposed properly.

4.1.5 Final Procedure of Waste Disposal

From the study of waste disposal procedure, the researcher found that only twenty percent of waste go to landfill, twenty percent are eliminated at incineration plant and the remaining sixty percent are recyclable waste by turning waste into fertilizer and energy. Japan focuses on transforming waste into electricity for the country by burning waste. Ashes from burning will be taken to landfill. According to limited land, Japan fill the ocean with waste to build a new solid land from waste. Singapore focuses on reducing waste and increasing recycling as much as possible. With waste that cannot be recycled, it will be burnt at the waste disposal plant turning into energy for the country. Ashes will be taken to landfill becoming a new land named Semakau Island which is a new learning and ecological center of Singapore. It can be stated that Thailand has less use of waste compared to all three prototype countries.

Due to the high contaminated waste being disposed since there is no waste separation within household, the country does not benefit from waste.

4.2 Guidelines for Managing Waste Separation in Thailand

From reviewing management guidelines of urban people in waste separation found that effective waste management practices require systemic management, from household waste reduction to final waste disposal. There must be a campaign for public education, including for stakeholders who are involved in waste management procedure. The management guidelines for waste separation should be divided into two main parts which are policy guidelines and action guidelines. Each part has following details.

4.2.1 **Policy Strategies**

Thailand should set a long-term waste management program and build waste disposal center that is designed and constructed with appropriate technology. Waste disposal center requires systems and measures to prevent environmental impacts that affect people and ecosystem. It must also be able to handle the large amount of waste coming from different communities. This method will help reduce waste management problems for each community in long-term.

4.2.1.1 Issue the policy on controlling of solid waste production.

4.2.1.2 Support the budget for local municipality to plan integrated waste management system from separation, collection, transportation, recycling, and disposal in accordance with sanitary waste management.

4.2.1.3 Promote and support local administrative organizations to cooperate in waste management by focusing on the establishment of a community waste disposal center.

4.2.1.4 Enforce waste management law and regulations for stakeholders to follow. Also, the government should set penalty and incentive to enforce waste management regulations.

4.1.2.5 Promote investment between government and private sectors in Waste disposal and waste utilization

4.1.2.6 Supporting the private sector in conducting waste management business

4.1.2.7 Cultivate correct attitude to youth by providing education raising awareness towards the importance of adequate waste management as well as allowing everyone to participate in waste management campaign to set a social norm.

4.1.2.8 Organize training program for government officers and stakeholders to increase knowledge about sanitary waste management system and sustainability solid waste management.

4.1.2.9 Support the researcher to develop appropriate technology for systematic waste management.

4.3 Implementation Strategies

Emphasize waste management plan with the highest efficiency that can reduce amount of waste and government expenditure on waste management at the same time. Moreover, the implementation project should aim for achieving 3R policy (reduce, reuse, recycle) and aim for the maximum benefit from waste such as transforming waste to energy or repurposing waste to a brand-new product. The following implementation guidelines should be followed.

4.3.1 The management system must be effective from the upstream to downstream (source reduction, collection, disposal). For example, placing the garbage bin in the public areas where everyone can access to as well as assuring that the condition of the bin is well maintained. The government agency should set a clear schedule of when and which type of garbage will be collected. Moreover, the government need to find the solution to stop illegal landfill and working with urban planner to plan land use for sustainable waste management.

4.3.2 Create a campaign to educate the public about waste production and reduction. This campaign needs to promote public participation as well.

4.3.2.1 Reduce packaging waste by using refilled products

4.3.2.2 Choose quality products with less packaging.

4.3.2.3 Reduce the use of hard disposal materials such as foam containing food and plastic bags.

4.3.2.4 Enforce the policy for manufacturer and importer to produce the product with less plastic packaging or multilayered packaging.

4.3.2.5 Enforce the policy for manufacturer and importer to manage waste especially toxic waste from their factory.

1) Establish a recycling system within each community.

2) Promote incentive and penalty on solid waste management both for public and business sectors.

4.4 Guidelines for Raising Awareness Among Urban Residents

Raising public awareness of waste separation can be considered as one of the factors that are important for solving the large number of waste problems. However, a concrete and longterm planning on building awareness is required for everyone in the society to continuously participate in solving waste problem. The campaign should start from individuals, family and community level and the government agency should monitor the performance and collect waste data during the campaign.

In this regard, guidelines for building awareness of waste separation should be implemented as follows:

1) Campaign to raise public awareness in separating waste with emphasis on understanding the 3R theory which are reduce, reuse, recycle.

2) The arrangement of waste container to accommodate various locations especially community, urban and attraction areas to create habits and adjust the behavior of hygienically littering and separating waste.

3) The management of the relevant departments must be efficient and strict. The government must focus on national wide campaign for proper waste separation. The relevant parties should set public relation about proper waste separation everywhere especially close to the littering areas.

4) Establish strict legal measures or policies to enforce public cooperation in waste management.

CHAPTER 5

CONCLUSION AND RECOMMENDATIONS

In this study, the researcher followed four objectives below.

1. To study guidelines and appropriate measures for waste sorting management in Thailand including study problems and obstacles in the development of a sustainable waste management system.

2. To study urban thinking and behavior in recognizing the importance of waste separation.

3. To study methods for building urban consciousness regarding waste separation.

4. To propose guidelines and methods of waste management that are appropriate for Thai society context and raising awareness of urban people in waste separation in Bangkok.

The main data source used in this research consists of documents related to waste separation and management, previous research publication and the official data report from the government website. The researcher focuses on studying holistic waste management system from source reduction at household until final waste disposal from three prototype countries that have systematic waste management such as Japan and Singapore. The result of this study aims to find suitable waste management methods to propose a model and guideline for appropriate waste sorting management for different contexts in Thai society. The research results can be summarized as follows.

5.1 Guidelines and measures for waste management in Japan and Singapore, and Thailand.

5.1.1 Waste Reduction and Separation

5.1.1.1 Japan and Singapore focuses on source reduction or household waste management. They will also clean the packaging that can be recycled before disposal. As a result, there are less contaminated waste and higher rate of recycling.

5.1.1.2 Japan and Singapore has public relations and educational campaign to educate consistent information on appropriate waste management methods. The campaign allows people and stakeholders fully understand their responsibility on waste management and take waste separation method seriously in their daily life.

5.1.2 Waste Disposal Site

5.1.2.1 The government of Japan and Singapore has set disposal sites and garbage bin classified by type of waste that are various. Manufacturer and importer are all responsible for strictly waste separation and assure that waste from the factory are reused as much as possible while Thailand does not enforce waste management law although there has been law and policy.

5.1.2.2 Disposal sites and garbage bin are more diverse than in Thailand.

5.1.3 Garbage Collection

5.1.3.1 Japan and Singapore waste collector collects household waste on a predetermined date and time according to the type of waste.

5.1.3.2 The amount of waste in Bangkok is increasing every year without systematic waste collection.

5.1.4 Waste Storage and Separation Center

5.1.4.1 The prototype countries have a storage and separation station to support waste disposal service from many communities.

5.1.4.2 Due to household waste separation, waste in prototype countries have a higher quality to be reused and recycled than the waste in Bangkok.

5.1.5 Waste Disposal

5.1.5.1 Thailand get less benefit from waste compared to prototype countries due to high contamination. Waste has not been cleaned and separated before dispose. Most of this solid waste is used for energy production or composted to be fertilizer, but still has a small proportion when compared to the total waste in Thailand.

5.1.6 Law / Policy

5.1.6.1 Prototype countries utilize law enforcement with producers, distributors and importers responsible for the disposal of waste from their end or reuse the packaging as much as possible.

5.1.6.2 In prototype countries, waste separation is everyone's responsibility and people follow waste management policy in their daily life as the government provides good condition waste infrastructure for the city.

5.2 Behavior and Awareness of Bangkok People in Waste Separation

There is a minority group of the residents in Bangkok who separate their household garbage. Most people are not cooperative and do not realize the importance of waste separation.

Solid waste management of Bangkok is not as efficient as it should be There are not enough littering locations and separation points. Garbage collection, waste collection and separation center are inefficient. People are clearly not aware of the government's waste disposal procedure, causing the people to have no motivation or see the importance of waste separation. Finally, the Thai government does not enforce the law and the policy on waste management seriously. There are no strict penalties for violators of waste management laws. Sustainable waste management measures require serious government support. People believe that if they separate garbage from their households, however, the garbage collector will collect it together in the same truck anyway. Therefore, people do not realize the importance of separating household waste. Building awareness in separating household waste requires a continuous campaign to motivate and change people behavior. The community sees waste separation and management problem smaller than solving income problems. Most people are not affected by waste on daily basis.

From the study, it can be concluded that the prototype countries which are Japan and Singapore have been effective in separating waste at the households' source, which is different from Thailand. By communicating and providing knowledge that is clear and consistent with appropriate waste management methods, it will enable habit and motivation in waste separation.

The determination of wet waste, general waste, and recyclable waste can be confusing and therefore not suitable for Bangkok society, or it can be said that the inefficiency in the past was partly due to the determination of the classification of waste that was confusing and ambiguous. Related government agencies must create a guideline to explain how to categorize each type of waste so that people can have reference and clear example to practice waste separation.

However, an effective campaign for waste management must consist of several factors. If the campaign does not fit into the context of the society, it is difficult to achieve sustainability. From the study of solid waste management of the prototype countries, the government has developed a waste management guideline book for each household. This guideline covers procedure of waste management, from the source reduction to the waste disposal. Date and time of waste collection is clearly defined when the garbage truck will pick up the garbage and what kind of waste will be collected. As a result, the prototype countries can reuse and recycle more waste than Thailand.

In addition, prototype countries have a law requiring manufacturers, sellers and importers to be responsible for the waste generated and to recycle as much as possible. Waste that cannot be used or that are hazardous waste are required for sanitary disposal. However, applying this law will incur additional costs for waste management, which can make the product cost more expensive unless the manufacturer recycles waste and cost is lower than producing the new material.

Hygiene issues in the recycling of waste is an issue that Thailand should be concerned about and establish hygienic waste separation measures to prevent chemical contamination with recyclable waste. In the prototype country, waste is cleaned up before it is thrown into the recycling bin to reduce contamination. While some Thai people has been focusing on destroying waste at its source so that it cannot be recycled. Some people are afraid of manufacturers to recycle or reuse waste especially glass bottle as they are not confident in waste cleaning process waste before reusing. Therefore, sanitation management is another important factor to define the direction of waste management in Thailand, whether that type of waste can be recycled how it can be safely recycled.

Waste power plants in Thailand with technology and standard systems to generate electricity, waste and steam, similar to a waste disposal facility in Singapore, but what different is the way of thinking about the economic principles of waste management and business structure to generate electricity from waste (Matichon Online, 2018). As a rule of thumb around the world, waste producers pay for the treatment. Unlike in Thailand, waste disposal plants have to buy waste to generate electricity. Thus resulting in high cost of production waste affects the cost of electricity because Thai people think that waste is more valuable to reduce waste and produce electricity sustainably. Thais need to adjust their perspectives and attitudes about their duties, responsibilities, and expenses for proper waste disposal. Campaigning for Thais to reduce waste production is important and urgent. Thailand should adopt a popular universal waste management concept, 4R, starting with reducing waste from origin, reuse, recycle, followed by recovery or converting to fuel and electricity and ending at landfill for sustainable waste disposal according to international principles.

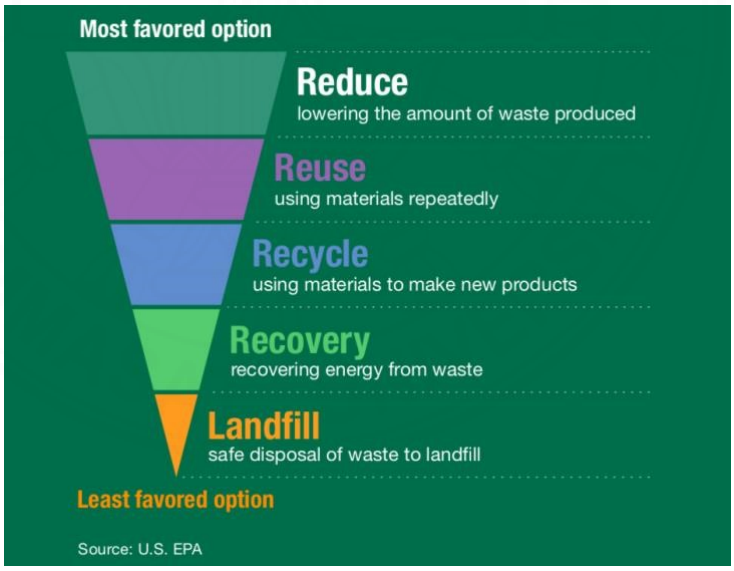

Figure 5-1 4R theory

5.3 Recommendation

This research resulted in creating an approach and a model for raising urban awareness in sanitary waste separation and management as well as being able to develop a strategy to develop adequate urban waste management in Thailand. The results of this research presented the following recommendations:

5.3.1 Policy Recommendations

5.3.1.1 There should be laws, regulations, and appropriate measures for each society, especially those that are consistent with the intention and goal of sustainability waste management in the entire system. For example, starting from the strictly control source reduction to the sanitary waste disposal.

5.3.1.2 The government should adopt tax measures as incentive or penalty to enforce producers, distributors and importers to take part in responsibility for waste management and disposal as much as possible.

5.3.1.3 The government should decentralize local municipalities to be responsible for budget management and personnel training to gain more responsibility in the waste management process. In addition, local government must initiate a waste management project that is suitable for their community.

5.3.1.4 The government must support and believe in capability of community regarding waste management. Nowadays, the community can play a significant role in the development of its own community, it is beneficial to manage community-based waste management. Even though the implementation of this approach must encounter with many problems and obstacles, but the government must have confidence that communities can work together to resolve problems within the community with mutual generosity. The government, however, must provide support the community and monitor their performance.

5.3.2 Operational Recommendations

5.3.2.1 Campaigns or raising awareness of waste separation in Bangkok or urban communities may receive more cooperation than in the past. This is because government or related agencies can use technology and media to

promote solid waste management projects and people from more access to information. The government must create interactive activities under the term of an integrated waste management for each community, that may face different solid waste problems, to participate in waste management program. The local administration must take concrete actions to be able to raise awareness of people.

5.3.2.2 The government should provide garbage bins in accessible location and in high population area as well as monitor and maintain the condition of the bin regularly.

5.3.2.3 The government should provide guideline to each household on how to separate waste correctly. The guideline must include waste characteristic that is belong to each category. It is not enough to categorize waste into only wet waste, recyclable waste, or toxic waste without explaining which type of waste falls into those categories. Moreover, waste collection schedule should be identified and distributed to everyone.

5.3.2.4 The government should divide garbage collection truck into different colours in consistent with type of waste. Collection truck and garbage collection boat should be sufficient balancing with the areas and number of wastes. The collector must collect household waste by type on date and time specified in advance only otherwise the collector must refuse to collect those waste. However, the government, local municipality governor and related agencies must inform and educate people regarding waste separation within their household until this behavior becomes norm.

5.3.2.5 The government should establish a waste disposal and disposal station to meet the amount of waste generated by incorporating current technology that is suitable with the context of the area and community. Government should strictly follow the Town Planning Act when planning waste disposal projects so that they do not affect people and the environment in the future. In addition, the government must conduct public hearings every time when establishing a solid waste disposal project. Staff must be sent to the area to educate and inform the community the facts and benefits of the project on a regular basis to prevent an opposition. People must be involved in the preparation of the project plan and be able

to review the project plan including monitor waste management procedure once the project has been established.

5.3.2.6 The government must strictly use tax measures as incentive or penalty to enforce producers, distributors, and importers to take part in responsibility for waste management and waste disposal. Moreover, this measure must be used with everybody in any level without exception. In addition, from tax measure, the government should consider using Volume Based Waste Fee system known as "pay-as- you-throw" for municipal solid waste.

5.4 Suggestions for Future Research

This study is a comparative study that led to execution. On the other hand, from the study, it was found that the research on raising public awareness on separation of solid waste in Thailand has never been focused on enough. Therefore, the researcher recommends that more research in this area should be done in order to bring the acquired knowledge to improve solid waste management in Thailand.

It was found that foreign countries have developed a model and method for long-term and sustainable waste management. Government and private sectors representatives often visit foreign waste management plant, especially in Japan, but those who are involved with Thai waste management system have not brought foreign management guidelines to improve Thai system well enough. Therefore, the researcher recommends the agencies or those responsible for the entire waste management system to thoughtfully study waste separation process and build awareness in waste separation in order to come to a conclusion that is suitable for Thai social context and can be used effectively.

From this study, it was found that the implementation of a sustainable solid waste management project in Thailand has many obstacles, such as opposition to a solid waste disposal plant project or a landfill near the community. Therefore, the reasons of protest and the opinion of the community towards waste management plant needs to be studied in order to analyze the results of the study and develop a solid waste disposal project that meets the needs of nearby communities. In addition, the

government can use the data from this research to understand the community's thought on waste management plant close to their area and how to plan the project that benefits every party and environment in long-term.

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