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Chapter 15

Sustainable Societies and Municipal Solid Waste Management in Southeast Asia

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15.1 Introduction

Urbanisation is a mega trend in Southeast Asia and the urban population in the region has been growing at about 2.6% per year [UNESCAP, 2014]. Consequently, waste generation in Southeast Asian cities has increased rapidly over the last decade. The Waste in Asia report (2011) cites that the World Bank estimates waste generation in Asian urban areas to be around 450,000–760,000 tonnes/day; this is expected to reach about 1.8 million tonnes/day by 2025. With waste in Asia rising in tandem with the region's fast economic growth, cities are struggling to handle the growing amounts of household waste. The waste generated per capita is expected to increase in developing Asian countries while remaining constant or slightly decreasing in developed Asian countries (see Table 15.1).

The key Solid Waste Management (SWM) issues in the Asian Region can be summarised as follows:

1. Increase in the amount of Municipal Solid Waste (MSW) associated with accelerated urbanisation, population growth, economic growth, and changing lifestyles.

Table 15.1: Indicative comparison of waste generation across Asia and the Pacific countries

GDP USD/Capita, Year	Low (<USD 5,000)	Medium (USD 5,000–15,000)	High (>USD 20,000)
Municipal waste generated (kg/capita/year)	150–250	250–550	350–750
Collection rate	<70%	70–95%	>95%
Average composition of municipal waste (%):			
1. Food/organic matter	50–80	20–65	20–40
2. Paper & cardboard	4–15	15–40	15–50
3. Plastic	5–12	7–15	10–15
4. Metal	1–5	1–5	5–8
5. Glass	1–5	1–5	5–8
Waste regulations	None or poorly defined national environmental strategy, regulations are lacking, no statistics.	Presence of national environmental agency, strategy and legislations, limited statistics.	Presence of national environmental agency and strategy, strict regulations, comprehensive statistics.
Overview of waste management	Little organised collection, recycling by informal sector, open dumping or burning of mixed waste, high exposure to disease.	Moderate coverage of collection service, growing capacity for hazardous waste management, mixture of dumpsites, and semi-controlled landfill sites.	Increased emphasis on total waste reduction, resource recovery and prevention of hazardous waste; controlled landfill sites or incineration.
Waste recycling and disposal rates	Unauthorised disposal >50%; informal recycling 5–15%	Landfill >90%; start of selective collection; organised recycling 5%	Landfill and incineration at or close to 100%; organised recycling >20%

Source: Lacoste and Chalmin [2007].

2. Difficulty in securing land for intermediate treatment and final disposal (due to the NIMBY, or 'Not In My Back Yard' phenomenon), leading to serious public health risks.
3. High, but untapped, potential for 3R (Reduction, Reuse, and Recycling), and other alternative waste treatment solutions.

In most Southeast Asian developing countries, recycling is carried out under both formal and informal market mechanisms. The safety and health of informal waste pickers collecting valuable secondary materials from landfill sites, the air and water pollution from the recycling of e-waste and used lead acid batteries, water pollution from paper mills using waste paper, and the improper dumping of waste by recycling companies are all problems that affect society. Furthermore, recycled products sometimes do not meet product and safety standards, which could cause accidents or health problems. As household incomes increase from economic growth, the demand for low-quality products made from recyclable waste decreases. Improving the quality of recycled products to meet market preferences is therefore important for the recycling sector's economic sustainability.

Many Asian countries have policies in place to tackle the aforementioned problems. Nevertheless, such efforts are fragmented and not well coordinated. The primary focus is on the downstream solutions for which local governments allocate significant funds for waste collection and recycling/disposal, but without adequate consideration for resource-saving measures, economic returns, and inputs from secondary raw material use. Upstream process-integrated solutions would provide additional opportunities for resource reduction through increased resource efficiency, waste prevention, and eco-friendly design and products. This would require production processes based on principles of industrial symbiosis that the waste generated by a specific industry turns to be the required secondary raw material input for another industry. However, the current economic systems in Southeast Asian developing countries do not offer sufficient incentives for the conservation of resources and for potentially replacing primary inputs with distributed efficient waste inputs in the production processes. Currently, the dominant production and consumption patterns are not oriented towards resource efficiency, and,

consequently, the amounts of waste generated are constantly increasing, ending up as a serious problem for final treatment and disposal. In this context, more sustainable consumption and production (SCP) patterns would help solve the waste issue from its root, in particular implementation of the 3R concept and sustainable product design to improve resource efficiency and reduce waste generation.

The remainder of this chapter will discuss and analyse the waste management of three countries: Cambodia, Lao PDR, and Vietnam.

15.2 Municipal Solid Waste Management (MSWM) in Cambodia

Solid waste has become an increasing concern for Cambodia, already facing various economic development issues, particularly in urban poor areas. There the population density is rapidly increasing, yet with extremely limited resources and safe alternatives for waste disposal. MSW in Cambodia (not including liquid and hazardous waste) contains many materials that can be recycled or “up-cycled” into products with a certain economic value, which should be separated before going to landfill or incineration for final disposal. This way, a recovery-based system (or a 3R strategy) not only contributes to the national economy through the production of valuable recovered materials (second raw materials), but it also alleviates the environmental stress by largely reducing the original volume of solid municipal waste, including the biodegradable fraction which is often the largest.

The lack of attention to sustainable urban waste management has resulted in large waste collection, transportation, and disposal facilities in major cities and towns in Cambodia. These are often operated by private small- and medium-sized enterprises (SMEs) that only fall under the weak supervision of local authorities and government-related technical agencies. In some cases, monopolies emerge, for instance, since 2003, the private-sector company CINTRI has held the 49-year monopoly contract for the capital Phnom Penh. Reliance on government officials to place the responsibility of waste management under the control of SMEs has raised the concern that the motivation to operate for a profit overwhelms the

public's primary concern, which is a sustainable waste collection and disposal system to ensure efficient and safe disposal of waste.

15.2.1 Legal framework for SWM in Cambodia

The Cambodian sub-decree on Solid Waste Management was enacted in April 1999 and established the legal basis for solid waste management including MSW and hazardous waste. The main purpose of the sub-decree was to regulate SWM in order to protect human health and the conservation of biodiversity/environment. The sub-decree applies to all activities related to collection, storage, transportation, recycling and disposal of municipal waste, as well as to hazardous waste management.

The crucial roles and responsibilities defined in the sub-decree (Article 4) states that the Ministry of Environment shall establish guidelines on collection, transport, storage, recycling, minimising, and disposal of household waste in provinces and cities, in order to ensure safe management of household waste. Authorities within the provinces and cities shall establish a waste management plan for their provinces and cities.

Article 6 states that the Ministry of Environment shall also be responsible for monitoring the management of household waste, including collection, transport, storage, recycling, and disposal. The enforcement of the sub-decree is granted through Article 7, which states that waste disposal in public areas or any unauthorised site is prohibited. Articles 9 and 10 also provide guidance for the import and export of household/recyclable waste to and from Cambodia, given the fact that trans-boundary shipment of waste can harm human health and cause environmental impacts, particularly for developing countries.

Complementary legislative acts, which have been issued more recently, include the drafted National Strategy on Integrated Solid Waste Management (2011–2025), which also includes a 3R chapter. At the municipal level, the Annual Report of the Department of the Environment of Phnom Penh [2014] and the Decision of the Cambodian Council of Ministers on the improvement of liquid and SWM in Phnom Penh (February 2015) are the latest policy developments. So far, the practice of 3R, is active only in major urban areas, while in rural areas only the

Box 15.1 Classification of SWM in Cambodia

The Cambodian sub-decree on SWM defines the key terms of “solid waste” and “garbage” as follows:

1. “Solid waste” refers to hard objects, hard substances, products or refuse which are useless or disposed of, are intended to be disposed of, or required to be disposed of.
2. “Garbage” is that fraction of solid waste, which does not contain toxins or hazardous substances and is meant to be discarded from industry, services, public and private offices, households, and other economic sectors.

The MOE [2004], classifies solid waste into three categories:

1. Domestic/household waste.
2. Commercial waste (from businesses).
3. Industrial and hazardous waste, including healthcare waste.

concept of practical material reuse or recycling is implemented. In both rural and urban areas, it has been found that informal waste recycling is undertaken by private recyclers and some NGOs, but at a limited scale.

15.2.2 *Waste management system in Cambodian cities*

Cambodia’s capital city, Phnom Penh, and 24 provinces (including 26 towns) under provincial supervision are all quickly developing their infrastructure and becoming more urbanised. Many of the cities within these provinces are extending their waste collection coverage to include the increasing population.

The Cambodian population in 2014 was approximately 15.4 million people [UNESCAP, 2014], generating an estimated 6,818,000 waste tonnes/year at the national level in 2008 [Sethy, Sothun, and Wildblood, 2014] which has since increased significantly. In the capital, the Environmental Department of Phnom Penh Municipality and the CINTRI sanitation company estimate that the current amount of waste has increased to approximately 500,000 tonnes/year [Sethy, Sothun, and Wildblood, 2014]. The Environmental

Department of the Phnom Penh Municipality's Annual Environmental Report [2015] informs that reported the amount of waste generated in 2014 was about 617,500 tonnes. According to Mongtoeun, Fujiwara, and Sethy [2014], based on data received directly from landfill sites, indicated that amounts of waste are quickly increasing from 1,027 tonnes per day in 2009 to 1,381 tonnes per day in 2013. Table 15.2 reconfirms the large variability in numbers indicating both a clear upward trend in waste generation for Phnom Penh, and insufficient capacity to account and manage the growing amounts of waste. This can be demonstrated throughout the country.

As shown in Table 15.3, JICA [2005] and MoE/DoEPC [2008] reported the average waste composition among the four largest cities of Cambodia are organic kitchen waste (63–81%), plastic (3–16%), and metal and glass (0.60–7.80%). Later in 2014, CINTRI refined its household waste compositions for Phnom Penh to cover organic kitchen waste (69.7%), plastic (14.5%), metal (0.5%), bottles/glass (1.8%), textiles (3.6%), paper (2.8%), grass/wood (1.5%), soil/stone (0.4%), and other (5.2%).

According to Sethy, Sothun, and Wildblood [2014], awareness of solid waste issues in Cambodia is poor and little attention is being paid to proper collection, transportation, and management of waste. Only a small number of towns (Phnom Penh, Preah Sihanouk, Siem Reap, and Battambang) have an official waste collection system, but without a related official

Table 15.2: Estimates of annual waste in Phnom Penh (in tonnes)

Year	Amount	Year	Amount
1994	14,500	2003	240,859
1995	14,548	2004	227,910 ^a
1996	15,264	2005	266,781 ^a
1997	15,203	2006	324,159 ^a
1998	18,038	2007	343,657 ^a
1999	20,440	2008	361,344 ^a
2000	20,702	2009	393,045 ^a
2001	21,050	2010	409,336 ^a
2002	21,367	2011	438,000 ^a

Source: MoE [2004]; ^aEnvironmental Department of Phnom Penh Municipality [2012].

Table 15.3: Estimates on household waste composition (in percentages)

Composition	Phnom Penh	Siem Reap ^a	Battambang ^a	Kampong Chhnang ^a
Kitchen waste	63.30	65.18	71.88	80.46
Textiles	2.50	4.34	2.88	1.26
Grass and wood	6.80	—	—	—
Metal	0.60	5.33	1.06	7.70
Ceramics and stone	1.50	—	—	—
Paper	6.40	0.88	2.72	2.10
Plastic	15.50	8.85	8.61	3.30
Rubber and leather	0.10	—	—	—
Glass	1.20	7.80	5.40	0.70
Other	2.10	—	—	—

Source: JICA [2005]; ^a MoE/DoEPC [2008].

reliable data collection system. Solid waste collection, transportation and disposal are properly administered only in the four population centres of Phnom Penh, Preah Sihanouk, Siem Reap, and Battambang.

New developments in the Cambodian waste management system, however, can be seen. In the past, CINTRI (the local sanitation company, part of CINTEC Canada) was the only contractor to provide the service of waste collection and transportation for Phnom Penh. However, in 2014, the Cambodian Government decided to put out to tender the opportunity to other sanitation companies, in order to reduce the monopoly on waste collection. In the same year, the Government of Cambodia requested three ministries (Ministry of Economy and Finance, Ministry of Environment, and Ministry of Industry, Mine and Energy) to survey and develop a plan for the taxation of waste collection services, separately from the electricity bill. The new taxation plan is, at the time of writing, still under development [Fondazione Acra CCS, 2015].

15.2.3. Options for integration of a 3R strategy for Cambodia's SWM

In 2009, the Cambodian Ministry of Environment, with support from the United Nation Environment Programme (UNEP), drafted a strategy on the

3Rs for sustainable SWM in Cambodia. The Cambodian national 3R strategy that was subsequently adopted aims to establish an efficient solid waste management system through an increased waste collection service, promotion of waste separation for recycling, enhancement of organic waste composting, and improvement of disposal sites. By end-2015, the government plans to compost 20% of organic waste from all sectors. By 2020, the government plans to increase composting of organic waste from households by 40% and from business centres by 50%. Because the 3R concept is new to Cambodian national and local officials, the Government of Cambodia plans to:

1. Establish the 3R policies and regulations for waste management at national and local levels, based on the existing environmental legal instruments and related statutes.
2. Organise capacity-building programmes for government officials.
3. Implement pilot projects in the selected urban areas.
4. Disseminate knowledge and implicate the 3R policies and regulations in both the public and private sectors, and
5. Integrate the 3R initiatives into national policy development.

It should be noted that only a few SMEs and NGOs have been involved in carrying out waste recycling in the country, while considerable amounts of valuable recyclable elements, such as plastics, have been exported to neighbouring countries, in particular Vietnam and Thailand.

15.2.4 *Improving the solid municipal waste management systems*

To improve the solid municipal waste management, a serious commitment to administer the existing regulations is required. The national government would need to develop practical guidelines for SWM suitable for different levels of implementation (cities, provinces) in the country. However, achieving real progress requires more synchronised efforts. Adequate budget allocations at both national and local government levels are required to ensure resources for proper SWM. Regulations directed at local governments should include increases in funding, which gives local governments the means to implement the regulations established by the national government. In some cities, the involvement of private sector and

SMEs in the waste collection creates business opportunities, as well as reducing costs and administrative workload at the local governmental level. However, local governments would need to monitor the contracted companies to ensure a correct and efficient waste collection service. Furthermore, public involvement through awareness raising and educational campaigns about waste reduction and proper disposal can support a more holistic approach towards sustainable consumption patterns (see a SWITCH-Asia case study in Box 15.2).

Box 15.2 SWITCH-Asia case study: Reducing plastic bag waste in some major cities of Cambodia: Less plastic, more opportunities

A project in Cambodia, under the EU-funded SWITCH-Asia Programme, is currently being implemented by ACRA-CCS Foundation (Italy), involving two local partners: the Department of Environment of Phnom Penh and the Royal University of Phnom Penh. The project objectives are to reduce the use and improper disposal of plastic bags in three main urban centres of Cambodia, which are the cities of Phnom Penh, Sihanoukville, and Siem Reap. Unlike in Europe, where plastic bags are mainly used for carrying packed dry goods, in Cambodia plastic bags serve as a low-cost substitute for widely different purposes (rice storage, gloves for food handling, containers for coffee, improvised measurement tools, etc.) without alternatives in place. It is estimated that around 3–3.5 million plastic bags/year — or about 16 tonnes — are disposed of in the municipality of Phnom Penh alone [Fondazione ACRA CCS expert interviews, in 2014].

Plastic bags are a rising national concern

In Cambodia, most of the used plastic bags are reused as waste liners and for further packaging. According to Fondazione ACRA-CCS's experts, the February 2012 Declaration by the Governor of Phnom Penh and the Clean City Contest (recently launched by the Cambodian Prime Minister) indicated that the issue of plastic bag disposal has received a higher level of political attention. The environmental impact caused by plastic bags has prompted some Asian countries to ban their use outright. However, instead of banning them, it is rather recommended that communication interventions, availability

(Continued)

Box 15.2 (Continued)

of substitutes, and incentives for the use of reusable bags to become part of the policy mix coupled with a behaviour change incentives for consumers.

The SWITCH-Asia project “Reducing plastic bag waste” aims at changing consumption patterns and consumer behaviour by working at three complementary levels:

- conducting a behavioural change communication (BCC) campaign that helps consumers in major Cambodian cities to adopt sustainable behaviour to use and dispose of used plastic bags correctly (level 1),
- providing eco-friendly alternatives to plastic bags (level 2),
- supplementing the efforts of the Ministry of Environment by setting an appropriate policy framework to minimise the impact of plastic bag disposal and on encouraging techniques for packaging replacements (level 3).

Through the project activities, local authorities and policy makers will gain knowledge on the **unrealised costs** associated with plastic bag usage to society, also skills and tools to reduce the environmental impact. There are an estimated 1,200 *commune* and district level officials who need to acquire internal expertise in order to effectively regulate, control, and monitor plastic bag waste in their communities. Other benefits are reduced numbers of plastic bags discarded outdoors. This will lead to an increased income generation for local SMEs and low-income artisans that produce viable and accessible alternatives to plastic bags. Tourists will benefit from cleaner cultural and recreational sites, which is a definite advantage to supporting and expanding Cambodia’s tourism.

SMEs and low-income artisans are involved in the supply chain of alternative designs for plastic bags. The communication campaign is intended to change consumer behaviour and enhance the adoption of effective wrapping substitutes for a significant number of key actors: 1,000,000 women, 200,000 school children, 150,000 students, 12,000 vendors/SMEs, and 6,000 street stalls.

According to the ACRA-CCS Foundation experts, the inhabitants of Phnom Penh, Sihanoukville, and Siem Reap will benefit from a 50% decrease in plastic bag trade in target areas; a 60% decrease in the amount of

(Continued)

Box 15.2 (Continued)

plastic waste dumped in landfills in the three major cities; and an 80% reduction in the number of plastic bags improperly disposed. Additionally, they will benefit from improved knowledge on the costs of plastic bags to society and improved skills for 1,200 commune and district level officials who will acquire new expertise to regulate, control, and monitor plastic bag waste.

15.3 MSWM in Laos¹

Most Laotians live a rural and subsistence-type of lifestyle. Household waste generation is small and mostly organic or bio-degradable. In the last decades, Laos has undergone a process of urbanisation that resulted in a growing urban population; between 1990 and 2014, the urban population increased from 15.4% to 37.6% [UNESCAP, 2014]. Along with urbanisation, Lao society experiences changing lifestyle and consumption patterns as urban residents consume more imported, processed, and manufactured products. Income levels are increasing through commercial and tourist activities. Laos' population and economic growth are concentrated in four main cities, the capital Vientiane, Savannakhet, Champasak (Pakse), and Luangprabang. Other cities, however, also experience economic growth, especially from tourism. Along with the economic growth that is partly caused by the flourishing tourism industry, Laos' new challenge is dealing with a growing amount of municipal solid waste. Between 40 and 70% of the waste, depending on the location, is being collected and disposed in designated open dumping sites, while the rest is being self-disposed by means of dumping or burning [Sang-Arun and Pasomsouk, 2012]. According to Ministry of Public Works and Transport and Ministry of Natural Resources and Environment [2013], in the city Kaysone Phomvihanh a recycling system exists, primarily based on

¹The number of studies on municipal waste management in Laos is very limited, therefore this section about waste management in Laos mainly draws on the study by Sang-Arun and Pasomsouk [2012], prepared for the SCP Group of the Global Institute for Environmental Strategies (IGES).

informal collection in the city of the most valuable fractions, selling them to junkyards and dealers, and a private recycling contractor is operating a simple material recovery facility. The percentage of recycled materials is assumable low in the range of 5–10% of the total waste stream. The recycling patterns in other cities are likely very similar.

The capacity of local government to collect and appropriately dispose of waste is exacerbated by the lack of budget, e.g., to purchase sufficient new collecting trucks to replace the old, inefficient ones. The collected waste is mostly disposed in dumpsites, which are classified as uncontrolled, having no lining, leachate collection or treatment systems. Waste separation at source is not practised, except for those recyclable materials that can be sold by households (plastic, paper, glass) and food waste collection for animal feed that is practised by farmers. Finally, there currently exists no systematic urban organic waste use such as composting [Sang-Arun and Pasomsouk, 2012].

Laos also faces problems with waste management due to improper handling of waste. It is common for Laotians to burn or bury household waste in their backyards. However, rapid degradation of urban organic waste has made Laotians change their way of managing waste by starting to treat the organic waste in the household or at the disposal site. According to Sang-Arun and Pasomsouk [2012], a family with 2–3 members generated about 2–4 kg of organic and food waste/day. The majority of households are single rooms with a small space for gardening, which would allow for organic waste treatment by composting or anaerobic digestion.

15.3.1 *Lao legislation and policies related to SWM*

The framework and legislation for waste management in Laos have been in progress for a number of years. The Department of Housing and Urban Planning (DHUP) of the Lao Ministry of Public Work and Transport and the Ministry of Natural Resources and Environment (MoNRE) are both responsible for municipal solid waste management. While DHUP is responsible for urban planning and development, MoNRE deals with

environmental issues related to SWM. Several Lao authorities have drafted relevant laws and national policies to improve MSWM. Under several legislative acts, the Urban Development and Administrative Agency (UDAA) is made responsible for solid waste collection and disposal in each city. More recent laws and regulations addressing waste issue include the Agreement of Waste Disposal Site Management of 2008 and the Agreement of the National Environmental Quality Standard issued in 2009. However, Laos still needs to establish a clear definition of waste, as categorised by main types of waste (municipal, household, industrial, healthcare, packaging waste, specific waste streams, etc.). Also, linking the policy and legal framework for SWM system with other established frameworks such as resource efficiency and SCP, would be an important next step to take. The government of Cambodia already in 2008 launched its Strategic Framework for the National Sustainable Development Strategy, which provides a conceptual framework to better integrate sustainable development principles into national and sectoral development planning.

Similarly, the National Environmental Strategy to 2020 and the Environment Action Plan 2006–2010 as well as the National Environment Strategy and Action Plan (NES-AP) aim at securing sustainable development and contribute to poverty eradication through proper environmental management and sustainable use of natural resources. So far, no specific SCP legislations or policies, which relate to waste management, have been issued.

15.3.2 *Classifying waste in Laos*

Laos still needs to develop a clear definition of waste based on the compositions to enable more efficient waste management. Establishing a reliable and harmonised national database based on clear definitions of waste compositions, statistical surveys for generation of data and indicators, and a national monitoring and control network for the SWM system is also required. So far a comprehensive national waste composition data in Laos are still lacking. However, research carried out in Laos' major cities by Sang-Arun and Pasomsouk [2012], who estimate waste composition at landfill sites of Vientiane, Luangprabang, Savannakhet, and Champasak.

Table 15.4: Waste composition in Lao four major cities

Waste Fraction	Vientiane %	Luangprabang %	Savannakhet %	Champasak %
Food & vegetables	30	51	54	62
Wood, grass, trees, leaves	19	23	16	21
Paper	6	8	9	4
Plastic	13	9	15	6
Glass	6	6	2	2
Metal	3	1	1	1
Textiles	2	1	1	1
Other	21	1	2	3
TOTAL	100	100	100	100

Source: Sang-Arun and Pasomsouk [2012].

It found the composition of waste from the four cities is largely the same: biodegradable waste (food and garden waste) is the largest waste composition in all cities, ranging from about 50% in Vientiane Capital to 70–80% in the other three cities, as shown in Table 15.4.

15.3.3 Waste collection and transport

Currently, the collection and disposal of municipal solid waste in Vientiane, Luangprabang, Savannakhet, and Champasak are much more organised than in other Lao cities. Waste collection service in urban areas is organised by the UDAA. However, some municipalities, such as that in Luangprabang, transfer waste collection attributions to private sector which in most cases are SMEs. Each city has a number of trucks that collect waste from households generally once or twice a week. The fee for the collection service is about USD 1.25–2.25 per month per household. Based on the UDAA records, the average amounts of waste collected and transported to landfill range from 40% to 70% of the total (Table 15.5). The coverage of this waste collection service is highly dependent on the number of waste collection trucks and the rate at which waste collection fees are received from the residents.

Table 15.5: Waste transported to landfill in 2010

	Vientiane	Luangprabang	Savannakhet	Champasak
Estimated waste generation in municipal areas (tonnes/day)	300	50	42	60
Collection and disposal in landfills (tonnes/day)	180	30	30	25
Coverage (%)	60	60	70	42

Source: Sang-Arun and Pasomsouk [2012].

15.3.4 Recommendations to improve the MSWM in Laos

Raising awareness of residents: According to Sang-Arun and Pasomsouk [2012], the main priority should be given to raise the awareness about waste management among consumers and urban residents. Due to a low level of awareness, many people still do not separate their waste, reuse it, or treat it properly. Changes in behaviour can contribute to improving the municipal solid waste selection for recycling and disposal by the simple practice of discarding the selected waste into specific waste bins, assuming that those waste bins are already in place. Local governments can increase public awareness not to dispose waste in public spaces, but to prioritise discarding waste in specific waste bins.

Implementing waste separation at source: Waste separation at source helps reducing the volume of waste transported and disposed of in final disposal sites, making transportation easier, increasing recovery rates of valuable waste, extending lifetimes of landfills, keeping the city clean, minimising the risk of sewerage clogging and overflows, and avoiding soil and water pollution. However, this practice is still to be established in Laos. Separation of recyclables or sellable waste can be encouraged through awareness raising campaigns. For this purpose, local governments could set up educational activities to promote city-wide recycling. Future SWITCH-Asia projects in Laos could also take up the waste issue

and help raise the awareness to change the waste disposal behaviour of residents and enhance waste management capacities of local authorities and SMEs.

Improving organic waste management through composting: Taking into consideration the type of waste mostly produced by Lao households, that is organic waste, composting is a promising waste management method. The method has significant potential to reduce the waste disposed of in uncontrolled landfills, avoid methane emission during waste degradation, improve soil quality, and increase carbon sequestration into the soil. Laos has good opportunities to promote household composting and centralised small-scale composting facilities. Composting techniques can range from simple windrow composting to a complex in-vessel system that requires advanced equipment and automatic control. The windrow composting technique does not require high capital investment. This method can be put into practice from a small scale, at the household level with less than 1 kg waste input per day, to a large scale, such as at the municipal or sub-regional levels.

Household composting system is relatively simple and does not require large operating space. Households would only need to adjust the moisture/dryness ratio of waste composition in a composting bin. Centralised small-scale composting facilities can create new business opportunities for local SMEs and would be suitable to manage from one tonne to several tonnes per day of organic waste. The methods available are also based on simple composting techniques.

15.4 Waste Management in Vietnam

Currently Vietnam is experiencing a phase of rapid economic growth which tends to concentrate in big cities as business centres. As a result, the country is undergoing considerable urbanisation. According to statistics published by the Vietnam Housing and Population Census in 1999 and 2009, new consumption patterns have emerged due to higher living standards and increased average incomes per household [Central Population and Housing Census Steering Committee, 2010]. Economic reforms have transformed Vietnam, from one of the world's poorest countries 25 years ago to a lower middle-income country (MIC); the 2014 per capita income was about USD 1,890 [World Bank, 2015]. Consequently, solid waste

generation increased to about 24 million tonnes per year in 2010 and several forecasts predict about 40 million tonnes for 2015 and 53 million tonnes for 2030, due to high rates of urbanisation, increasing household incomes, changing consumption habits, and population growth [Thai, Pariatamby, and Tanaka 2014].

15.4.1 *SWM in Vietnam*

Thanh and Matsui [2010] reported that the Urban Environment Company (URENCO) organised about 70–80% of the national waste collection, while the rest has been collected and managed by local small- and medium-sized sanitation companies. In this context, the partnership between government and SMEs is essential to ensure a well-organised solid waste management system in the country.

To have a more sustainable approach to waste management in the country, the 3R approach that minimises waste generation can play a key role. The recycling sector in Vietnam is already very active, thus providing a good basis for high reuse and recycling rates. The **informal recycling sector**, which includes waste-pickers and scavengers, also plays a significant role in waste management and recycling activities. Plastic recycling is a growing sector in Vietnam, which attracts large investments from private companies. For instance, the Vietnam-based Thanh Tai Gas Company installed a recycling plant in 2012, which has a capacity of up to 1.5 billion PET bottles per year [Waste Management World, 2011]. In addition to efficient recycling facilities, initiatives focusing on changing consumption patterns and waste generation of the growing urban consumer class are becoming increasingly important. An example of such an initiative is the SWITCH-Asia project “GetGreen Vietnam” (see Box 13.2, in Chapter 13).

15.4.2 *MSWM in Vietnam*

According to data reported by Vietnamese provinces in 2008 [Thai, 2014], the daily average waste generation volumes range from 0.8 to 1.2 kg per person per day in large cities and 0.35–0.50 kg per person per day in small towns. The generation volumes vary due to factors such as living conditions in urban areas, different categories of urban areas, topography, and socio-economic

Table 15.6: Variation of solid waste volumes in Vietnam (in tonnes per year)

Type of Solid Waste	2003	2008
Municipal solid waste	6,400,000	12,802,000
Industrial solid waste	2,638,400	4,786,000
Healthcare solid waste	21,500	179,000
Rural solid waste	6,400,000	9,078,000
Craft village solid waste	774,000	1,023,000

Source: Thai, Pariatamby, and Tanaka [2014].

development of each province, etc. The variation of solid waste generation in Vietnam is shown in Table 15.6.

Further, municipal solid waste among major cities in 2009 can be classified into:

- organic substances (accounted for a high rate of 50–66%),
- inert matters (13–28%),
- plastic (3–13%),
- paper and cardboard (3–10%).

Figures in Table 15.7 are based on the average composition of solids taken from selected samples from various city locations of Hanoi, Da Nang, Hue, and Pleiku (residential areas, markets, and landfill).

In most urban areas, MSW is not yet sorted at source. Few households separate their solid waste, selling bottles, jars, metal, and paper to scrap collectors. However, in recent years, a number of pilot projects promoting solid waste separation have been implemented in the large cities of Hanoi, Da Nang, and Ho Chi Minh. For several reasons, these efforts have not yet been very successful, partly due to the lack of community awareness and few processing facilities for the separated recyclables. In urban areas, household waste is mostly sorted by private waste collectors.

At the national level, the average rate of MSW collection is estimated to be about 72%. The collection rate in urban areas has increased from 80% in 2008 to 85% in 2010, but the percentage fell drastically to 45% in rural areas in 2010, while the reuse and recycling rate was estimated to range from 18 to 28% in the same year. In urban areas, SMEs and

Table 15.7: Average composition of solid waste (in % weight) in Vietnam's major cities in 2009

Composition	Hanoi ^a	Da Nang ^b	Hue ^c	Pleiku ^d
Organic	53.80	66.0	55.0	60.49
Plastic	3.42	4.0	5.2	12.77
Paper and cardboard	4.2	3.1	4.4	9.65
Metal	1.4	4.9	7.0	1.16
Glass	1.0	0.9	1.8	0.13
Inert matters	28.18	16.4	21.3	12.6
Rubber	4.9	1.6	1.5	2.8
Textile rags	1.7	2.3	3.0	0
Hazardous substances	1.4	0.8	0.8	0.4
Total	100	100	100	100
Moisture content (%)	43.04	51.2	50.0	50.5
Ashes (%)	13.70	16.0	15.5	13.9
Density in bulk (tonne/m ³)	0.41	0.40	0.40	0.38
Recyclable fractions (%)	16.62	16.80	22.90	26.51

Notes: a: city category special, b: city category I, c: city category II, d: city category III. Classification in accordance with the 2009 Vietnam Governmental Decree No. 42/2009/ND-CP.

Source: Thai, Pariatamby, and Tanaka [2014].

cooperatives have a growing role in SWM. URENCO and other local sanitation cooperatives take care of the waste collection in most urban areas. In Lang Son, a city on the northern border of Vietnam, a small enterprise has recently replaced URENCO as the city's major waste collector. In Buon Ma Thuot, an SME collects municipal waste alongside URENCO [Thai, 2014].

Composting can contribute to a more efficient MSWM in Vietnamese cities, but is not yet implemented countrywide for a number of reasons, including: poor technical implementation that leads to low quality of compost, low input of feedstock, and low domestic market acceptance. For centralised composting facilities, organic waste is collected from households and businesses, also several neighbouring areas, to have sufficient quantities of waste. Centralised composting facilities, most of them operated in the north of Vietnam, are privately operated but governmental authorities undertake the required funding and technical assistance [Nguyen, n.d.].

Centralised composting facilities are currently operating in Vietnam without a pre-defined standard. The compost has low quality and often contains fragments of glass and metal, which makes the compost inappropriate for selling to direct consumers, commercial farmers, wholesalers, retailers, bagging operators, and brokers. Despite the potentials that the centralised composting facilities have, several factors still hamper their implementation where interventions could be made:

1. Improving the composting methods, where dry waste feedstock is manually applied with supervision to ensure a good, continuous distribution resulting in a stable, efficient loading capacity.
2. Switching the waste separation process from manual to automatic, which increases compost quality and reduces transportation and recovery costs.
3. Providing incentives for households or companies that support waste separation at source, and for farmers or businesses that use compost produced by the facilities. As the demand for good quality compost increases, there is, in turn, an incentive for composting facilities to increase their quality standards.

15.4.3 Legal framework and 3R policies in Vietnam

Vietnam has issued several policies and legal provisions on waste management. The Law on Environmental Protection [2005] provides incentives for the reuse, recycling, energy recovery, and other resource efficiency related activities. The National Strategy for Environmental Protection [MoNRE, 2012] sets targets for the recycling industry, including 30% of waste to be diverted for recycling. The National Green Growth Strategy [2011–2020] with a vision towards 2050 (as issued in 2012) includes directions along the whole chain of waste reduction and management processes. As recently as 2015, Vietnam issued new regulations concerning the imports of waste for recycling. With the new regulation, SMEs need to obtain permission to import plastic refuse as a production material, and are required to conform to certain conditions on waste imports and the materials allowed to be imported [Vietnamnet, 2015]. These policies provide sufficient targets and policy instruments for 3R implementation and a good waste management system. However, there is

still a gap in their implementation. Concrete guidelines are, therefore, mandatory to enable all parties to understand the policies and regulations, assume their responsibilities and gain incentives.

The Government of Vietnam could also promote the 3R approach by issuing a directive on the reduction of material and energy use or on economic instruments for 3R implementation. Technologies for municipal waste recovery, recycling and disposal exist but they are underutilised. It should become a priority to make the existing technologies available, since the amounts of waste are constantly increasing. Low incentives for industry will not encourage waste recycling efficiency.

In general, NGOs are recognised as important in the implementation of 3R and SWM activities. Yet, sometimes the existing NGOs do not support such activities. Volunteer groups are present in Vietnam, but they lack organisation or coordination. There is also general lack of awareness in citizens regarding the importance of formal 3R.

15.4.4 *Improvement potentials in Vietnam's SWM system*

In relation to implementing a sustainable waste management system in the whole country, several proposals in close accordance to the Green Growth Strategy and the 2012 National Strategy on Environmental Protection to 2020, with Visions to 2030 can be made:

1. Developing a more-focused legal and policy framework for a solid waste management system. The framework would encourage increased coordination among authorities responsible for the waste management system.
2. Creating national and local plans towards an integrated SWM system.
3. Ensuring a reliable and harmonised national waste management database to help monitor and evaluate the entire network.
4. Promoting the 3R approach by means of technical assistance and potential funding as well as awareness raising campaigns on SCP and environmental education in schools from an early age.
5. Following the National Green Growth Strategy's objectives and tasks.

15.5 Conclusions and Recommendations

As discussed above, resource efficiency achieved through the 3R approach, is inherently part of the SCP agenda. It is clear that SCP and the 3R concept can contribute to effective municipal waste management in developing countries in Southeast Asia. Furthermore, it is essential to develop national SCP policy frameworks that regulate sound waste management for resource efficiency with clear targets, monitoring procedures, and benchmarks. Policies at national and local levels for integrated waste management, including the 3R approach, have been promoted in all three countries covered in this chapter.

Local initiatives are most effective when supported by national legislation or programmes, especially those which provide incentive mechanisms for local governments. Community-based organisations and NGOs can also play a role in local waste management programmes, especially in the areas of public awareness and education, and by working with the informal sector. Examples of such civil society initiatives are the EU-funded SWITCH-Asia project in Cambodia that aims to reduce the use of plastic bags by urban consumers, and the SWITCH-Asia “GetGreen Vietnam” project, which built the capacity of consumer groups to reduce waste as part of sustainable consumption practice. Meanwhile, international agencies, like EU DEVCO and other multilateral organisations, can further support countries by channelling financial and technical support at local level and by boosting collaboration to provide a common platform to share ideas, experience and knowledge on SCP and the 3R concept, and support local action for better SWM systems.

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