CHAPTER-4

COMPARATIVE STUDY OF WASTE MANAGEMENT LAWS

4.1 INTRODUCTION

Emergent urbanization and changes in the pattern of life, give rise to generation of increasing quantities of wastes and it’s now becoming another threat to our already degraded environment. However, in recent years, many programs were undertaken for the control of urbanization gift in the world because the dumping of industrial wastage without proper treatment, responsible for the lowering of a soil fertility, which increases the amassing of essential and non essential trace metals in the plants. On the other hand domestic waste management in a soil and aquatic resources are also accountable for the reduced field productivity. At this time the world is now facing an extreme situation of waste management from both the side i-e from industrialization and municipal waste management especially in a under developing countries. Current paces of urbanization, consumerist societies and waste generation have challenged global sustainability in many ways. With the unplanned urbanizations and rapid growth of middle class families with changing lifestyles, most of the countries are facing an enormous challenge of managing urban waste. Predictions on global waste generation levels are presented in figure 2 below:

Fig. 2 Predictions of global waste generation levels

1 www.intechopen.com/download/pdf/18480 visited on 21-4-2012
A study conducted by the World Bank, reveals that urban areas in Asia generate about 760,000 tonnes of Municipal Solid Waste (MSW) or approximately 2.7 million m³ per day; and in 2025 it is expected to reach 1.8 million tonnes of waste or 5.2 million m³ of waste per day.² According to Center for Science and Environment, India’s “Down To Earth”, urban India produces 120,000 tons of MSW each day.³ Population growth along with the rapid urbanization and industrialization has created great pressure on the limited natural resources. Sustainable use and management of natural resources, therefore, have become the focus of national concern. The Ecological Footprint of the Asia-Pacific region has risen by more than 130% since 1961, now requiring 1.3 global hectares of biologically productive area per person.⁴

In the past, managing solid waste was simply transporting waste to distant places for dumping. Only a fraction of waste was properly collected and transported. Sometimes they were burnt to reduce the volume, minimize attraction of animals and vermin and to retrieve recyclable items. However, these practices are being challenged due to the increasing value of land, inadequate space, and the limited carrying capacity of the environment, ultimately posing a threat to human health. Many countries in the world have been facing looming waste crises with unsuitable technology and lack of manpower to effectively treat the generated waste. Although some governments have recently formulated and incorporated measures and cleaner production options to tackle the waste crisis, most of these have been implemented only in the national capital cities.

4.2 INTERNATIONAL DIFFERENCES OF SOLID WASTE CHARACTERISTICS

4.2.1 Waste Characteristics

The impact of waste characteristics⁵ (both quantities and composition) on the design and selection of waste collection equipment is one of the major themes of this document. The importance of this cannot be overestimated. Some of the reasons why waste characteristics vary so much are listed here:

4.2.1.1 Cooking and Eating Habits

In some countries the shops sell mostly food that has largely been prepared, either frozen or canned. In other countries and in smaller communities, poultry is purchased alive and vegetables are bought with considerable extra material in addition to the part that is consumed (maize is a good example). If fruit and vegetables are cheap and plentiful, and often damaged when being transported, large amounts may be discarded. Different types of fruit and vegetables generate different amounts of waste – compare bananas and watermelons for example. Where significant amounts of fish are consumed, the waste quickly acquires a very strong smell. Cooking (and heating) with solid fuel has a major impact on the waste, because paper, which would otherwise be discarded, may be burned, and hot and abrasive ashes affect the characteristics of the waste, as well as damaging plastic containers and starting fires.

4.2.1.2 Difference in Lifestyles

Differences in lifestyle can be big, even within one city. This not only affects the type and amount of kitchen waste that is generated, but also the amount of paper (because of higher literacy and the purchase of newspapers and magazines). More affluent citizens are more likely to discard durable items (such as used clothing and electrical equipment) as they become obsolete, instead of repairing them. Some high-income houses may be equipped with garbage grinders for sending their food waste into the sewerage system. The use of domestic servants can also have an impact on the type of waste that is generated.6

4.2.1.3 Recycling and Reuse

In some towns much of the waste is fed to livestock and poultry. Food and drinks containers may be reused for household purposes. Certain items may be segregated from the waste and sold. Waste pickers may sort through wastes, taking out what they can use or sell. Such practices can have a major influence on the waste that is put out for collection.7

4.2.1.4 Architecture

In cities where the housing is constructed mainly of mud brick and the floors and courtyards are not paved, there are large quantities of soil and dust in the waste.

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6 Ibid.
7 Id. at p. 16.
Sweeping of unpaved roads also increases the amount of soil in the waste. The lack of adequate toilets may increase the amount of excreta in the waste.

4.2.1.5 Climate and Geography

Heavy rainfall increases the moisture content of solid waste stored in the open. In tropical climates large amounts of vegetation can be expected in the waste, and seasonal climates may result in huge piles of leaves during certain times of the year. Some cities accumulate large quantities of fine windblown soil. The climate also influences the types and yields of crops, and therefore the food wastes generated by residents, e.g. sugarcane waste in countries where vendors sell cane juice on the streets may result in huge amounts of crushed cane during certain seasons. The characteristics of municipal solid waste are also influenced by the definition of the term. In some situations, construction and demolition debris may be included with domestic and institutional wastes, and this inclusion can have a significant influence on the overall weights and characteristics of the waste that is collected.

4.2.2 Social and Economic Factors

Apart from the nature of the waste, there are other impacts of social and economic factors which must be considered when designing a system.

4.2.2.1 Service Level

The frequency and convenience of the waste collection service that is expected by the population cannot be ignored when planning collection systems. As an illustration, many residents of Cairo expect a daily collection service, the waste being picked up outside the apartment door, even on the tenth floor. In contrast, residents in Switzerland are prepared to carry their waste to a shared container at street level, whereas Cairo residents are reluctant to be seen carrying their wastes. Householders in England are becoming accustomed to having their non-recyclable waste (including kitchen wastes) being collected once every two weeks. The ambient temperature has a strong influence on the length of time that food wastes can be stored and therefore on the frequency at which they should be collected.

4.2.2.2 Labour Costs and Unemployment

Because of high wage levels, industrialised countries have developed capital-intensive technologies for collecting solid waste in order to keep wage bills and total
costs down to the minimum. Low-income countries at the other extreme have large pools of unemployed labourers who are willing to work for very low salaries, and in such cases labour-intensive methods may be appropriate. When this phenomenon is coupled with the problems some developing countries experience in keeping sophisticated vehicles and other machines in good condition, labour-intensive methods become attractive because of their economy and reliability. Managing large teams of labourers in an effective way is quite a challenge.

4.2.2.3 Willingness to Pay

In some cities there is an almost universal conviction that municipal authorities should provide a waste collection service without charging directly for it. Other communities may be accustomed to making their own arrangements for waste collection and paying for this service directly. Any plan to finance a solid waste management system from user charges must take into consideration local attitudes and the existing situation.

4.2.2.4 Attitudes to Littering

Some social groups are very careful to always put all their waste inside the appropriate container, whereas others regard the street as an appropriate place for dumping litter and domestic waste (even though they keep their houses and yards very clean). It is easy to write in a project proposal that a programme of public education will change this attitude, but in practice education alone may not be effective in changing habits.

4.2.2.5 Environmental Awareness

Since the 1960s there has been a gradual process of extending the boundaries of environmental concern, from neighbourhood to nation, and now, with the concern about climate change, to the global level. However, this process is at different stages in different countries and is proceeding at different speeds. Therefore it cannot be assumed that householders will be interested in whether their waste is dumped illegally or taken to an approved disposal site, provided that it is taken out of the immediate neighbourhood. This is often referred to as the “NIMBY” factor (Not In My Back Yard). City officials may show the same lack of concern with regard to the destination of the waste, and may give solid waste management in general a low priority. A low level of environmental awareness among the public may make it difficult to implement
household segregation into two or more waste streams. This lack of awareness is often accompanied by the lack of any effective enforcement mechanism to ensure correct use of waste storage facilities.

All of these factors can have an influence on the success or failure of a waste collection system, and so should be considered when any system is being designed.

4.2.3 Other International Variations that Affect Collection Systems

Ambient temperatures affect the frequency at which waste should be collected. At high temperatures the breeding cycle of houseflies is much faster and so the waste should be collected more frequently to control the numbers of these insects. Higher temperatures also accelerate microbiological processes, leading to quicker generation of offensive odours and earlier production of fungal micro-organisms that can cause lung disorders. As a result, solid wastes should be collected at least twice a week in hot climates, whereas a monthly collection would probably cause no problems in the sub-zero temperatures of a northern winter. Daily collection may be necessary in hot climates where fish are a major part of the diet, since fish wastes quickly generate very offensive odours. The layout of urban areas and road conditions also affect how a waste collection system should be designed.

Traditional core areas of old cities and unplanned slum areas pose a particular problem because of narrow access routes and the lack of space for refuse containers. Steep gradients and unsurfaced roads may prevent certain types of vehicle from being used. Weight limits for roads and bridges must be respected in selecting equipment, keeping in mind that some types of waste collection truck are often overloaded. Wherever there are poorly surfaced roads with inadequate foundations, refuse vehicles with excessive axle loads can be a major factor in damage to water pipes underneath the roads resulting in excessive water wastage, often in countries where water is scarce. The capacities and experience of local administrations should also be considered when planning improvements to waste management systems. In industrialised countries, the evolution of waste collection systems, particularly in terms of management, efficiency and reliability, has taken decades, so it is unrealistic to expect that the same process can be achieved in a low-income country in three months, or even three years. Solid waste management is primarily an engineering function but it is common to find that municipal waste management is the responsibility of the Medical Officer of Health or
some other administrative official who has no background in vehicle operation and cannot be expected to make complex decisions concerning the choice of vehicles of which he or she has no experience.

Access to spare parts is another issue that must be considered. Whereas a maintenance manager in an industrialised country may be able to obtain a spare part within hours of realising that it is needed, in a developing country, the process of acquiring spare parts can take more than six months, because of restrictions on foreign currency, bureaucracy and customs procedures. This issue alone can have a major impact on the type of vehicle that should be selected. The lack of well-equipped maintenance workshops is another aspect to be considered.

Legislation and, more importantly, the enforcement of legislation, have a significant impact on waste management. These factors are closely linked to public attitudes and awareness, and also to the willingness to pay for waste collection services. To be effective, legislation needs to have the general support of the public, being regarded as necessary and appropriate. Inspectors and others involved in enforcing the law should be motivated by the conviction that environmental issues are vital and in the public interest. Penalties should be high enough to motivate compliance and should be administered in an effective way by a judiciary that is convinced of the need to penalize environmental crime. All of these factors vary from place to place, and where there are deficiencies in this aspect, waste collection suffers, in terms of both the usage of containers and the payment of charges. An example is the often-quoted “polluter pays” principle, which states that generators should pay for the removal and disposal of their wastes according to their quantity and the difficulty of disposing of them in a satisfactory way. Although this principle is just and rational, it needs good enforcement or a high degree of universal environmental awareness, otherwise generators of large quantities of waste or difficult wastes simply avoid the charges by dumping their wastes illegally. For this reason the “polluter pays” principle cannot yet be applied effectively in many countries.

4.3 SOLID WASTE MANAGEMENT IN THE WORLD’S CITIES

The UN-Habitat prepared a third Global Report on Water and Sanitation in World’s cities – ‘Solid Waste Management in the World’s cities’ which was launched

At the 5th Urban Forum in Rio on 23rd March, 2010. The report carried out comparative data of solid waste management in low, middle and high income countries. Case studies from 20 cities on six continents provide comparable data to investigate into the topics of waste policy, technology, good and bad practice, management, financing and governance with the focus on processes and sustainability. It reveals a new approach for viewing a solid waste management system. A major constraint in comparing SWM systems in different cities is the lack of consistent global solid waste and recycling system benchmarks – not even the most common indicator, cost per tonne is available in most cities. Some of the important points of reports are referred below.

4.3.1 Integrated Sustainable Waste Management (ISWM) instead of Waste Engineering

The concept of Integrated Sustainable (solid) Waste Management – ISWM distinguishes three dimensions in analysis of solid waste management and recycling systems: technological components, sustainability aspects (social, institutional, political, financial, economic, environmental and technical) and stakeholders (also called actors) present at certain location.

When the current modernisation process started in developed countries in the 1970s, ‘modern waste management’ was largely defined in engineering terms – a technical problem with a technical solution. Gradually, as many city authorities will confirm from their own experience, the world community learnt that no technology can solve the problems related to economic and social sustainability of waste management solutions.⁹

If the costs of day-to-day operations are not recovered, if the citizens are not interested or willing or simply cannot afford to pay, the system will not be able to sustain itself over a longer period of time, regardless of access to grants and loans for capital investments from the central government or international financing agencies. ‘Better’ technology cannot solve this kind of problems.

Benchmarking of waste management services is far from being a straightforward exercise, even within a single small country with uniform regulations, governance system, culture, level of development, and climatic conditions. In order to

make comparison possible among vastly different cities from all over the world, a
diverse combination of 20 cities are listed below:

**TABLE 15: REFERENCE CITIES**

<table>
<thead>
<tr>
<th>City, Country</th>
<th>Population</th>
<th>GDP per capita (USD) (UNDP, 2009)</th>
<th>Human Development Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adelaide, Australia</td>
<td>1,089,728</td>
<td>39,066</td>
<td>0.970</td>
</tr>
<tr>
<td>Rotterdam, Netherlands</td>
<td>582,949</td>
<td>46,750</td>
<td>0.964</td>
</tr>
<tr>
<td>San Francisco, USA</td>
<td>835,364</td>
<td>45,592</td>
<td>0.956</td>
</tr>
<tr>
<td>Tompkins County, USA</td>
<td>101,136</td>
<td>45,592</td>
<td>0.956</td>
</tr>
<tr>
<td>Varna, Bulgaria</td>
<td>313,983</td>
<td>5,163</td>
<td>0.840</td>
</tr>
<tr>
<td>Belo Horizonte, Brazil</td>
<td>2,452,617</td>
<td>6,855</td>
<td>0.813</td>
</tr>
<tr>
<td>Canete, Peru</td>
<td>48,892</td>
<td>3,846</td>
<td>0.806</td>
</tr>
<tr>
<td>Curepipe, Mauritius</td>
<td>83,750</td>
<td>5,383</td>
<td>0.804</td>
</tr>
<tr>
<td>Kunming, China</td>
<td>3,500,000</td>
<td>2,432</td>
<td>0.772</td>
</tr>
<tr>
<td>Sousse, Tunisia</td>
<td>173,047</td>
<td>3,425</td>
<td>0.769</td>
</tr>
<tr>
<td>Quezon City, Philippines</td>
<td>2,861,091</td>
<td>1,639</td>
<td>0.751</td>
</tr>
<tr>
<td>Managua, Nicaragua</td>
<td>1,002,882</td>
<td>1,022</td>
<td>0.699</td>
</tr>
<tr>
<td>Bangaluru, India</td>
<td>7,800,000</td>
<td>1,046</td>
<td>0.612</td>
</tr>
<tr>
<td>Delhi, India</td>
<td>13,850,507</td>
<td>1,046</td>
<td>0.612</td>
</tr>
<tr>
<td>Ghorahi, Nepal</td>
<td>59,156</td>
<td>367</td>
<td>0.553</td>
</tr>
<tr>
<td>Dhaka, Bangladesh</td>
<td>7,000,000</td>
<td>431</td>
<td>0.543</td>
</tr>
<tr>
<td>City</td>
<td>Population</td>
<td>Population</td>
<td>Density</td>
</tr>
<tr>
<td>--------------</td>
<td>------------</td>
<td>------------</td>
<td>---------</td>
</tr>
<tr>
<td>Nairobi, Kenya</td>
<td>4,000,000</td>
<td>645</td>
<td>0.541</td>
</tr>
<tr>
<td>Moshi, Tanzania</td>
<td>183,520</td>
<td>400</td>
<td>0.530</td>
</tr>
<tr>
<td>Lusaka, Zambia</td>
<td>1,500,000</td>
<td>953</td>
<td>0.481</td>
</tr>
<tr>
<td>Bamako, Mali</td>
<td>1,809,106</td>
<td>556</td>
<td>0.371</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td><strong>2,462,386</strong></td>
<td><strong>10,610</strong></td>
<td><strong>0.717</strong></td>
</tr>
<tr>
<td><strong>Median</strong></td>
<td><strong>1,046,305</strong></td>
<td><strong>2036</strong></td>
<td><strong>0.760</strong></td>
</tr>
</tbody>
</table>

Source: UN-Habitat’s Third Global Report on Water and Sanitation in the World’s Cities\(^{10}\) “Solid Waste Management in the World’s Cities”.

### 4.3.2 Components of the Physical System

#### 4.3.2.1 Waste quantities and composition

As one of the first steps in addressing waste management and recycling systems in reference cities, the report defined municipal waste to include: household waste, institutional (office), commercial (shops, markets), small businesses, street cleansing and maintenance of public spaces. In addition to these streams, the report throw light about special healthcare waste, as hospitals and other healthcare facilities are usually situated within cities. While most cities keep records for municipal waste separate from those for industrial waste, the few cities combines information on industrial and commercial municipal waste into one stream, thus making it difficult to compare with other cities.

#### 4.3.2.2 Collection

Waste collection is one of the most visible urban services. The two indicators: waste collection coverage and availability of vehicles and equipment are correlated and found that it is important to enquire about both of them, as the former reflects the interests of system users, while the later is primarily important for service providers.

Cities in high-income countries and former socialist countries such as China and Bulgaria reach a complete 100% coverage. The cities in low-income countries with GDP under 1,000 USD per capita, including Lusaka, Ghorahi, Dhaka, Bamako, Moshi, Moshi, Moshi.

and Nairobi, are still struggling to provide adequate waste collection and street sweeping services to their citizens. In their efforts they are partnering with diverse stakeholders, ranging from the private sector, community based organizations (CBOs), and the informal sector and their associations, with varying success.

Waste management systems in low-income countries have often failed due to use of imported vehicles and equipment (often purchased or donated by donor-funded projects or public private partnerships, PPPs), for which spare parts and servicing facilities are not locally available.

4.3.2.3 Disposal

The findings regarding waste disposal in 20 reference cities in report encompass the entire range of possibilities, including uncontrolled open dumping in Bamako and controlled dumping at officially recognised dumpsites (developed over time and now used in absence of a better alternative) such as Dandora in Nairobi, Pampa Arena in Canete, and La Chureca in Managua. Another possibility, cities such as Quezon City and Dhaka have upgraded their enormous dumpsites, in different contexts and for different reasons. Improvements at Payatas dumpsite of Metro Manila situated in Quezon City, Philippines, are a direct result of policies and actions taken following the collapse of Payatas in 2000, which resulted in the deaths of 300 waste pickers. Upgrading of the Matuail dumpsite of Dhaka was carried out as a part of a long-standing partnership between Dhaka City Corporation (DCC) and Japan International Co-operation Agency (JICA). In Moshi, Tanzania, due to financial constraints, the upgrade level achieved at the new disposal site at Kaloleni is mainly in terms of operation practices – expressed as 3Cs: Confine, Compact, Cover – rather than engineering controls installed. Nonetheless, this is an important step away from indiscriminate open dumping, and towards adequate environmental protection. Other cities have constructed or are in the process of constructing engineered landfills for their needs.

4.3.2.4 Resource Recovery

The highest material recovery rates have been identified in the cities where resource value is the main driver governing current developments in solid waste management. In Bamako, Mali, as in much of West Africa, raw organic waste is sold to grain farmers while partly decomposed organic waste (called fumure) is sold to the
vegetable farmers in the floodplain of the Niger River. In itself, this traditional system of nutrient recovery would constitute a global good practice for others to learn from, were it not for the fact that the waste nowadays contains plastic waste, posing acute health risks to the cows that eat it.

At the other end of the modernisation range, the U.S. cities of San Francisco and Ithaca in Tompkins County, and the Australian city of Adelaide are reaching similarly high recovery rates, in the region of 55 to 70%. This is due to their strong commitment to ‘zero waste’ policies and accompanying schemes for separate collection of organic waste and recyclables, which have in part developed as a way to divert waste from costly disposal at local state-of-the-art landfills. Problems – amounting to a crisis – with severe lack of disposal capacities have accelerated adoption and implementation of Zero Waste Resource Management policies in Quezon City as a part of Metro Manila, the Philippines.

In some of the reference cities resource management is still a completely separate set of activities, institutions, actors and economic relations, and has virtually no relationship to the municipal solid waste system. Kunming, China, is an illustrative example: the existing – thriving – material recycling is a separate system that functions, as any commodity trade does, dependent upon and influential in the global market. In a populous country like China, resources management has always been considered as one of the most important economic activities. Therefore, recycling is under the Ministry of Commerce whereas municipal solid waste management is under the Ministry of Housing and Urban-Rural Development (widely known as the Ministry of Construction).11

4.3.3 Governance

Poor governance is a major reason why cities’ solid waste and other urban systems fail. In examining governance aspects, we focused on inclusivity of users and service providers, financial sustainability, and the strength of the institutional framework.

Inclusivity and equity of service users comprises three distinct elements, namely (a) waste collection coverage, (b) consultation and involvement of users in decision-

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making on policy, planning and siting of facilities, and (c) formal procedures for measuring customer satisfaction and effective feedback mechanisms between service users and service providers. While the citizens in industrialized countries as well as former socialist countries such as China and Bulgaria receive waste collection services irrespective of their social status, waste collection services in mega-cities such as Nairobi, Delhi Horizonte and Quezon City are well on the way to the goal of 100% coverage, thus including slum areas.

### 4.4 SOLID WASTE MANAGEMENT IN ASIA

As urbanization and economic development increases in Asia, nowhere is the impact more obvious than in society’s “detritus,” or solid waste. The urban areas of Asia produce about 760,000 tonnes of municipal solid waste (MSW) per day, or approximately 2.7 million m³ per day. In 2025, this figure will increase to 1.8 million tonnes of waste per day, or 5.2 million m³ per day. These estimates are conservative; the real values are probably more than double this amount. Local governments in Asia currently spend about US $25 billion per year on urban solid waste management.\(^\text{12}\) This amount is used to collect more than 90 percent of the waste in high income countries, between 50 to 80 percent in middle income countries, and only 30 to 60 percent in low income countries.\(^\text{13}\) In 2025, Asian governments should anticipate spending at least double this amount on solid waste management activities.

To carry out integrated solid waste management, local governments need partners. National governments must reduce the externalities of waste by considering measures such as full cost accounting, package deposits, manufacturer responsibility, and extended product care. The general community, which is probably the most important stakeholder in waste management activities, must also actively participate in the solutions by modifying their behavior patterns. For example, they need to exert discipline in separating waste, using containers in a beneficial way, and exercising environmentally friendly purchasing habits.

Figure 3 gives urban MSW generation rates, as a weighted average of the waste data available from various cities.

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13 Ibid.
Low income countries have the lowest percentage of urban populations and the lowest waste generation rates, ranging between 0.4 to 0.9 kg per capita per day. All of the countries that have a GNP per capita less than US $400 produce under 0.7 kg per capita per day. As GNP increases toward the middle income range, the per capita waste generation rates also increase, ranging from 0.5 to 1.1 kg per day.\textsuperscript{14}

\textsuperscript{14} World Bank, World Development Report 1997, Washington, D.C., USA.
Table 16: Urban Municipal Solid Waste (MSW) Generation in Selected Asian Countries

<table>
<thead>
<tr>
<th>Type of income</th>
<th>Country</th>
<th>GNP per capita (US$)</th>
<th>Current urban MSW generation (kg/capita/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-income</td>
<td>Nepal</td>
<td>200</td>
<td>0.50</td>
</tr>
<tr>
<td></td>
<td>Bangladesh</td>
<td>240</td>
<td>0.49</td>
</tr>
<tr>
<td></td>
<td>Myanmar</td>
<td>240</td>
<td>0.45</td>
</tr>
<tr>
<td></td>
<td>Vietnam</td>
<td>240</td>
<td>0.55</td>
</tr>
<tr>
<td></td>
<td>India</td>
<td>340</td>
<td>0.46</td>
</tr>
<tr>
<td></td>
<td>Laos</td>
<td>350</td>
<td>0.69</td>
</tr>
<tr>
<td></td>
<td>China</td>
<td>620</td>
<td>0.79</td>
</tr>
<tr>
<td></td>
<td>Sri Lanka</td>
<td>700</td>
<td>0.89</td>
</tr>
<tr>
<td>Low-income country’s average</td>
<td>490</td>
<td>0.64</td>
<td></td>
</tr>
<tr>
<td>Middle income</td>
<td>Indonesia</td>
<td>980</td>
<td>0.64</td>
</tr>
<tr>
<td></td>
<td>Philippines</td>
<td>1050</td>
<td>0.52</td>
</tr>
<tr>
<td></td>
<td>Thailand</td>
<td>2740</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>Malaysia</td>
<td>3890</td>
<td>0.81</td>
</tr>
<tr>
<td>Middle-income country’s average</td>
<td>1410</td>
<td>0.73</td>
<td></td>
</tr>
<tr>
<td>High-income</td>
<td>Republic of Korea</td>
<td>9700</td>
<td>1.59</td>
</tr>
<tr>
<td></td>
<td>Hong Kong</td>
<td>22990</td>
<td>5.07</td>
</tr>
<tr>
<td></td>
<td>Singapore</td>
<td>26730</td>
<td>1.10</td>
</tr>
<tr>
<td></td>
<td>Japan</td>
<td>39640</td>
<td>1.47</td>
</tr>
<tr>
<td>High-income country’s average</td>
<td>30990</td>
<td>1.64</td>
<td></td>
</tr>
</tbody>
</table>

Source: The World Bank, 1999
As predicted, the high income countries show the greatest generation rates, which vary from 1.1 to 5.07 kg per capita per day. Hong Kong generates enormous quantities of construction and demolition waste, which explains their exceptionally high per capita MSW generation rate in comparison to other countries. Hong Kong’s waste generation rate better reflects the true quantities of waste produced by all activities within the municipality than some of the other countries. Singapore and Japan report significantly higher generation rates than other high and middle income countries.

As mentioned previously, very little information about rural waste generation rates in Asian countries is available; however, one can assume that rural populations will generate less waste because these areas have lower per capita incomes. Urbanization and rising incomes, which lead to more use of resources and therefore more waste, are the two most important trends that factor into rising waste generation rates. Individuals living in Indian urban areas use nearly twice as many resources per capita than those living in a rural setting. Because they consume and generate more solid waste, the Indian urban population is expected to produce far more waste per capita than its rural population. This difference between rural and urban waste generation rates also exists in other Asian countries, such as in Bangladesh, where the rural population generates only 0.15 kg per capita per day, while their urban counterparts generate 0.4 to 0.5 kg per capita per day.15

4.4.1 Waste Composition

Waste composition is also influenced by external factors, such as geographical location, the population’s standard of living, energy source, and weather. The compositions for municipal solid waste are assumed to be based on wet weight. Generally, all low and middle income countries have a high percentage of compostable organic matter in the urban waste stream, ranging from 40 to 85 percent of the total. China and India diverge from this trend because they traditionally use coal as a household fuel source. The ash that is subsequently produced is very dense and tends to dominate the waste stream in terms of weight. Ash is included in the “others” category and makes up 45 and 54 percent of India and China’s waste composition, respectively.

The compostable fraction in high income countries, which ranges between 25 and 45 percent, is significantly lower than for low and middle income countries. The percentage of consumer packaging wastes increases relative to the population’s degree of wealth and urbanization. The presence of paper, plastic, glass, and metal becomes more prevalent in the waste stream of middle and high income countries.

4.4.2 Waste Trends

Waste quantities are inextricably linked to economic activity and resource consumption. Over the next 25 years, poverty in Asia is expected to continue declining (despite recent economic performance). If the pace of capital accumulation and productivity growth continues, then the wages of unskilled workers in all countries and regions are expected to increase substantially. Besides economic growth, Asian countries are also experiencing urban growth rates of approximately 4 percent per year; a trend that is expected to continue for several decades. By 2025, the Asian population is projected to be about 52 percent urban. Cities in developing countries are experiencing unprecedented population growth because they provide, on average, greater economic and social benefits than do rural areas. In fact, rural-to-urban migration is estimated to account for 40 to 60 percent of annual urban population growth in the developing world.

Japan has experienced waste trends comparable to the United States over the past two decades. Waste quantities were rising until 1970, declined temporarily after the 1973 energy crisis, and then rose again slightly. As the economy prospered in the late 1980’s, waste quantities increased sharply.

However, since 1990, generation rates have stabilized due to an economic slow-down and the implementation of waste reduction policies. Historical waste generation patterns of both developed and developing countries, economic trends, and population predictions, and per capita municipal solid waste generation rates and compositions are estimated for Asian countries in 2025.

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16 World Bank, Global Economic Prospects and the Developing Countries, International Economic Department, Washington, D.C. USA
4.5 OVERVIEW OF SOLID WASTE MANAGEMENT REGULATORY FRAMEWORK IN FEW ASIAN COUNTRIES

4.5.1 Republic of China

The Republic of China (RoC), founded on 1 January 1912, is Asia’s first constitutional democratic country. In 1949, due to serious setbacks after a long-running civil war against the Chinese communists, the RoC government was forced to relocate itself to its present place with territorial jurisdiction only over the island of Taiwan and adjacent islets. The history of environment-related legislation in the Republic of China can be divided into three distinct periods: prior to 1980, 1980–90, and 1991 to the present. The maturation of environmental-protection laws during the last decade was coupled with a large increase in manpower and an improvement in enforcement. The net effect pressed the pollution-prone industries to install pollution-control equipment and had a strong positive impact on environmental quality throughout the country. This has placed the RoC’s environmental protection standards on a par with those of the leading industrialized nations. Present laws are expected to bear fruit gradually after the start of the coming decade.

4.5.1.1 National Environmental Regulatory Framework

During the decades of rapid economic expansion, the Republic of China paid scant attention to environmental issues. When problems arose due to rapid industrialization, the government drafted relevant laws and regulations to cope with them. Thus, the early days were characterized by disorder and lack of a purposeful legal framework.20

Prior to 1980, three cornerstones of environmental protection laws—the Air Pollution Control Act, the Water Pollution Control Act, and the Solid Waste Disposal Act—were enacted. Since they were unable to abate multimedia pollution impacts, during the 1980s the above three acts were tightened and revised, and two new acts, the Noise Control Act (1983) and the Toxic Substance Management Act (1986) came into effect.

Things began to change for the better in 1986 when the Executive Yuan set up the Environment Protection Task Force under its jurisdiction and clearly established the

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importance of a sustainable environment. The task force then formulated plans and advised policymakers to achieve “Economic Growth while Protecting the Environment.” It was then superseded in 1987 by the newly established Environmental Protection Administration (EPA) under the Executive Yuan.

Concurrent with the Environmental Impact Assessment Act (1990) came a full-scale review and revision of all current environmental laws and regulations. Since the establishment of the EPA on 22 August 1987, a total of 14 sets of laws have been promulgated. They are listed as follows.

<table>
<thead>
<tr>
<th>Statutes establishing the EPA</th>
<th>Soil and Groundwater Pollution Remediation Act</th>
</tr>
</thead>
<tbody>
<tr>
<td>Environmental Impact Assessment Act</td>
<td>Toxic Substance Management Act</td>
</tr>
<tr>
<td>Air Pollution Control Act</td>
<td>Drinking Water Management Statutes</td>
</tr>
<tr>
<td>Noise Pollution Control Act</td>
<td>Environmental-Dispute Settlement Act</td>
</tr>
<tr>
<td>Water Pollution Control Act</td>
<td>Statutes Concerning EPA Inspection Organizations</td>
</tr>
<tr>
<td>Solid Waste Disposal Act</td>
<td>Statutes Concerning the Training of Environmental Workers</td>
</tr>
<tr>
<td>Marine Pollution Control Act</td>
<td>Environmental Agent Management Act</td>
</tr>
</tbody>
</table>

Later in 2002, the Resource Recycling Act was put into effect.

**4.5.1.2 Overview of Solid-Waste Management in China**

With a dense population and limited land space, the Republic of China faces the environmental burden of growing waste volumes. This has resulted in a very undesirable situation. In earlier times, garbage was mostly disposed of in landfills or by dumping it in open spaces. This created numerous environmental problems. The treatment-capacity shortage of municipal and industrial waste in the late 1990s caused serious illegal dumping problems. As a result, about 160 illegal dumping sites were identified by the local authorities during those years. The government has since effectively addressed the problems of waste treatment and final disposal. The EPA has adopted a strategy favoring incineration as the primary treatment method for municipal solid waste, with landfill as a supplement.
4.5.1.3 National Solid-Waste Management Regulatory Framework

To solve the problems of MSW disposal effectively, in 1984 the Executive Yuan promulgated the Guidelines for the Disposal of Urban Garbage. Several sanitary landfill sites were established based on the guidelines. The first phase focused on setting up standardized sanitary landfill sites, the formulation of a proper definition of garbage disposal, and the improvement of environmental hygiene.21

The Waste Disposal Act and the Resource Recycling Act are the major legislations concerning solid-waste management. Solid waste is classified as either “general waste” or “industrial waste.” Industrial waste is further subdivided into “general (nonhazardous) industrial waste” and “hazardous industrial waste.” These two components of industrial waste are further identified through the Standards for Defining Hazardous Industrial Waste. Concurrently, the EPA has promulgated the Measures for General Waste Recycling and Clearance and the Criteria of Industrial Waste Storage, Removal, and Disposal Facilities to strengthen general and industrial-waste management. For the purpose of conserving natural resources, reducing waste generation, promoting materials recycling and reuse, lessening environmental burden, and building a society of sustainable resource utilization, the Resource Recycling Act was passed on 3 July 2002, as mentioned previously. Since 1997 the EPA has promoted the widespread use of the “Four-in-One Recycling System”.

4.5.1.4 National Strategic Plan for Solid-Waste Management

The EPA announced the Three-year Action Plan for Environmental Protection on 15 March 2004. This three-year action plan contains the following six subplans.

1. Model Environmental Lifestyles Plan
2. Open Information and Full Citizen Participation Plan
3. Environmental-Pollutant Reduction Plan
5. Industrial-Waste Control and Zero-Waste Strategy
6. Environmental-Fate Monitoring Action Plan

Based on the contents of the Review and Prospects of the Garbage Disposal Plan approved by the Executive Yuan on 4 December 2003, the EPA is aggressively promoting the Complete Sorting of Garbage for Zero-Waste Plan. This action plan comprises seven major tasks: (1) garbage sorting, recycling, and reduction, (2) kitchen-waste recycling and reuse, (3) a followup plan for garbage disposal in the Taiwan area, (4) building a new image of municipal solidwaste incineration facilities, (5) promotion of environmental-protection related hi-tech parks, (6) promotion of awareness of new items to be stipulated as mandatory recyclables, and (7) raising the recycling rates of the waste items already regulated as mandatory recyclables.

To further raise the effectiveness of waste disposal and promote the reuse and recycling of resources, the action plan for the Industrial-Waste Control and Zero-Waste Strategy consists of seven focal work areas: (1) promotion of industrial-waste recycling, (2) improvement of the industrial-waste management strategies, (3) completion of the electronic management system for industrial waste, (4) industrial-waste-flow tracking and investigation, (5) promotion of the construction of agricultural-waste treatment facilities, (6) integrated management for incineration ashes from industrial waste, and (7) control of industrial-waste imports and exports.

4.5.1.5 Green Productivity Practices and Other Proactive Measures

4.5.1.5.1 The Four-in-One Recycling System

Since 1997 the EPA has been promoting widespread use of the “4-in-1 Recycling System”. The program for carrying out this system involves four parties: local communities, recycling management organizations, government trash-treatment crews, and the Recycling Foundation of the EPA. The goal is to implement the country’s comprehensive waste minimization and recycling effectively, and to encourage greater public participation.

The manufacturers or importers of the regulated items must register with the EPA, report the amount of items sold or imported, and pay a recycling fee for such items. Recyclable general waste, which is regulated in the 4-in-1 Recycling System, is classified into 15 categories and can be further divided into 32 items, including the following.
<table>
<thead>
<tr>
<th>Paper containers (including aluminum-foil packaging)</th>
<th>Tires</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic containers (PET, PE, PVC, PP, PS)</td>
<td>Lead-acid accumulators</td>
</tr>
<tr>
<td>Ferrous containers</td>
<td>Lubricants</td>
</tr>
<tr>
<td>Aluminum containers</td>
<td>Appliances (TV sets, washing machines, refrigerators, air conditioners, and heaters)</td>
</tr>
<tr>
<td>Glass containers</td>
<td>Computers and peripherals</td>
</tr>
<tr>
<td>Pesticide containers</td>
<td>Dry-cell batteries</td>
</tr>
<tr>
<td>Packaging puff</td>
<td>Fluorescent lights (straight tube only)</td>
</tr>
<tr>
<td>Mobile vehicles (sedans, scooters)</td>
<td></td>
</tr>
</tbody>
</table>

**4.5.1.5.2 Green Mark**

Green consumption has gradually become a world trend, and most developed nations have actively implemented eco-labeling systems. The EPA has promoted the RoC’s eco-label to the public since 1992, as illustrated in Figure 2.6. As of the end of July 2003, Green Mark specifications for 80 product categories had been designated, and 1,859 products have been approved to use the Green Mark. In addition to Green Mark Products, the EPA announced an application for a second category of environmental products and actively encouraged priority procurement of green products by government organizations.

**4.5.1.5.3 The Zero-Waste Plan for General Waste**

In the Zero-Waste Plan, general-waste reduction and resource recycling are two main issues that the EPA is aiming at to replace the waste-disposal management strategies adopted in the past. In order to operate in coordination with the incinerator plants, the EPA will assist local government in the construction of reusable garbage-separation plants, incineration bottom ash reclamation plants, and leachate-and septic-treatment plants.
Two other treatment methods, the recycle and reuse of food residue and garbage and the recycle and reuse of bulky waste, are utilized to separate and classify the reusable waste from general waste and general industrial waste.

4.5.2 Malaysia

Malaysia is a relatively small country by Asian standards, both in terms of size and population. It covers an area of about 329,758 sq km, and has a hot-wet climate due to its location just above the equator in the Southeast Asia. The annual rainfall ranges from 2,500 to 4,000 mm a year. The population of Malaysia (2003 estimate) is about 25 million. The country has experienced rapid urbanization in last few decades. At present, more than half of the population lives in urban areas. However, unlike many developing countries, there is no phenomenon of a primary city. Kuala Lumpur, the capital city, has fewer than 2 million people. Even if the towns surrounding Kuala Lumpur are taken into consideration, metropolitan Kuala Lumpur has less than 4 million people, which is much lower than the population figures of Bangkok, Manila, or Jakarta, not to mention Mumbai, Beijing, or Tokyo.

4.5.2.1 National SWM Regulatory Framework

The management of solid waste in Malaysia is neither carried out under the Environmental Quality Act nor managed by the Department of Environment. It is the responsibility of the local authorities and they operate under the Local Government Act of 1976. Using the provisions of the government act, all local authorities have passed sanitation related by-laws that provide them with the power to regulate solid-waste disposal in their jurisdictions. In addition to general sanitation by-laws, there are other by-laws with waste disposal regulations. For example in the hawkers by-laws, there are provisions on how waste generated through their business is to be stored and disposed of. It is important to note that although there is some similarity in the sanitation by-laws among the local authorities in Malaysia, there are also differences.

4.5.2.2 SWM Situation Analysis

SWM is the responsibility of the 144 local authorities in Malaysia, but there are variations in the way each local authority carries out the implementation. The variation depends on the size of the town. For example, the bigger towns and cities may have

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state-of-the-art compactors to collect waste from door to door and the smaller towns might only use modified open trucks.

The effectiveness of each council also varies. For instance, Kuching, Ipoh, and Kuantan, the capitals of Sarawak, Perak, and Pahang respectively, are generally acknowledged as cleaner than other urban areas in Malaysia. Since it is reasonable to suppose that the behavior of Malaysians is the same everywhere in the country, it appears that the Ipoh, Kuantan, and Kuching authorities are doing a better job than other local councils in the management of solid waste.

Even within a local authority area, the effectiveness of solid-waste management is different depending on the localities. Generally, the richer areas seem to get better service than the poorer ones. However, as a result of numerous complaints about the lack of cleanliness in most urban areas and as part of the trend to privatize these activities, the federal government decided in the mid-1990s that SWM would be managed completely by private companies. In the late 1990s, the government divided the country into four zones and each zone was assigned to a private company who is to manage the solid waste. Since the proposed solid-waste management act that will provide legislative backing for the private companies managing solid waste is tabled in parliament, details about the privatization of solid-waste management are still not clear. However, in the Central and Southern Zones, a temporary system has been implemented.23

4.5.3 Philippines

The Philippines is an archipelago of 7,107 islands. The country is divided into three geographical areas: Luzon, Visayas, and Mindanao. It has 17 regions, 79 provinces, 115 cities, 1,499 municipalities, and 41,969 barangays. The population of the Philippines was 76.5 million as of May 2000. (The estimate for 2004 was 82.7 million.) The Filipino is basically of Malay stock with a sprinkling of Chinese, European, and Arab blood. The population is divided according to geographical locations and each group is recognizable by distinct traits and dialects, of the total population, 56.9% of the people live in urban areas. The literacy percentage of the country is 94.6%. The population growth rate is 2.36%.

### 4.5.3.1 National Environmental Regulatory Framework

The Department of Environment and Natural Resources (DENR) is the principal government agency responsible for maintaining the quality of air, water, and land at levels conducive to health and productive work.\(^{24}\) It is mandated to enforce the following laws.

- The Clean Water Act, Republic Act (R.A.) 9275 for water-quality management and water pollution permits and charges
- The Clean Air Act, Republic Act 8749 for air-pollution control and air-quality management
- The Pollution Control Law, Presidential Decree (PD) 984 for water-pollution control and river classification and monitoring
- The Ecological Solid-Waste Management Act, Republic Act 9003 for garbage and other solid waste
  - The Toxic Substances and Hazardous and Nuclear Waste Control Act, Republic Act 6969 for chemical and hazardous waste
  - The Environmental Impact Assessment System, Presidential Decree 1586 for environmentally critical areas and projects

### 4.5.3.2 National SWM Regulatory Framework

The main legal instrument governing SWM in the country is the Ecological Solid-Waste Management Act of 2000 (R.A. 9003), signed into law by President Gloria Macapagal-Arroyo 26 January 2001. This law declares the adoption of a systematic, comprehensive, and ecological solid-waste management program as a policy of the state. It adopts community-based approaches to SWM and mandates waste diversion through recycling and composting, among others.\(^{25}\)

### 4.5.3.3 SWM Situation Analysis

Based on the national waste-generation data for 2000–10, the National Capital Region, or Metro Manila, has the highest waste generation (23%), almost a quarter of the country’s generated waste as a whole. On the other hand, the Cordillera Region has

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\(^{24}\) Id. at p. 189.

\(^{25}\) Id. at p. 195.
the lowest generation (1.6%). The Table below shows the status of waste generation in the Philippines.

The waste-production rates are: National Capital Region: 0.71 kg/person/day; urban population: 0.5 kg/person/day; rural population: 0.3 kg/person/day. It was assumed that the urban population would increase its waste production rate by 1% per year due to rising income levels. This is attributed to the fact that Metro Manila is a major contributor to the national GDP and therefore has the highest consumption rates, and consequently the highest waste generation. This same trend is expected to continue to the year 2010.

4.5.3.4 Waste Minimization, Reuse, and Recycling Practices:

Paper, scrap metal, and clean glass bottles and cullets have traditionally been segregated, traded, and recycled. Big companies are actively buying these recyclables, for example, M/S. San Miguel Corporation buys clean glass and cullets and M/S. TIPCO buys paper. Both are mostly monopoly buyers of such materials. Several medium-size companies in Luzon and Cebu melt scrap metal. In addition, the NSWMC is expanding the recycling activities with tire manufacturers and intensifying the buying of polyethylene terapthalate (PET) by the PET Task Force and San Miguel Corporation. Likewise, the NSWMC has set up more redemption centers for recyclable materials like aluminum cans, bottles, tetra packs, polypropylene (PPs), batteries, and others. Various shopping malls, groceries stores, schools, and other large establishments are already serving as redemption centers for these materials.

Plastic recycling is one of the most interesting concerns of environmentally conscious people, as plastic is considered a major cause of the worsening garbage problems such as flooding due to clogged canals and street litter because it is not biodegradable.

In the 2001 World Bank Report, an NGO, Linis Ganda (literally, clean is beautiful) organized the Federation of Multi-Purpose Cooperatives. It is an alliance of more than 500 scrap shops that employ Eco-aides to conduct recycling activities. In 2000, they reportedly purchased 101,850 tons of waste paper, corrugated boards, cullets, plastics, and metals worth PHP132.5 million. But this is only about 4.5% of the

26 Urban and Rural Population and growth rates by region are based on National Statistical Office data from 2000.
total waste generated in Metro Manila. Elsewhere in the Philippines, scrap shop operations have grown rapidly, especially in the commercial business districts. Estimates have shown that trade in waste materials has increased in volume by 39% and in value by 47% in 2000 compared to 1998.

4.5.3.5 Incentives and Disincentives for Waste Minimization, Reuse, and Recycling

The World Bank study revealed that LGUs allocate between PHP12 to PHP250 per person for solid-waste management. LGUs allot about 1.2% to 11.7% of their total budget for SWM.

Given the considerable amount needed for the service, LGUs need to look for additional sources for funding. R.A. 9003 specifies that fees shall be levied on all waste generators for SWM services. Fines and penalties are also set for any violations. All revenues from the implementation of the law accrues to SWM funds (both national and local) earmarked to support research and development, provide awards and incentives, provide technical assistance, and conduct training, education, communication, and monitoring activities.

R.A. 9003 offers various incentives for LGUs, enterprises, private entities, and NGOs to encourage their active participation. These include tax and duty exemptions, a tax credit on domestic capital equipment, provisions and grants to LGUs to improve their technical capabilities, and incentives to communities hosting shared treatment and disposal facilities. As an additional support, the Department of Trade and Industry is to prepare an inventory of existing markets for recyclable materials and compost. The ESWM Act also stipulates that procedures, standards, incentives, and strategies should be specified to develop local markets for recyclable materials and compost. The act places restrictions on the use of environmentally nonacceptable packaging materials.

To encourage the participation of the barangays in SWM, the DENR launched the Nationwide Search for the Model Barangay in Eco-Waste Management. More than 500 entries were received in the search which was based on a rating system that determines the degree of compliance with the requirements of R.A. 9003. Cash prizes ranging from PHP100,000 to PHP1,000,000 and presidential trophies were given to the model barangays.
4.5.4  Singapore

Singapore is an island city-state and the smallest country in southeast Asia. Situated between latitudes 109°2 and 1°29 N and longitudes 103°30' 2 E and 104°252 E, the main island of Singapore is about 660 sq km. It measures 43 km from east to west and 23 km from north to south. More than half of the mainland is urban area, while the remaining area is occupied by parkland, reservoirs, and nature reserves. Malaysia, Indonesia, and Brunei are Singapore’s immediate neighbors. Being very close to the equator, Singapore’s climate is characterized by abundant rainfall, relatively uniform temperatures, and high humidity throughout the year. The island is wettest from November to January and driest from May to July.28

4.5.4.1 National Environmental Regulatory Framework

The main role of the ENV was to maintain a high standard of hygiene, provide infrastructure and measures to prevent and control air and water pollution, and to manage hazardous waste and municipal solid waste. In August 2004, ENV was renamed to Ministry of Environment and Water Resources (MEWR) to reflect the synergies between the land, air, and water issues that the Ministry carefully looked after. There are two statutory boards under MEWR:

(1) The Public Utilities Board (PUB) and (2) the National Environment Agency (NEA) formed on 1 July 2002.

MEWR focuses on policy issues, PUB focuses on water-related issues, and NEA’s focus is on ensuring a clean living environment and a high standard of public health in Singapore. The NEA works with industry as coregulatory partners with the aim of achieving responsible care in environmental management. Singapore strives to balance environmental protection and economic development through close collaborative relationships between its environmental agencies and the key economic development and promotion agencies. Close interagency cooperation ensures that the environmental requirements are conveyed to prospective investors in the early stage of planning so that investors can consider them into their economic and technical feasibility studies.

4.5.4.2 National SWM Regulatory Framework

Licensing solid-waste collectors was introduced in 1989 as a means of regulating the waste-collection industry. Under the legislation, it is an offense for any person or company to collect or transport solid waste as a business without a solid-waste collector’s license issued by the NEA. Any person who is found collecting solid waste as a business without the license is liable on conviction to a fine not exceeding SGD10,000 or to imprisonment for a term not exceeding 12 months, or to both.

There are currently three classes of license, namely Class A, B, and C. Each class allows the licensed waste collector to collect respective types of solid waste. A solid-waste collector may apply to hold more than one class of license at any one time. Approval for the license depends on the applicant’s having the proper vehicle and equipment to collect and transport that particular class of waste. Licensed waste collectors are required to comply with: the Environmental Public Health Act, the Environment Public Health (General Waste Collector).

4.5.4.3 Future Strategies: National Strategic Plan for Solid-Waste Management

The main challenge in managing solid waste in Singapore is to minimize another possible “waste explosion” similar to the one the country experienced from the 1970s to 1990s. Waste disposed had increased sixfold from about 1,300 tons per day in 1970 to 7,800 tons per day in 2000. In order to manage this potential problem, Singapore has placed a new emphasis on waste minimization and recycling as a long-term solution to address waste disposal. In 2003, about 47% of the waste was recycled, mainly by the industry and commercial sectors, as their waste is more homogeneous in nature and generated in larger quantity. Singapore has set the following targets to work toward better solid-waste management: (1) raise the overall recycling rate to 60% by 2012, (2) extend the lifespan of Semakau Landfill to 50 years and strive toward “zero landfill,” and (3) reduce the need for building new incineration plants.

Based on the above targets, three strategies were developed to address solid-waste disposal:

(1) reduce waste disposed of at incineration plants, (2) reuse incineration ash to reduce landfilling, and (3) reduce waste disposed of directly at landfills.
4.5.5 Thailand

Thailand is situated in the heart of the southeast Asian mainland, covering an area of 513,115 km². Thailand borders the Lao People’s Democratic Republic and the Union of Myanmar to the north, the Kingdom of Cambodia and the Gulf of Thailand on the east, the Union of Myanmar and the Indian Ocean to the west, and Malaysia to the south. Out of the total area, 511,770 km² is occupied by land and the rest is covered with water. The coastline adds up to 3,219 km. Thailand is divided into four distinct areas: the mountainous north, the fertile central plains, the semi-arid plateau of the northeast, and the southern peninsula, distinguished by its many beautiful tropical beaches and offshore islands.

4.5.5.1 National Solid-Waste Management Regulatory Framework

All municipal waste is managed under the Public Health Act A.E.1992 which gives full responsibility to the local administrations to develop ordinances and regulate solid-waste management systems including collecting fees. Citizens are prohibited from littering or dumping waste at clandestine sites, punishable by penalty of fine.

The Cleanliness and Orderliness of the Country Act A.E.1992 further obliges householders to maintain the cleanliness of their dwellings and prohibits the illegal disposal of solid waste. Also local community ordinances generally specify how householders should store and place their solid waste for collection, prohibit illegal disposal and littering, and establish potential penalties for offenders. The Factory Act A.E.1992 provides a legal basis for the establishment and control of industrial operations including setting and enforcing industrial standards. The import, export, manufacturing, storage, transport, use, and disposal of hazardous substances are controlled according to the Hazardous Substance Act A.E.1992.

Furthermore, the Enhancement and Conservation of the National Environmental Quality Act A.E.1992 empowered local administrations to construct central disposal facilities for public use either by themselves or by licensed private contractors. The Environment Fund was established to disburse grants or loans to government agencies and the private sector for investment in and operation of those central facilities. This act also empowered the Ministry of Science, Technology, and Environment to publish
emission/effluent standards and guidelines/regulations for the control of waste disposal facilities. In addition, the polluter-pays principle (PPP) was also introduced.\textsuperscript{29}

The other laws involving the control, prevention and solution of solid wastes are as follow.

- Canal Maintenance Act B.E.121
- Internal Water Navigation Act B.E.2456 (as amended by the Internal Water Navigation Act, No.14, B.E.2535)
- Civil and Commercial Code
- Royal Irrigation Act B.E.2485
- Fisheries Act B.E.2450
- Criminal Code
- Minerals Act B.E.2510
- Petroleum Act B.E.2514
- National Executive Council Announcement No. 68 (B.E.2515) on the Control of Canal Anchorages
- National Executive Council Announcement No. 286 (B.E.2515) on the Control of Land
- Allocation (including Land Allocation Regulation B.E.2535 dated 17 August 1992 which repealed the Land Allocation Regulation B.E.2530)
- Building Control Act B.E.2522 (including Ministerial Regulation No. 33 (B.E.2535) dated 14 February 1992)
- Bangkok Metropolitan Regulation on Building Construction Control B.E.2522
- Water Supply Canal Maintenance Act B.E.2526
- Highway Act B.E.2535 (which repealed the National Executive Council Announcement No. 295 B.E.2515 on Highways)

Laws involving organizations that have powers and duties to operate garbage collection and disposal activities are vested with the Bangkok Metropolitan Administration, established under the Bangkok Metropolitan Administration Act B.E.2528; the District Municipality, City
4.5.5.2 Future Strategies

The problems of MSW management in large communities like Bangkok and major regional cities have become evident and enhanced in recent years. The steadily growing amount of MSW each year, inadequate provisions of waste collection and disposal equipment and tools, and the inability of the recyclable agencies to find appropriate disposal sites are among the major causes of the problems. Unless they are tackled, more unsanitary disposal sites can be anticipated and consequently, potential risks to humans and the environment are unavoidably aggravated.

It is reported that in 2003, 39,240 tons of waste were generated throughout the country each day, with an annual growth rate of about 6%. While the overall waste-collection service did not fully cover the service area (about 70–80% of the total MSW generated), the uncollected waste coupled with the improper disposal methods have inevitably created health hazards and environmental contamination. The causes for these problems are as follows.

- The allocated budget for MSW management is always meager and the service-fee collection is also ineffective.
- There is no active planning on establishing common disposal facilities among adjacent communities.

4.6 WASTE MANAGEMENT POLICY - DEVELOPED COUNTRIES

4.6.1 European Union

Every year about 2 billion tonnes of waste are produced in the European Union (EU). The wealthier the European Union becomes, the more waste it generates, this is the reason for its ambitious aims to face this problem. The European Union's approach to waste management is based on three principles:

4.6.1.1 Waste prevention

This is a key factor in any waste management strategy and it is closely linked with improving manufacturing methods and influencing consumers to demand greener products and less packaging.

4.6.1.2 Recycling and reuse

The European Commission has defined several specific 'waste streams' for priority attention, the aim being to reduce their overall environmental impact. This includes packaging waste, end-of-life vehicles, batteries, electrical and electronic waste.

4.6.1.3 Improving final disposal and monitoring

The EU has recently approved a directive setting strict guidelines for landfill management. It bans certain types of waste, such as used tires, and sets targets for reducing quantities of biodegradable rubbish. The Union also wants to reduce emissions of dioxins and acid gases such as nitrogen oxides, sulfur dioxides, and hydrogen chlorides, which can be harmful to human health. Each Member State is required to build its own disposal capacities by the establishment of a system of national treatment facilities.

The best solution is for the EU is to prevent the production of such waste, reintroducing it into the product cycle by recycling its components where there are ecologically and economically viable methods of doing so. In this regard, one key principle guiding policy-making process is "Producer Responsibility", in which producers have to take responsibility for their products throughout their complete life cycle.

Some of Waste Management policies are:

- **The Landfill Levy**: This policy was introduced to encourage the diversion of waste away from landfill and generate revenues that can be applied in support of waste minimization and recycling initiatives.

- **The Circular WPPR**: This policy pretends reduce the quantity of biodegradable waste sent to landfill set and helps.

- **The Directive of waste**: This Directive establishes a legal framework for the treatment of waste within the Community. It aims at protecting the environment and human health through the prevention of the harmful effects of waste generation and waste management.

Europe has as a framework for coordinating waste management in the Member States in order to limit the generation of waste and to optimize the organization of waste treatment and disposal.

4.6.2 Germany

Germany is a Federal Republic consisting of sixteen Federal States (Bundesländer). Responsibility for waste management and environmental protection is shared between the national Government, the Federal States and local authorities. The National Ministry of Environment sets priorities, participates in the enactment of laws, oversees strategic planning, information and public relations and defines requirements for waste facilities. Each Federal State adopts its own waste management act containing supplementary regulations to the national law, e.g. concerning regional waste management concepts and rules on requirements for disposal. There is no national waste management planning in Germany. Instead, each Federal State develops a waste management plan for its area (EEA, 2009).

Germany was the first country in the EU to introduce producer responsibility with a packaging waste regulation in 1991. According to this principle, which is a core tenet of German waste legislation, the producer of a product is generally responsible for the product when it becomes waste. However, this principle has been implemented only for some product types such as packaging, waste electric and electronic equipment, vehicles, solvents, waste oil and batteries.

For waste generated by households, the Recycling Management and Waste Act assigns responsibility to the local public waste disposal authorities (in most Federal states these are districts and towns). Their responsibility covers collecting and transporting waste, measures to promote waste prevention and recovery, and planning, constructing and operating waste disposal facilities. Municipalities have more practical tasks such as providing sites for waste collection (EEA, 2009).

4.6.2.1 MSW Indicators

The development of MSW generation per capita in Germany from 2001 to 2010. There has been a decrease from 632 kilogram per capita in 2001 to 564 kilogram

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in 2006. From 2007 to 2009 there has been a minor increase, but the level seems to have been quite constant since 2006.

The total German generation of MSW decreased from 52.1 million tonnes in 2001 to 46.4 million tonnes in 2006. The generation increased to 48.5 million tonnes in 2009 but then decreased from 2009 to 2010 to 47.7 million tonnes.

Germany was among the first European countries to introduce policies to limit landfilling in the 1990s. Measures included schemes for collecting packaging waste, biowaste and waste paper separately. The result of this was that by 2001 Germany already recycled about 48 % of municipal waste, whereas approximately 25 % was landfilled and 22 % was incinerated. In 2010, the level of recycling had increased to 62 %, landfilling was almost 0 % and incineration had increased to 37 %.

4.6.6.2 Landfilling of Biodegradable Municipal Waste

It is a general requirement of the EU Landfill Directive that all Member States have to reduce the amount of biodegradable municipal waste landfilled (BMW) by a certain percentage by 2006, 2009 and 2016. The targets are related to the generated German amount of BMW in 1995 (28.4 million tonnes).

Germany has reported to the Commission that zero tonnes of BMW were landfilled in 2006, 2007, 2008 and 2009. This is due to the fact that Germany introduced a ban on non-pretreated MSW. It was introduced in two steps using three pieces of legislation because the initial statute contained severe loopholes. The first step was an administrative regulation (TASI) in 1993, which limited the organic content in waste going to landfills to less than 3 % total organic carbon (TOC) supplemented by a transition period until 1 June 2005 (EEA, 2009). The second step was two ordinances in 2001 and 2002 that aimed at closing some of the loopholes within the 1993 administrative regulation (EEA, 2009) and setting the following two requirements (ETC/SCP, 2009):36

- Municipal waste after 1 June 2005: max 5 % carbon content in waste direct landfilled;

• Municipal waste, which has been mechanically/biologically pre-treated: max 18%
carbon content and very low content of biodegradable organic carbon in
waste landfilled measured with degradation tests.

With the implementation of the above mentioned initiatives of landfilled BMW and
according to the Landfill Directive, Germany had already fulfilled the 75 %
requirement in 2006, the 50 % requirement in 2009 and the 35 % requirement in 2013.

4.6.2.3 Future Possible Trends

Germany has now had a MSW recycling level higher than 50 % for many years.
Germany will continue fulfilling the EU recycling target of 50 % by 2020, if the
respective recycling trends from the years 2001-2006, 2006-2010 and 2001-2010
continue.

The question is more whether Germany will be in the position to further
increase its recycling level and how much. Germany’s own target from 1999 that all
municipal waste including waste treatment residues will be completely recovered by
2020 is ambitious and it will increase the recycling percentage of MSW. However,
Germany may experience a surplus of incineration capacity in the coming years. This
will imply lower prices on incineration, which may well be the strongest challenge for
increasing recycling of MSW. A first indication of this development is that in the last
two years there has been a very slight decrease of recycling of MSW.

As of from 1 June 2012, the new (KrWG)\(^{37}\), which transposes the Waste
Framework Directive into national law came into force in Germany. From the
beginning of 2015, the new law makes the collection of bio-waste mandatory.

This will have an effect on the running of MBT plants because the
biodegradable material will be redirected from MBTs into fermentation and composting
plants for the production of bio-gas. In the mid and long term it may be possible that
both MBT plants and composting plants will have to be closed.

4.6.3 Australia

Most of the companies in Australia offering waste management are members of
the Waste Management Association of Australia (WMAA). The Biohazard Waste
Industry Australia and New Zealand (BWI) (formerly ANZCWMIG) is one of the

\(^{37}\) Recycling Management Act (RMA)
divisions of the WMAA. Waste management policies also take into consideration OHS legislation, Australian Standards and the requirements of state and territory Environment Protection Authorities. They also have to follow “Extended Producer Responsibility” philosophy.38

4.6.3.1 Principles:

1. Waste management policy should adopt a zero waste goal to conserve natural resources for future generations, avoid the build up of toxic and noxious substances, conserve water and achieve deep cuts in greenhouse gas emissions.39

2. Reducing, reusing and recycling are integral to achieving zero waste.

3. Full social, environmental and economic costs must be taken into account in decisions about creating, managing and disposing of waste.

4. The transportation of hazardous waste must be minimized, and the Australian community must be fully informed about its location, disposal and transportation.40

4.6.3.2 Policies

National Waste Policy: Less waste, more resources which has been described as the most advanced policy in Australia. This policy establishes a comprehensive work program for national coordinated action on waste across six key areas: Reducing hazard and risk, Tailoring solutions, providing the evidence, Taking responsibility, Improving the market, Pursuing sustainability.

National Waste Policy sets the direction for Australia over the next 10 years to produce less waste for disposal and manage waste as a resource to deliver economic, environmental and social benefits. And also this policy heralds a new, coherent, efficient and environmentally responsible approach to waste management in Australia.41

4.7 COMPARISON BETWEEN THE POLICIES OF DEVELOPED AND DEVELOPING COUNTRIES ON SWM

There are six remarkable similarities in waste management policies of the developed and developing countries. Although specific regulations are diverse, they follow essentially the following same principles:

4.7.1 Aim at waste minimization

All countries in question attempt to encourage product designs and production methods that can utilize a larger portion of raw materials (China), and limit the amount of waste generated at the product's life end (EU), especially those harmful to the environment and human health (India). Among them, one even strives to set policies that can produce zero waste (Australia).

4.7.2 Promote Reuse and Recycle philosophy

Beside the goal of reducing useless substances and materials, all governments promote the practice of reusing and recycling materials as input production materials (EU, Australia, China and India).

4.7.3 Seek to impose stricter monitoring process on waste disposal

One of the major directions of waste management policies, stricter monitoring is being developed. In some countries, it is specified by various regulations on the kinds and methods of waste treatment (EU) or by taking into consideration social and environmental factors on making waste-related decisions, rather than only the conventional economic component (Australia). Two countries regulate treatment facilities through a licensing system (China and India); one of them allows only registered players in waste management industry, such as collectors, dismantlers and recyclers, with modern and environmentally sound technology to operate (India).

4.7.4 Regulate the waste transport

One state aims at minimizing waste transport and demands full information of any waste transport taking place (Australia). Another state issues permissions to exporters and importers transporting harmless, necessary wastes that can be used as production materials, while prohibiting the transfer of waste through its territory (China). Still another defines a list of wastes banned from export and import (India).
4.7.5 Extended Producer Responsibility

Policy-makers enjoin producers to take responsibility for their products throughout the entire product life cycle - from design to spent-product management. Three governments incorporate this principle into either its directives for Member States (EU) or its environmental law (Australia and China). One state has regulations enjoining consumers to return their used batteries, and manufacturers to take back their products (India).

4.7.6 Government takes part in setting up disposal facilities and defines methods to process different kinds of wastes

One government requires the Member States to develop their treatment capacities individually by setting up a national network of disposal facilities (EU). Two countries assign municipal authorities the duty to establish treatment sites. (China and India). All the three states stipulate appropriate disposal method for each kind of waste.

The analysis leads to an apparent conclusion that developing countries are catching up developed countries in terms of environmental protection. Comparing policies is a difficult task, as policies following the same directions may vary greatly. Although many similar principles have been identified, there are possibilities that one law is more effective than another.

4.8 SOLID WASTE PERSPECTIVE UNDER CLEAN DEVELOPMENT MECHANISM (CDM)

With the increase in the industrialization and urbanization of cities, the developmental activities consume fossil fuels-arid-natural resources, which ultimately produce greenhouse gases and raise the temperature of our planet leading to global warming.

In order to combat or alleviate the global warming, the Kyoto Protocol of the United Nations Framework Convention on Climate Change came into force on 16th Feb, 2005. This protocol binds the various developed nations listed in its Annex I, to reduce their emission of GHGs and collectively to restrict their emissions GHGs to at least 5.0 per cent below their 1990 levels as an average, over the commitment period 2008-2012. Thus it has become important for various developing countries, particularly India, to explore various opportunities to reduce emissions which not only provide a
way of sustainable development but also prepare a platform for the implementation of
the Clean Development Mechanism.

4.8.1 Kyoto Protocol and Clean Development Mechanism

The Kyoto Protocol shares the ultimate objective of the United Nations
Framework Convention on Climate Change to stabilize atmospheric concentrations of
greenhouse gases. The Kyoto Protocol allows Annex I parties to change the level of
their allowed emissions over the commitment period, by trading Kyoto Protocol units
with other parties. This trading is carried out through the so-called Kyoto mechanisms.

• **Emissions Trading**: Under emissions trading an Annex I party may transfer
Kyoto Protocol units to or acquire units from another Annex I party.

• **Joint Implementation (JI)**: It is a mechanism by which one Annex I party can
invest in a project that reduces emissions or enhances a sequestrate in another
Annex I party, and receives credit for the emission reductions or removals
achieved through that project. (Sequestrate is a chemical compound that takes
away or prevents the usual precipitation. reactions of metallic ions in solution.)

• **Clean Development Mechanism (CDM)**: The clean development mechanism
is also a project-based mechanism. CDM projects must meet all detailed
requirements and follow exact procedures for registration, validation and
verification by designated operational entities, thus crediting to demonstrate that
reductions or removals associated with the project are additional to what would
otherwise occur in the absence of the project. CDM projects may result in three
types of Kyoto Protocol units - certified emission reductions (CERs), temporary
certified emission reductions (TCERs) and long-term certified emission
reductions (LCERs).

Developing countries offers a large potential for the Clean Development
Mechanism (CDM) because of its inherent dependence on fossil fuels for development.

4.8.2 CDM in Solid Waste Management

Present municipal Solid Waste Management and utilization in India has severe
limitations. The very high rate of urban growth is a major reason for the increase Solid
Waste Management problems. Approximately 0.1 million tonnes of municipal solid
waste is generated in India every day. This translates approximately 36.5 million tonnes
of waste annually. Per capita, the municipal waste generation in major Indian cities ranges from 0.2 kg to 0.5 kg per day.

Gases emitted from the solid waste dumping sites contain 50% methane and 50% carbon dioxide and other trace gases collectively. Due to methane’s positive aspect like its energy values and its negative aspects of being a greenhouse gas, it is very important to capture before it can be emitted into the atmosphere. Methane emissions from solid waste are a major cause of concern in developed countries and these countries have started recovering methane from landfill sites and reusing it for energy production. In India, however, there are no such facilities and solid waste is simply discarded in open dump-yards, which do not provide an opportunity for methane recovery. In view of this, other options for waste disposal and the recovery of resources from the waste should be tried out so that methane emissions from municipal solid waste are minimized.

GHG emissions produced during municipal Solid Waste Management can be tackled by using different measures that ultimately can lead to opportunities under the CDM.

4.9 CONCLUSION

Current global MSW generation levels are approximately 1.3 billion tonnes per year, and are expected to increase to approximately 2.2 billion tonnes per year by 2025. This represents a significant increase in per capita waste generation rates, from 1.2 to 1.42 kg per person per day in the next fifteen years.

MSW generation rates are influenced by economic development, the degree of industrialization, public habits, and local climate. Generally, the higher the economic development and rate of urbanization, the greater the amount of solid waste produced. Income level and urbanization are highly correlated and as disposable incomes and living standards increase, consumption of goods and services correspondingly increases, as does the amount of waste generated. Urban residents produce about twice as much waste as their rural counterparts.

Developing countries are catching up developed countries in the terms of environmental protection laws specially in relation to solid waste management. Comparing policies is difficult task as policies following the same direction may vary greatly. Compare to developed countries developing countries also have relative sound
environment policies. In particular, regulations on waste management are rather comprehensive. In some countries, it is specified by various regulations on the kinds and methods of waste treatment (EU) or by taking into consideration social and environmental factors on making waste-related decisions, rather than only the conventional economic component (Australia). Two countries regulate treatment facilities through a licensing system (China and India); one of them allows only registered players in waste management industry, such as collectors, dismantlers and recyclers, with modern and environmentally sound technology to operate (India). Besides the goal of reducing useless substances and materials, all governments promotes the practice of reusing and recycling materials as input production materials (EU, Australia, China and India).