State of Waste Management in South East Asia

UNITED NATIONS ENVIRONMENT PROGRAMME

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I INTRODUCTION

Human activities generate waste. In recent years the volume of waste has been increasing at an alarming rate, posing a formidable challenge to governments. A 1999 World Bank report predicted that the total volume of municipal solid waste alone that is generated in Asia and the Pacific will more than double by year 2025, greatly surpassing capacities of existing waste treatment facilities. The complexities and enormity of the challenges become evident when we consider other waste types to be managed. These include industrial solid waste, municipal wastewater, industrial wastewater, storm water and hazardous waste. This paper provides snapshots, or quick but comprehensive pictures, of what is happening in terms of waste generation, treatment, disposal and management within the Association of South East Asian Nations (ASEAN). We will also look at current approaches at sustainable integrated waste management.

Urban population in ASEAN countries, except in Singapore, is expected to increase between 5.1 percent to 7.2 percent within this decade (Table 1). The volume of waste generated by human activities is expected to continue to increase accordingly.

Table 1: Urban Population Trends in Selected Countries of South East Asia 1980-2020

Country	Total Population 1990 (million)	Urban population as a percentage of total population					Percentage change in urban population territory			
		1980	1990	2000	2010	2020	1980 1990	1990 2000	2000 2010	2010 2020
Malaysia	15	34.6	43.0	51.2	58.4	64.8	+11.6	+18.2	+7.2	+6.4
Myanmar	42	24.0	24.8	28.4	35.4	43.3	+0.8	+3.6	+7.1	+7.9
Philippines	62	37.4	42.7	48.9	55.7	62.5	+5.3	+6.2	+6.8	+6.2
Singapore	3	100.0	100.0	100.0	100.0	100.0	0.0	0.0	0.0	0.0
Thailand	55	17.1	22.2	28.9	36.7	44.7	+5.1	+6.7	+7.8	+8.0
Vietnam	67	19.2	19.9	22.3	27.4	35.1	+0.7	+2.4	+5.1	+7.7

At the same time issues of rapid urbanization continue to challenge ASEAN cities. There is a widening gap between society's rapidly changing demands for more urban services and the capacity of cities to meet these demands. This has led to significant environmental and health issues associated with wastes, such as water and soil contamination from solid and liquid wastes, and pollution of rivers, lakes, seas from wastewater.

In the succeeding sections the waste-generating sectors are classified into six sub-sectors, which will be discussed according to their specific natures. Often, different government agencies are mandated to manage different waste sectors, which will be presented in the subsequent discussions. This fragmented approach to waste management, coupled with a lack of clear definition and delineation of the different waste types, makes an assessment of current waste management practices in most ASEAN countries difficult. Be that as it may, as an initial attempt at sub-regional analysis, our discussion will focus on the following waste sub-sectors:

II TYPES OF WASTES – Sources & Composition

The most fundamental step in waste management is quantifying and qualifying the different types of waste being generated. It is important to have a system for the collection and analysis of basic information about wastes. Among the data needed are: the sources of wastes, the quantities of waste generated, their composition and characteristics, the seasonal variations and future trends of generation. Such information forms the basis for the development of appropriate waste management strategies. In fact, data collection and management should be an on-going exercise for monitoring purposes and to enable future and long-term planning and decision-making.

A. Municipal Solid Waste

Municipal Solid Waste (MSW) can be defined using Chapter 21.3 of Agenda 21 (United Nations Conference on Environment and Development, Rio de Janeiro, June 14, 1992 Chapter 21 "Environmentally Sound Management of Solid Wastes and Sewage-related Issues")

"Solid wastes…include all domestic refuse and non-hazardous wastes such as commercial and institutional wastes, street sweepings and construction debris. In some countries the solid wastes management system also handles human wastes such as night-soil, ashes from incinerators, septic tank sludge and sludge from sewage treatment plants. If these wastes manifest hazardous characteristics they should be treated as hazardous wastes."

MSW is thus seen as primarily coming from households but also includes wastes from offices, hotels, shopping complexes/shops, schools, institutions, and from municipal services such as street cleaning and maintenance of recreational areas. The major types of MSW are food wastes, paper, plastic, rags, metal and glass, with some hazardous household wastes such as electric light bulbs, batteries, discarded medicines and automotive parts. Table 2 highlights the main sources of MSW, the waste generators, and types of solid waste generated.

Table 2: Sources and Types of Municipal Solid Waste

Sources	Typical waste generators	Types of solid waste
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, glass, metals, ashes, special wastes (bulky items, consumer electronics, batteries, oil, tires) and household hazardous wastes
Commercial	Stores, hotels, restaurants, markets, office buildings	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Institutional	Schools, government center, hospitals, prisons	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes
Municipal services	Street cleaning, landscaping, parks, beaches, recreational areas	Street sweepings, landscape and tree trimmings, general wastes from parks, beaches, and other recreational areas

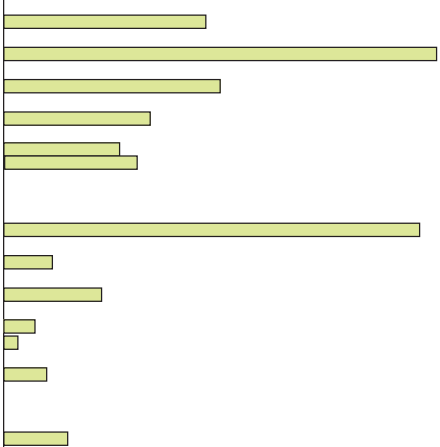
Among the ASEAN countries there is a marked range of waste generation per capita. Malaysia (population of 22 million) generated an estimated 5,475,000 tons of solid waste. This is about 0.68 kg per capita/day in 2001. This was comparable to Singapore's 5,035,415 tons of waste in the same year. However, Singapore's per capita waste generation is much bigger because it has a population of only 4,452,700.

Vietnam generates about 49,134,000 tons per year (about 0.61 kg/capita/day). In the

A detailed breakdown of the types and quantities of solid waste generated in Singapore is given below in Table 3. Note that paper and cardboard and metal wastes together constitute almost 50 percent of the total volume of solid waste. Singapore, as with most other ASEAN countries, considers construction and demolition waste as part of total municipal solid waste.

Table 3: Types and Quantities of Solid Waste Generated Per Year in Singapore, 2001

Type of Solid Waste	Percentage of Total Waste, percent	Quantity generated (tons), Yr. 2001
Food	10.6	535,648
Paper/cardboard	24.5	1,236,137
Plastics	10.9	546,537
Construction Debris	7.0	351,288
Wood/timber	5.3	268,388
Horticultural Waste	5.6	280,870
Earth spoils	0.2	9,550
Ferrous metal	22.1	1,114,930
Non-ferrous metal	2.4	119,241
Used slag	4.5	227,478
Sludge	1.6	79,016
Glass	0.7	34,395
Textile/leather	1.9	94,268
Scrap tyres	0.2	11,571
Others	2.5	126,098
TOTAL	100.0	5,035,415



In Singapore, solid waste is generated by both domestic as well as non-domestic, i.e. commercial and industry, activities. In most ASEAN countries, there is generally no system to identify and classify MSW into domestic, commercial and/or industrial wastes. All types of solid waste are mixed together and not sorted at home or at other sources. So there is no differentiation during collection by public or private contractors. In some countries waste collected is taken to a common processing center for separation, treatment and disposal.

B. Industrial Solid Waste

Industrial solid waste - the non-toxic or non-hazardous waste generated by various industries is normally not identified as different from municipal solid waste coming from domestic and commercial activities. In many ASEAN countries, it has been included as part of municipal solid waste. As a result, there is an absence of a systematic database on industrial solid waste and the exact rates of industrial waste generation are not known. The lack of information on industrial solid waste is lamentable because it can actually include a wide range of materials that may have different levels of impact on the environment.

The types of industrial solid waste would include packaging materials, paper, housekeeping wastes, food wastes, scrap materials such as glass and ceramics, resins, plastics, metal and plastic scraps, stones, cloth, rubber, straw, wood waste, products which are off-specification and a variety of materials not officially specified as or are known to be hazardous/toxic.

Yangon City in Myanmar generates about 500 tons industrial solid waste a year, which comprises packing paper 10 percent, scrap materials 5 percent, wood wastes 5 percent, straw 30 percent, cloth 5 percent, glass 5 percent and others 40 percent from industries which include leather, cement, brick, glass, ceramic ware, asbestos cement, and marble factories, wood industry and chemical plants. Mandalay City, also in Myanmar, generates 4,792.09 tons of wastes from light industries (56.43 percent food, 38.37 percent mixed inorganic, 4.49 percent wood, 0.37 percent plastic/rubber, 0.20 percent cloth/leather, 0.07 percent paper and 0.07 percent others). Thus the variations from city to city, even within the same country can be very wide.

It is reported in the Draft Final Report of the Study on the Master Plan for Bangkok and its vicinity in the Kingdom of Thailand, 2001, that the generation of industrial solid waste in Bangkok and its vicinity was estimated at about 2.365 million tons in 2001, with projected increase to 2.485 and 2.602 million tons in 2005 and 2010 respectively. In Bangkok, since mid-1990s, industrial solid waste is collected and disposed of in an environmentally sound manner in licensed waste treatment facilities, which are controlled and regulated by the Department of Industrial Works.

In Malaysia non-scheduled wastes from industry are normally collected by either private or public contractors, who are licensed by the local authorities.

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Photo 4: Example of Industrial Solid Waste in Malaysia

Singapore uses only licensed contractors. It is estimated that Singapore has an industrial waste intensity of approximately 0.2 kg per US Dollar industrial production compared with approximately 2.3 kg per US Dollar industrial production for People's Republic of China and 1 kg per US Dollar for Japan (ESCAP, 1997. Refer to Figure 3). The generation ratio of municipal waste to industrial solid waste is 1:3 for PR China, 1:8 for Japan, and likely to be lower for Singapore. It is surmised that as the ASEAN countries develop, there is likely to be substantial increase in industrial solid waste generation. This would pose serious challenges to those ASEAN countries that do not have adequate collection, processing and disposal systems for this type of wastes.

Figure 3: Waste Intensity of Industrial Production in Singapore Compared to PR China and Japan of Industrial Solid Waste in Member Countries

Sources: ESCAP, 1997

C. Hazardous Waste

As members of ASEAN continue to develop, it is expected that there will be increasing use of toxic chemicals and generation of hazardous wastes.

Different ways of classifying and defining hazardous wastes have led to some difficulties in

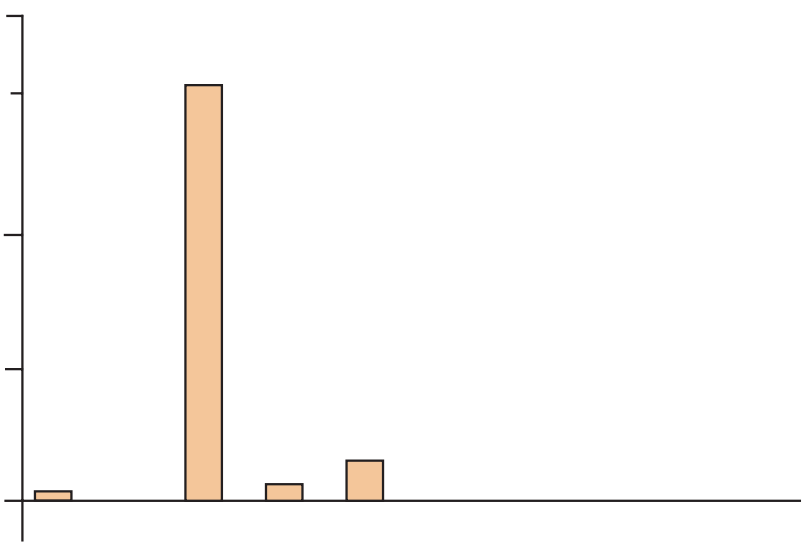
D. Municipal Wastewater

The volume of municipal wastewater generated depends on the supply and demand for water. In developing countries, the requirement is about 160 to 200 liters/person/day, while for developed countries it can be as high as 250 to 300 liters/person/day. It is estimated that 60 percent of the total population of developing countries have access to water supply, 90 percent of which is in urban areas. The main uses of water would be for toilet, laundry, bath, kitchen, etc. In Indonesia, typical usage is 30 percent for toilet, 15 percent for laundry, 25 percent for bath, 10 percent for kitchen and 20 percent for other uses.

Based on the population of each country in 1999 and using an average of 150 litres per capita per day for developing countries, the estimated volume of municipal wastewater in the ASEAN countries varies from 49,500 m3 in Brunei Darussalam to 31.05 million m3/day in Indonesia.

See Figure 4 below.

Figure 4: Estimated Municipal Wastewater Generated by the ASEAN Countries, 1999



Countries:
1 - Brunei Darussalam
2 - Cambodia
3 - Indonesia
4 - Laos
5 - Malaysia
6 - Myanmar
7 - Philippines
8 - Singapore
9 - Thailand
10 - Vietnam

Associated with municipal wastewater generation is domestic sludge generation. Malaysia produces about 3.2 million m3 domestic sludge each year (Regional Institute of Environmental Technology, 2000). By 2005 this is expected to rise to 4.3 million m3 per year. In Malaysia sludge is handled separately from municipal and industrial solid wastes. In Singapore sludge (500,000 m3/year) is handled as municipal solid waste. It is first treated with soil conditioner before being applied primarily for land reclamation.

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Photo 6: Receiving Stream for Agro-Based Industrial Effluent, Malaysia

F. Storm Water

Storm water quantities are generally estimated from the precipitation-evaporation rates of each country. ASEAN countries lie in the tropics and generally experience high rainfall compared with other regions in the world. However, there can be wide variations depending on location. Mandalay in Burma experiences rainfall of from 661mm to 1024 mm annually. Kuala Lumpur, Malaysia, has an average annual rainfall of about 2500 mm.

Singapore has an estimated storm water runoff of 770 million cubic meters annually (1990-2000 data). Malaysia has a total estimated average runoff of 566,000 million m3 annually (1997). From the precipitation-evaporation data of each country it will be possible to estimate the respective quantities of storm water runoffs.

Storm water could be collected from house roofs, paved areas and roads, and could carry solids depending on how much debris and pollutants lie in the path of the runoff. Storm water drainage in most urban areas would generally consist of roadside drains leading ultimately to natural streams, rivers and other bodies of water.

In most cases the pollutant load of storm water would be lower than that of other types of wastewater. However, water in the drainage system may inevitably be contaminated with fecal matter from latrines and coliform septic tank effluent, presenting direct health risks. Poor drainage may result in flooding as well as cause stagnant pools of water - both further contributing to health risks.

III WASTE PROCESSING - Current Waste Management Practices

A. Municipal Solid Waste

The cost for solid waste management are high and are mainly for collection and transport, which is borne by the public sector, but with a growing trend for contracting or privatization as practiced in Singapore, Malaysia, Thailand, Philippines and Indonesia. Collection and transport are labor intensive as well as capital intensive, requiring motorized fleets. Collection is either door-to-door or using containers and communal bins. All medium and large cities would have administrative structures for providing collection services. Singapore has a collection rate of more than 90 percent while in Bangkok, Jakarta and Kuala Lumpur the rate is more than 80 percent. In Indonesia, collection rates have been improved through a pre-collection system at villages, which deposit their MSW at transfer or temporary storage facilities. Unfortunately, collection services are not extended to the poor and informal settlements which do not pay or are inaccessible.

Photo 8: A Municipal Waste Truck

Most of the cities in Thailand use non-compaction trucks for daily collection, with few cities using compaction trucks and hauling trucks. The collection and efficiency is improving with an average collection of 70 percent – 80 percent of wastes generated.

Municipal waste management practices in the ASEAN region include the following:
a) Recycling/recovery
b) Composting
c) Incineration
d) Landfilling/open dumping

1. Recycling/recovery
MSW may contain the following materials, which are considered recyclables:

- Ferrous and non-ferrous metals
- Construction debris
- Scrap tires
- Paper/cardboard
- Plastics
- Textiles (including cloth and leather)
- Glass
- Wood/timber
- Animal bones/feathers
- Waste oil and grease
- Cinders/ashes

Varying percentages of municipal solid waste are collected for recycling. In Year 2001, for instance, about 44.4 percent of solid waste in Singapore was recycled, compared to about 1 percent in Malaysia. In the Philippines the percentage of recycling and reuse was 12 percent. Of the above-listed materials, the increasing amounts of plastic waste is a big issue in most of the ASEAN countries.

In the middle- to low-income cities of ASEAN, there exists a long-standing practice of informal source separation and recycling of materials. This has led to the development of enterprises for the gathering, trading and reprocessing of materials, e.g. in Bangkok and Jakarta. In Vietnam, waste recovery and recycling activities at city the level are supported by the national ministries although many of these are family businesses. A high percentage of operators are women, as high as 50 percent as in Ho Chi Min City. However, in places like Phnom Penh, waste pickers comprise a large percentage of children below 18 years of age (51 percent in 1998), both in the streets and in the dumpsites. Cooperatives have been formed to assist and improve this informal sector, for instance, in Bangkok and Manila.

In most countries, the volume of both the formal and informal sources of separation and recycling of most non-organic wastes (manufactured materials) is significant. However, since industries would only be interested to use recycled materials when they cost less than the virgin materials, the practice of recycling is so market-driven that recycling has become selective. The disposal of those unselected recyclables remains a problem

Informal waste separation or waste picking takes place in three ways:

(a) At source - this is in large urban areas, e.g., commercial areas or residential areas with apartments/high-rise buildings for high income earners. Here waste pickers sort out the waste before the authorized collection vehicle arrives.
(b) During collection – when the collectors segregate recyclable materials during loading and store them inside the truck or on the sides of the vehicles.
(c) At the disposal site – where the waste pickers often live on or near the dumps. However, they risk the danger of potential slides and fires.

While waste picking means survival for waste pickers the methods of uncontrolled waste picking can reduce the efficiency of the formal collection system and can be detrimental to health due to exposure to biological pathogens, e.g., during sorting when garbage bags get broken and produce spillage.

2. Composting

Composting is not well practiced in ASEAN. Household organic wastes, including wastes from the restaurants, are often collected for animal feed, e.g. in Thailand, Philippines and Vietnam. However, a few imported mechanical composting plants have been installed in Bangkok and Hanoi. But these are either not working or are not operating at full capacity for a number of reasons, such as:

- High operating and maintenance costs
- Poor maintenance and operation of facilities
- Incomplete separation of non-compostables, such as, plastics and glass
- High cost of compost compared to commercial fertilizers

3. Incineration

Another waste treatment method that is practiced especially in Singapore is incineration where 90 percent of non-recyclable MSW is incinerated. Final disposal of waste is at landfills where 10 percent of non-recyclable MSW is deposited. Singapore has four government-owned and operated incinerators for the disposal of solid waste that is not recycled.

Malaysia has one existing municipal incinerator in a local township and has plans to establish another in Kuala Lumpur due to an increasing solid waste generation but reducing availability of land for open dumping and landfilling. Indonesia and Thailand also have one municipal waste incinerator in their capital cities.

However, controversy remains over the soundness of incineration as a waste treatment technology because of greenhouse gas emissions from incinerators. Local opposition to incineration, e.g. in Bangkok, is growing. And in the Philippines, incineration has been completely banned under the new law on solid waste management (RA 9003).

The practice of informal incineration or open burning is, however, still prevalent, not only in the rural areas where waste collection is rare but also in peri-urban and urban areas.

4. Landfilling

Landfills are generally the cheapest and most common disposal method for MSW. An exception is a large city like Singapore, which faces rising disposal costs due to exhaustion of traditional disposal sites, stricter environmental controls and greater waste quantities, thus requiring other methods like incineration to reduce the volume of waste for final disposal. In Thailand, the most preferred disposal method is through the sanitary landfill, of which there are 95 currently operating and 36 more under construction. In the other developing countries, open dumping is the common practice, i.e., MSW is dumped on swamplands and low-lying areas, which are eventually reclaimed for development. In Kuala Lumpur, for example, the development of Sri Petaling was on and around a filled former tin mine.

Photo 9: A Municipal Waste Truck

The problems associated with landfills, even with those that are clay-lined, include high water table, groundwater contamination and gas migration. High percentages of organics and plastics have led to breakouts of fire due to methane gas generation, e.g. in Bangkok and Manila. But there are well-designed and reasonably well-operated sanitary landfills, for example, in Jakarta and Bandung, Indonesia. In places like Jayapura and Irian Jaya in Indonesia, wastes are generally disposed of by open dumping, burning or disposing to the sea.

In many of the ASEAN countries collection of MSW is inadequate in varying degrees, especially in the rural areas. While data is not fully available it is observable that some MSW is thrown directly into the waterways. Large amounts of MSW may be also found indiscriminately dumped by the roadside. But in the countrysides, the amount of MSW dumped openly is not known. There are a number of factors why countries do not have sanitary landfills. These are: lack of finance, land acquisition problems, insufficient collection and disposal fees and unqualified or non-licensed operators. Very often there is great difficulty in acquiring appropriate landfill sites because of the "not-in-my-backyard" or NIMBY syndrome and an unsuitable soil profile if the site happens to be near the urban center.

Where there are licensed contractors or licensed waste collectors, the likelihood of a proper and adequate waste collection, treatment and disposal system is greater. For instance, in Singapore, waste management is quite efficient because all waste collectors and recycling plants are licensed, while the landfills are owned and operated by the government.

In Malaysia, municipal waste collection, treatment and disposal services have also been privatized but with Government supervision. Two out of four consortia are collecting solid waste in 26 out of 145 local authorities. Wastes are deposited in government-owned landfills, which are managed by a private consortium.

An overview of the disposal methods applied by selected ASEAN countries for municipal solid waste is given in Table 6. The most prevalent method is open dumping.

Table 6: Disposal Methods for Municipal Solid Waste in Selected ASEAN Countries

Country	Disposal Methods (%)				
	Composting	Open dumping	Landfilling	Incineration	Others
Indonesia	15	60	10	2	13
Malaysia	10	50	30	5	5
Myanmar	5	80	10	-	5
Philippines	10	75	10	-	5
Singapore	-	-	30 *(10 in 2002)	70 *(90 in 2002)	-
Thailand	10 **(0 in 2001)	65 **(67 in 2001)	5 **(32 in 2001)	5 **(1 in 2001)	15 **(0 in 2001)
Vietnam	10	70	-	-	20

Source: ENV 1997
**Communication with National Environment Agency officials*
***Draft Annual Report, The State of Pollution, Thailand B. E.2544 (2001), Pollution Control Department 2002*

B. Industrial Solid Waste

As mentioned earlier, most of the ASEAN countries handle and treat industrial solid waste together with municipal solid waste. This means that the same methods are used, which would comprise of open dumping, landfilling, and incineration. However, in those countries where there are few waste management facilities, the industrial solid wastes are often dumped on private land, or buried within or close to the premises of the industrial facility where they have been generated. There are concerns that some hazardous waste may be disposed along with non-hazardous industrial solid wastes, which are collected and deposited in municipal landfills and open dumps. However, data is lacking on the quantities and characteristics of these wastes. In most of the ASEAN countries, except in the Philippines where a new law (R.A. 9003) was recently passes (2001), there is no specific legislation requiring separate management of industrial waste from municipal solid waste.

C. Hazardous Waste

Many ASEAN countries are in the early stages of industrialization and many of their industries lack the capital needed to invest in waste treatment systems or to replace old equipment with modern technologies. In order to save costs many industries import outdated second hand equipment despite government prohibitions and guidelines, e.g. Vietnam's Law on Environmental Protection (1993), which bans import of technology that does not meet environmental standards. However, a number of ASEAN countries have laws mandating various aspects of hazardous waste management, such as, the methods of handling, treatment and disposal of hazardous wastes.

The most acceptable method of disposal for hazardous wastes is through the use of sanitary landfills as practiced in Malaysia. Although hazardous waste incinerators have been developed in Singapore, Malaysia and Thailand. In the case of the Philippines, one facility for treatment of metal finishing wastewater available on Cebu Island and an incineration plant for medical wastes is found in Laguna. In the rest of the countries in the ASEAN region there is usually co-disposal of hazardous waste with municipal solid waste in open dumps, including, perhaps, storage of toxic wastes in sealed containers.

Singapore uses off-site hazardous waste management facilities for recovery of 65 percent of the waste. It sends 29 percent of the waste to an integrated hazardous waste management facility for treatment and disposal and exports 3 percent to Europe.

Thailand has a hazardous waste management program for its petrochemical, chemical and non-ferrous industries, which produce 250,000-300,000 tons annually of commercially viable waste along the Eastern Seaboard. A hazardous waste treatment plant managed by the Industrial Estate Authority of Thailand has been also established. In addition, Thailand has five existing central facilities for industrial hazardous waste recovery and disposal that is licensed by the Department of Industrial Works. These consist of three secured landfills with a total capacity of 635,000 tons per year, two plants of secondary fuel and material recovery in cement kilns having a total capacity of 2.73 million tons per year, one solvent recovery plant with a total capacity of 15,000 tons per year, one chemical and solution treatment plant having a capacity of 2,500 tons per year, one used/obsolete chemical and hazardous treatment plant with a capacity of 2,500 tons per year and one electronic recycle plant with a capacity of 20 tons per year.

In Malaysia, the Bukit Nanas Integrated Waste Treatment Plant has facilities for high-temperature incineration, physical and chemical treatment, stabilization and a secure landfill. In 2000, some 84,000 tons of hazardous waste were treated in this plant.

Box 1

Integrated Hazardous Waste Treatment Plant at Kualiti Alam, Malaysia

The treatment facility was officially opened in November 1998. Modeled after the Danish hazardous waste processing plant, Kommunekemi in Nyborg, it is the first integrated facility for the processing of hazardous wastes in Malaysia. The owners of Kualiti Alam hold a concession for treatment of all hazardous wastes in Peninsula Malaysia for 15 years. More than USD70 million has been invested in the facility.

The facility receives all types of hazardous wastes except hospital and radioactive wastes. Organic wastes are burnt in the incineration plant. Acidic and basic organic fluids are chemically treated to neutralize them. The residues from chemical treatment and other solid inorganic residues are bound with lime and cement before being disposed in a double membrane lined landfill, which should have capacity for waste residues storage of up to 20 years.

Companies are required by law to inform the authorities on the types and quantities of hazardous wastes they generate and associated collection, storage and processing methods used. In addition, the companies have to pay for the services on the basis of the polluter-pay-principle.

Photo 10: Kualiti Alam Hazardous Waste Treatment Facilities

Indonesia has developed a centralized hazardous waste treatment facility in West Java to treat hazardous wastes from Jakarta, Bogor, Tangeran and Bekasi. The quantities have ranged from 9.7 – 29 tons (1994-1997) to 18.8 tons in 1999.

D. Municipal Wastewater

The more developed cities have a sewer and drainage system for municipal wastewater. Wastewater from homes run through lateral pipes that are connected to the main sewer, which leads to the trunk sewer. From the trunk sewer, wastewater is channeled into treatment facilities before final discharge. However, more often than not, the existing systems are in poor condition due to lack of maintenance, poor design and construction, as well as insufficient capacity.

Public storm water drainage systems are also used in some cities for municipal wastewater removal. Phuket Municipality, for example, has no public sewage disposal system.

In most towns and cities, municipal wastewater is generally discharged without treatment into rivers and lakes. Most households in the urban areas have flush toilets but the septic tank effluents are discharged into streets, ditches and natural water bodies. Only 40% to 50% of municipal wastewater is treated. Futhermore, environmental management and control of wastewater from both the public and private sanitation facilities is still lacking.

There is a wide variation of sewage systems among the ASEAN nations. There are countries that have high percentage of bucket latrines and communal septic tanks. In some countries, there is no system at all, particularly in the rural areas. In Vietnam, a central sewerage system is being built in Buon Thot province for the first time. On the other hand, 99 percent of the population of Singapore is serviced by a centralized treatment system.

On-site and off-site technologies for municipal wastewater treatment that are currently used in ASEAN countries in varying degrees are:

On-site
- Ventilated improved pit latrine (no water)
- Pour flush latrine/flush toilet with septic tank
- Soakway/soakage pits for septic tank effluent
- Communal/shared facilities for squatter areas

Off-site
- Small-bore sewer
- Septage cartage and treatment in multi-stage lagoons
- Simplified condominial (low cost) local sewers
- Dry weather flow interceptors
- Conventional trunk sewers and pumping stations
- Treatment of collected/intercepted wastewater by low cost means including multi-stage lagoons/aquatic plants
- Basic primary treatment and disposal through marine outfalls with diffusers or directly onto the land

Malaysia has about 1.2 million septic tanks, which account for about 53 percent of all sewage treatment plants in Malaysia. Other systems used are Imhoff tanks (24 percent), oxidation plants (12 percent) and mechanical plants (11 percent). In 1993, the government awarded a 28-year national sewerage privatization concession to Indah Water Consortium to upgrade and manage 5,400 public sewage treatment plants, upkeep over 7,400 km of sewer pipes, and desludge septic tanks regularly.

In the more developed countries, flush toilets are common. These sewerage systems function well and are adequately operated and maintained. Thailand has extensive treatment facilities and has a sewage plan for 2011. This plan includes construction of a mix of stabilization ponds, aerated lagoons, activated sludge systems and oxidation ditches, with drying beds or dewatering units for sludge treatment. However, in the Philippines only 1 percent of 1500

The common treatment systems used for industrial wastewater in ASEAN countries include:

- Oil interceptors – physical systems to capture oily discharges, allowing separation of oil from water,
- Balancing/equalization tanks – to homogenize variations in wastewaters over time or from different sources,
- Sedimentation/settling/clarifying systems - physical systems to enable the separation and removal of settleable solids from the water,
- Neutralization systems – adjustment of pH , acidity or alkalinity of the wastewater, to required levels for further treatment or discharge
- Chemical treatment systems – chemical process to either precipitate out the polluting compound (e.g. a heavy metal like copper) or cause destruction of the pollutant (e.g. cyanide) so that these can be removed from the treated wastewater, using coagulants/flocculants,
- Activated sludge systems – a biological treatment system to reduce the organic pollutants in wastewater,
- Biological filtration systems – uses biological growth to reduce organic pollutants in wastewater being filtered,
- Ion exchange systems – used for removing inorganic pollutants, normally complex compounds of heavy metals in wastewater,
- Activated carbon absorption –used for reducing fine organic contaminants, such as color pigments and odor-causing organic pollutants,
- Other aerobic and anaerobic systems – a large number of technologies are available in the form of biological systems, with aeration (aerobic), or in the absence of oxygen (anaerobic).

Depending on the characteristics of the wastewater stream, various combinations of the

©CETEC Malaysia

Photo 13: Example of Influent into Wastewater Treatment Plant

©CETEC Malaysia

Photo 14: Clarifier for Final Settling of Treated Effluent

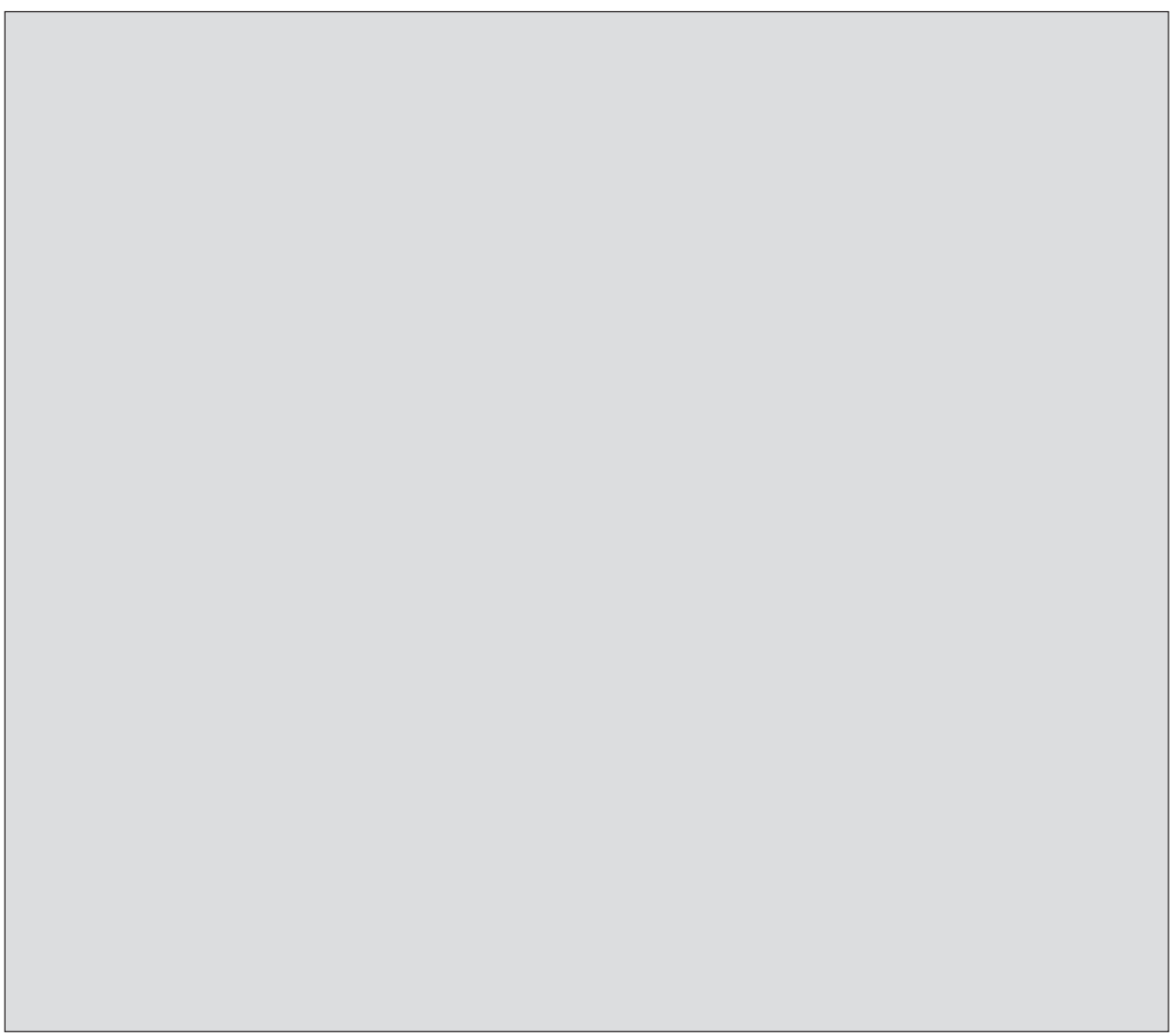
An associated issue in wastewater management is sludge management. Disposal of organic sludge is usually not regulated since it can be easily disposed of in the landfills or recycled in composting. The problem is disposal of chemical or inorganic sludge. In Malaysia, sludge is considered scheduled (or hazardous) waste, which has to be further treated before being approved for disposal. In Singapore, chemical sludge can be easily disposed of in landfills after fixation.

In many of the ASEAN countries, sludge is not treated but simply disposed of in local landfills. Because of a growing concern for potential environmental and health impacts from sludge, local governments are looking at ways to improve the system of sludge management but are constrained by limited resources.

F. Storm Water

In most of the ASEAN countries, storm water is discharged into the nearest water course and not into the sanitation systems that are usually designed to receive runoff generated by tropical thunderstorms. In the less urbanized areas, storm water is allowed to seep into the ground and also discharged into the nearest watercourse.

Data and records of storm water quantities, quality and incidences are lacking in many of the ASEAN countries, making it difficult to design the management of storm water. In the absence of the necessary information, in Malaysia, the Department of Irrigation and Drainage under the



G. Mixed Waste

In the developing countries of ASEAN where infrastructure and management accountability for waste management are lacking, the kind of waste that lands in municipal or public dumpsites and landfills is totally mixed waste. Mixed waste is the result of lack of differentiation of the sources of wastes. More often than not, mixed waste contains hazardous components, which can be harmful to the environment and most of all to the workers and scavengers at the landfills and the residents in the vicinity.

Mixed waste are breeding grounds of disease-carrying vectors like mosquitoes. They can contain toxic wastes, e.g. solvents, poison, heavy metals, and other chemicals that could leach into the groundwater and contaminate major source of drinking water. And should a fire breakout in the landfill or dumpsite, the toxic substances could produce air pollutants that would adversely affect the air quality of the neighborhood.

IV WASTE MANAGEMENT POLICIES AND STRATEGIES

A. National

In the ASEAN countries, various regulations and standards have been introduced for waste management. Many have sewer-related laws, which cover wastewater quality regulations for sewerage systems. Town or City planning Acts and water pollution control laws are normally related to such sewerage acts. Examples of acts/laws relating to waste management include:

Country: Brunei Darussalam

- National Development Plans and National Environment Strategy for broad policy statements on waste management
- Administrative procedure manuals and guidelines for waste handling and disposal
- Sectoral legislation - Penal Code, Minor Offences Act, Land Code, Water Supply Act, Petroleum Mining Act, Forestry Act, Fisheries Act, Miscellaneous Licensing Act and Municipal Boards Act.

Country: Cambodia

- Law on Environmental Protection and Natural resources management
- Sub-Decree on Solid Waste Management
- Sub-Decree on Water Pollution Control

Country: Indonesia

- Environment Management Act Number 23, 1997
- Government Regulation Number 82, 2001 (Water Quality Management and Wastewater Controlling
- Local Government Regulation – each district
- Government Regulation Number 18, 1999 juncto Government Regulation Number 85, 1999 about Hazardous Waste Management
- Presidential Decree Number 61, 1993 about Basel Convention Ratification on the Control of Trans-Boundary Movement of Hazardous Waste and Their Disposal
- Number Kep-01 to Kep-05/BAPEDAL/09/1995 Various procedures and requirements for hazardous and toxic wastes
- Number Kep-68/BAPEDAL/05/1994 on procedures for license for hazardous waste s torage, collection, operations of treatment equipment, treatment and final disposal.

Country: Lao PDR
- Ministry of Industry and Handicraft Decree on Industry Management, 1992
- Ministry of Industry and Handicraft Decree on Discharges and Emissions, 1994
- Environmental Action Plan 1993, revised 1995
- Environmental Protection Law

Country: Malaysia
- Environmental Quality Act 1974, and its subsidiary legislation thereunder
- Local Government Act 1976
- Street, Drainage and Building Act 1974
- Drainage Works Ordinance 1954 (Revised 1988)
- Urban Storm water Management Manual for Malaysia 2000

Country: Myanmar
- Pollution Control and Cleansing Rule
- The Protection of Environment Directive
- The Municipal Act
- The City of Yangon Municipal Act
- The Union of Myanmar Public Heath Act
- Mandalay City Development Committee regulation

Country: Philippines
- Integrated Environmental Protection and Natural Resources Management Policy 25
- Presidential Decree 1586 The Environmental Impact Statement (EIS) System
- Presidential Decree 984 Pollution Control Law, 1978: Water Quality Management Program
- Clean Air Act 1999 (RA 8749)
- Solid Waste Management Act (RA 9003), Ecological Solid Waste Management Act of 2000
- Toxic Chemicals and Hazardous Waste Management (RA 6969)
- The Philippine Agenda 21

Box 2
Philippines Republic Act 9003: Year 2000, Approved in January 2001

An Act providing for an Ecological Solid Waste Management Program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited and providing penalties, appropriating funds therefore, and for other purposes.

Country: Singapore

- Environmental Public Health Act: Environmental Public Health (General Waste Collection) Regulations - under the National Environment Agency - Environmental Public Health Toxic Industrial Waste) Regulations
- Sewerage and Drainage Act and associated subsidiary legislation - under the Public Utilities Board
- Environmental Pollution Control Act and its Regulations - under the National Environment Agency
- Hazardous Waste (Control of Export, Import and Transit) Act - Hazardous Waste (Control of Export, Import and Transit) Regulations

Country: Thailand

- Enhancement and Conservation of National Environmental Quality Act, B.E. 2535
  - Water Quality Standards
  - Solid Waste, Night soil and Hazardous Waste Management
  - Toxic Substance Legislation

Country: Vietnam

- National Conservation Strategy 1988
- Law on Environmental Protection 1994
  - Directive on Urgent Measures on Solid Waste Management in Urban & Industrial Areas, 1997
  - Decision on Hazardous Waste Management 1999
- National Plan for Environment & Sustainable Development 1999

While statements on sanitation are usually very positive in long-term plans and development strategies, generally, waste management as a priority is not as high as other development priorities. Budgets for waste management are generally low. For example, in Indonesia, its overall budget in 2001 and 2002 for Environmental Sector was only 1 percent of the National Budget.

B. Institutional Arrangements

In the ASEAN countries different aspects of waste are managed by different agencies, as illustrated in the following table. The local governments are also expected to manage waste, especially municipal solid waste and some special waste, such as, waste from slaughterhouses.

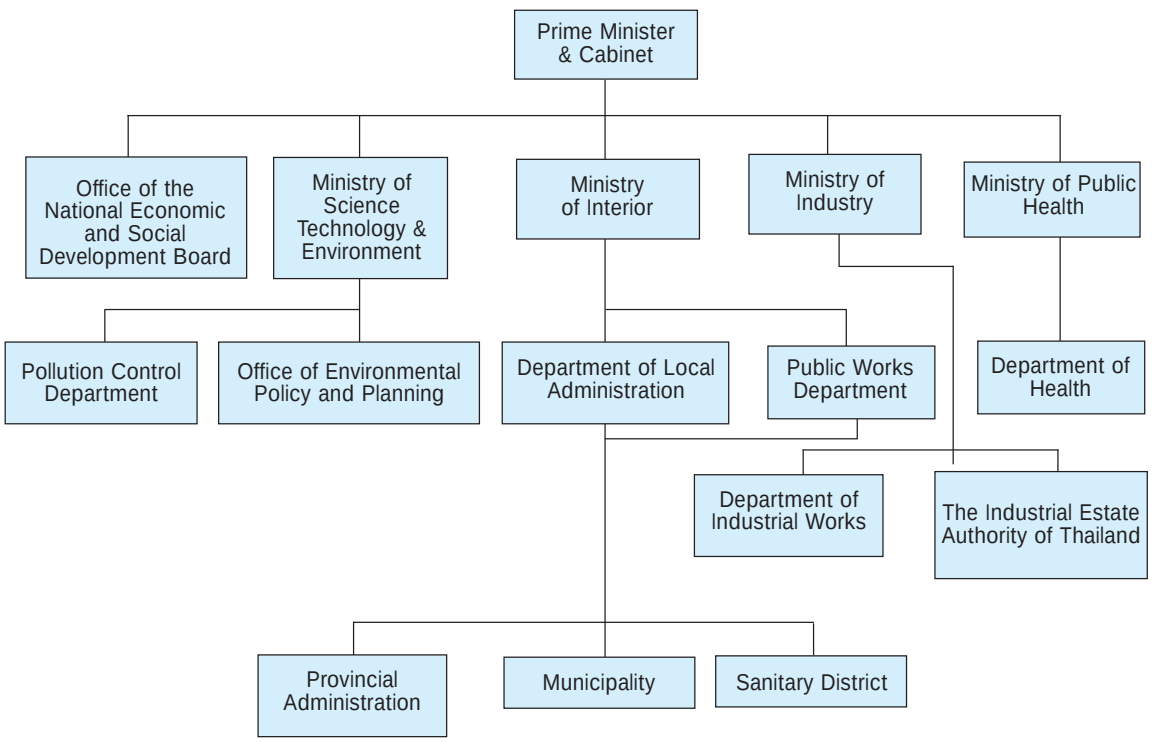
In some countries, the institutional framework for waste management is complex and without a clear definition of roles and responsibilities. There is overlapping or duplication of activities in some areas, but there are also grey areas or concerns where no activities take place because there is no particular agency identified as responsible.

Table 8: Summary of Main Agencies Responsible for Waste Management in the ASEAN Countries

Country	Municipal solid waste	Industrial solid waste	Municipal wastewater	Industrial wastewater	Storm water	Hazardous waste
Brunei Darussalam	• Department of Environment, Parks and Recreation • Public Works Department	• Department of Environment, Parks and Recreation • Public Works Department	• Department of Environment, Parks and Recreation • Public Works Department	• Department of Environment, Parks and Recreation • Public Works Department	• Department of Environment, Parks and Recreation • Public Works Department	• Department of Environment, Parks and Recreation • Public Works Department
Cambodia	• Dept. of Environmental Pollution Control. • Office of Solid Waste and Hazardous Substances Management • The Municipal Department of Public Works and Transport	• Dept. of Environmental Pollution Control. • Office of Solid Waste and Hazardous Substances Management	• The Municipal Department of Public Works and Transport.	• Dept. of Environmental Pollution Control. • Office of Water and Soil Quality Management.	• The Municipal Department of Public Works and Transport.	• Dept. of Environmental Pollution Control. • Office of Water and Soil Quality Management.
Indonesia	• Ministry of Environment	• Ministry of Environment	• Ministry of Environment	• Ministry of Environment	• Ministry of Environment	• Ministry of Environment
Lao PDR	• Ministry of Communications, Transport, Post & Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post & Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors	• Ministry of Communications, Transport, Post & Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post & Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors	• Ministry of Communications, Transport, Post & Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post & Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors	• Ministry of Communications, Transport, Post and Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post and Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors	• Ministry of Communications, Transport, Post and Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post and Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors	• Ministry of Communications, Transport, Post and Construction (MCTPC) (national level solid waste management) • Department of Communications, Transport, Post and Construction (DCTPC) at provincial level. • Special municipal committees under provincial governors
Malaysia	• Dept. of Local Government • Dept. of Environment	• Dept. of Local Government • Dept. of Environment	• Sewerage Services Dept. • Dept. of Environment	• Dept. of Environment	• Dept of Irrigation and Drainage. • Dept. of Local Government	• Dept. of Environment
Myanmar	• City Development Committees	• City Development Committees • Ministry of Industry	• City Development Committees	• City Development Committees • Ministry of Industry	• City Development Committees	• City Development Committees • Ministry of Industry
Philippines	• Local Government Unit/ Dept of Interior & Local Government • All members of National Solid Waste Management Commission	• Department of Environment and Natural Resources	• Local Government Unit/ Dept of Interior & Local Government	• Local Government Unit/ Dept of Interior & Local Government • Department of Environment and Natural Resources	• Bureau of Soils & Water Management • Dept of Public Works & Highways • Phil Atmospheric Geophysical & Astronomical Services Admin.	• Department of Environment and Natural Resources/ Environment Management Bureau
Country	**Municipal solid waste**	**Industrial solid waste**	**Municipal wastewater**	**Industrial wastewater**	**Storm water**	**Hazardous waste**
Singapore	• National Environment Agency	• National Environment Agency	• Public Utilities Board • National Environment Agency	• National Environment Agency	• Public Utilities Board	• Pollution Control Dept. • National Environment Agency
Thailand	• Ministry of Science Technology and Environment	• Ministry of Science, Technology and Environment • Department of Industrial Works	• Ministry of Science, Technology and Environment	• Ministry of Science, Technology and Environment • Department of Industrial Works	• Ministry of Science Technology and Environment	• Ministry of Science, Technology and Environment • Department of Industrial Works
Vietnam	• Ministry of Science, Technology and Environment • Urban Environment Companies	• Ministry of Science, Technology and Environment • Urban Environment Companies	• Ministry of Science, Technology and Environment • Urban Environment Companies	• Ministry of Science, Technology and Environment • Urban Environment Companies	• Ministry of Science, Technology and Environment • Urban Environment Companies	• Ministry of Science, Technology and Environment • Urban Environment Companies

In Thailand, for example, the institutional framework for water pollution control was a complicated one, as illustrated in Figure 4, before the current restructuring exercise.

Figure 4: Institutional Framework for Water Pollution Control, Thailand



Source: UNEP IETC, 2002

Integrated solid waste management is practised to some extent in some of the ASEAN member countries although IWM is more sectoral than comprehensive. For instance, Singapore uses the IWM approach in managing municipal and industrial solid waste as well as for managing municipal wastewater and storm water. Malaysia uses the IWM approach in managing its industrial wastewater and hazardous waste. The Philippines uses the IWM approach in its national solid waste management program.

Some of the tools the ASEAN countries use to implement IWM include:

- Research and database development
- Planning and management
- Regulatory and enforcement
- Awareness and education
- Technical assistance, capacity building and information exchange

In most ASEAN countries, it is the national or federal authorities that establish the policy for waste management as well as develop the appropriate legislation and standards for policy implementation at local government level. The provincial and state governments implement environmental management programs, including waste management, by applying considerable investment in planning, staff training, purchasing equipment and providing support. However, since most local authorities have inadequate financial resources and central governments often do not have sufficient revenue raising powers, conflicts of interest arise within and between local authorities over the benefits of economic development versus environmental protection.

Governments are also trying to mobilize community-based organizations (CBOs) and non-government organizations (NGOs) to strengthen environmental management at the local level especially in the areas of public awareness and education. NGOs are growing in number and they have professionals who can provide technical advice and help in coordinating small-scale environmental projects in low-income countries. But in most countries, community mobilization is still largely on an informal basis, except in the Philippines, which has a legislation that requires involvement of NGOs and the private sme o/dinating 1e co 8021anizbme ynity

Most of the ASEAN countries lack revenues to support waste management. Their fiscal and financing policies are weak as well. While the 'polluter pays' policy has been generally accepted by ASEAN countries, however, the implementation of the policy has not taken place. The public, including most waste generators, expect the bulk of capital, operating and maintenance expenditures for waste management to be borne by the government since current tariffs are low, budget support for waste management is disproportionately low compared to the cost of services. Clear policies and objectives with supporting financial mechanisms and strategies to establish a sustainable base for waste management are most needed in all the countries.

It is recognized in most ASEAN countries that IWM is an important tool. Some agencies, e.g. DEPC of Cambodia and DOE of Malaysia are currently engaged in defining responsibilities, strengthening capacity and improving the utilization of existing and future resources for waste management. However, in all the ASEAN countries, the need for human financial and technical resources for waste management is common. Specifically, their needs are in the following areas:

(i) expertise in planning and management
(ii) analytical equipment
(iii) supporting budget
(iv) technologies for waste management
(v) establishment and maintenance of waste sector databases

C. Future Plans

The Singapore Green Plan 2012 has a "zero landfill" objective for the longer term. It includes a national waste recycling program, which has a target of 60 percent recycling by 2012. More commercial applications for recycled products are being currently developed. An Eco-Recycling park has been set up and a private sector initiative - Waste Minimization and Recycling Association of Singapore - has been established.

Malaysia is encouraging self-regulation and waste minimization by developing programs, such as, MAWAR (Malaysian Agenda for Waste Reduction) and Cleaner Production to educate industry in particular and the public in general on government efforts towards IWM. Malaysia's National Solid Waste Action Plan will be ready by end of 2003. The Urban Storm Water Management Manual released in 2001 provides guidance for storm water management. All its programs towards Integrated Waste Management will be guided by the recently launched National Environmental Policy 2002.

Indonesia is developing a National Policy for Drinking Water and Environmental Sanitation for

D. Regional and International Cooperation

On the international level protocols, such as, the Basel Convention provide measures for control of transboundary movement of hazardous wastes. It is envisaged that regional cooperation initiatives can help alleviate or resolve some of the issues raised by the ASEAN countries that lack resources for IWM. Currently, there are short to medium-term bilateral programs between individual ASEAN member countries and with some European countries (e.g. Denmark, Germany, Sweden), U.S.A, and Japan, which are helping to fill short-term gaps and assist in longer-term planning for various aspects of waste management, including IWM.

Existing bilateral/regional programs with involvement of one or more of ASEAN member countries include the following:

1) Asian Development Bank projects with most of the ASEAN member countries (regional and bilateral)
2) Asia-Pacific Roundtable for Cleaner Production (regional)
3) Canada, e.g. CIDA (mainly bilateral)
4) Denmark, e.g. Danida (and the former Danced) projects with Thailand, Malaysia, etc. (mainly bilateral)
5) Germany, e.g. CDG, INWENT (regional and bilateral)
6) Global Environment Center, Japan (mainly regional)
7) Japan, e.g. JICA, with most of the ASEAN member countries (mainly bilateral)
8) Regional Network of Local Authorities For the Management of Human Settlements (mainly regional)
9) Sweden, e.g. SIDA (mainly bilateral)
10) UNDP-GEF (regional and bilateral)
11) UNDP – The Urban Governance Initiative (mainly regional)
12) UNEP-IETC (regional and bilateral)
13) UNEP/ROAP (regional and bilateral)
14) UN Habitat (regional and bilateral)
15) Urban Waste Expertise Program (regional and bilateral)
16) United States Asian Environment Partnership (regional and bilateral)
17) Waste Management Asia (regional and bilateral)
18) World Health Organization (regional and bilateral)

V CONCLUSIONS

There is a growing concern among the ASEAN countries on the increasing rate of waste generation as their populations grow. There is a significant variation of waste types and in percentages of waste generation due to varying income levels and extent of urbanization in the different countries. There are a number of laws for waste management but in most countries these do not address waste management in its entirety. What is especially missing is legislation for storm water management.

The institutional framework for waste management in most ASEAN countries is unclear. Specific government agencies are mandated to manage different waste sectors but their roles and responsibilities are clearly defined. Furthermore, data collection has to be improved especially in terms of quantification and characterization of wastes and their impacts on environment and health.

IWM is practiced to some extent and only in some waste sectors. For instance, Singapore uses the IWM approach for municipal and industrial solid waste, while Malaysia uses the same approach for industrial wastewater and hazardous waste. Generally, a majority of ASEAN countries suffer from lack of resources, notably, financing, technologies, capacity and skills for waste management. However, all member countries of ASEAN aim to be able to apply IWM in some, if not all, of the waste sectors in the future. It is envisaged that a facility for regional cooperation would be able to assist in this respect, by enabling the exchange of ideas and resources among member nations. This facility would allow and prepare the region as a whole to be better equipped for managing wastes now and in the future on a more sustainable basis.

In summary, Table 9 provides an overview of the general waste management status in the ASEAN countries, which is reflected in terms of availability of formal policies, institutional and regulatory frameworks, budget support, training programs, participation from the private sector and the communities, and information system for waste management.

Table 9: Summary of Waste Management Status in the ASEAN Countries

Waste Management Aspect	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
1. Policy on Integrated Waste Management	NA	NA	NA	NA	NA	NA	NA	A	NA	NA
2. Policy on Solid Waste Management	NA	NA	NA	NA	NA	NA	A	A	A	NA
3. Institutional arrangement to handle/ manage wastes	A	A	A	NA	A	A	A	A	A	A
4. Regulatory framework for waste management	NA	NA	A	NA	A	NA	A	A	A	A
5. Budget support for waste management	A	NA	NA	NA	A	NA	A	A	A	A
6. Training program for waste management	NA	NA	NA	NA	NA	NA	NA	A	NA	NA
7. Private sector participation	NA	NA	NA	NA	A	NA	A	A	A	NA
8. Community participation	NA	NA	A	NA	NA	NA	A	NA	A	A
9. Information system	NA	NA	NA	NA	NA	NA	NA	A	NA	NA

ANNEX
ASEAN DIRECTORY OF INFORMATION SOURCES FOR WASTE MANAGEMENT

This initial inventory of resources for IWM covers main government and international agencies, many of which are focal points for waste related policies and management programs and services for individual countries or for the region. The agencies maintain their own list of experts or consultants on the different aspects of waste management.

1. Asia Pacific Roundtable for Cleaner Production

907-A West Tower, Philippine Stock Exchange Center,
Exchange Road, Ortigas Center, Pasig City, Metro Manila, Philippines 1604

Tel : +632-637-9537;631-4648
Fax : +632-637-9540
Email : aprcp@info.com.ph
Contact : Dr. Olivia Castillo,
Chair and President

Description : The mission of Asia Pacific Roundtable for Cleaner Production is to foster dialog among industry, government, academia, and non-government organizations in the region to address pollution problems and solutions. Its goals include promoting information exchange among its members through the APRCP website, newsletters, e-mail list servers, technical journals, special publications, conferences, and symposia to provide leadership and support that will enhance information flow and human resource development, and will strengthen public-private partnership to stimulate the promotion and implementation of Cleaner Production strategies and technologies in the region.

Website : http://www.aprcp.org
Consulting/support services : Provided by members
Fees : Some materials are distributed free and others at a low cost

2. Asian Development Bank (Philippines Country Office)

6 ADB Avenue, Mandaluyong City, 0401 Metro Manila Philippines

Tel : + 63-2-683-1000
Fax : + 63-2-683-1030
Email : phco-mailbox@adb.org
Contact : Dr. Shih-Liang Tu
Environmental Specialist

Description : ADB is a regional development bank, which makes loans and equity investments for the economic and social advancement of Asian countries, provides technical assistance in the preparation and execution of development projects, and catalyses investment of public and private capital for development purposes. Communication is in English.

Website : http://www.adb.org/
Consulting/support services : Responds to requests for assistance in coordination development policies and plans
Fees : some materials are distributed free and others at a low cost

3. Asian Society for Environmental Protection (ASEP, Bangkok)
Rm. IC 1-210-211,131 Thailand Science Park, Paholyothin Road, Klong 1, Klong Luang, Pathumthani 12120,Thailand

Tel : +66 2 564 7945
Fax : +66 2 564 7944
Email : asep@asepinfo.org
Contact : The Secretary-General
Editor, ASEP Newsletter

Description : ASEP is an international non-profit association composed of professionals and institutions committed to the pursuit of sound environmental management and protection towards achieving sustainable development in the Asian Region. It has many publications on environmental and waste management issues. Information is in the form of newsletters, news reports and articles in English.

Website : http://www.asepinfo.org
Consulting/support services : Provided by members of the Society
Fees : Computer printouts are free of charge; reports at cost of reproduction, publication research services at cost.

4. Department of Environment and Natural Resources (DENR, Philippines)
DENR Building
Visaya Ave Diliman
Quezon City 1116
Philippines

Tel : +63 2 920 2252
Fax : +63 2 922 6991
Email : albertmg@emb.gov.ph, ecowaste@emb.gov.ph
Contact : Albert Magalang
Executive Director, National Solid Waste Management Commission Secretariat.

Description: DENR sets policies, formulates plans, disseminates environmental information. Promulgates rules and regulations for environmental protection. Establishes management policies and quality standards for environment with pollution control, provisions for air, water quality, land use management, natural resources management and conservation. Information is provided via reports, pamphlets and guidebooks, which are available in Tagalog and English.

Website : http://www.denr.gov.ph, http://www.emb.gov.ph
Consulting/support services : Provides technical support to government agencies including local government.
Fees : None or at very low cost

5. Department of Environment (DOE, Malaysia)
Ministry of Natural Resources and the Environment, Levels 3-7, Block C4
Federal Government Administration Complex, 2662 Putrajaya, Malaysia

Tel : +60 3 88858200
Fax : +60 3 88889987
Email : hri@jas.sains.my
Contact : Puan Hajah Rosnani Bt. Ibarahim, Director-General

Description : The Department administrates and enforces the Environmental Quality Act and associated legislation. It is responsible for coordinating activities related to waste discharges into the environment and on the prevention and control of pollution (including licensing) to protect and enhance the quality of the environment. DOE publishes an annual Environmental Quality Report and environmental awareness information. Publications are in English and Malay.

Website : http://www.doe.gov.my
Consulting/support services : Provides training on environmental management and related technical skills for environmental enforcement. Provides advice to other government agencies and funds selected environmental awareness programs.
Fees : None or at cost

6. Department of Environmental Pollution Control (DEPC, Cambodia)
#48, Samdech Preah Sihanouk
Tonle Bassac, Chamkarmon
Phnom Penh, Cambodia

Tel : +855 12 926108
Fax : + 855 23 987880
Email : moelab@bigpond.com.kh
Contact : Mr. Heng Nareth, Director

Description : Controls/monitors official activities on solid and industrial waste management and water pollution management, including issuing appropriate measures to curb and phase out environmental pollution activities.

7. Development Technology Center of the Bandung Institute of Technology – Indonesia
Jalan Ganesha 17
Bandung 40132
Indonesia

Tel : +62 22 250 3307
Fax : +62 22 250 1768
Email : dtcitb@ibm.net
Contact : Lanny T. Hardhy

Description : The centre works on municipal solid waste management issues as part of its Village Technology Development Program. It runs training courses and promotes composting and appropriate recycling practices. It evaluates and monitors composting programs all over Indonesia, working with NGOs under the aegis of UN Habitat, through the Metropolitan Environmental Improvement Program (MIEP). The center conducts seminars and produces reports and pamphlets, mainly in Indonesian, an in English for international dissemination.

Website : -
Consulting/support services : Provides advice on urban solid waste management and community development projects, and conducts workshops on experimental technology.
Fees : usually negotiated.

8. Drainage and Irrigation Department (DID, Malaysia)
Ministry of Natural Resources and Environment,
Jalan Sultan Salahuddin
50620 Kuala Lumpur

Tel : + 603 2697 2401
Fax : + 603 2697 2411
Email : kp@water.gov.my
Contact : Datuk Ir. Hj. Keizrul Abdullah
Director-General
Description : Provides flood mitigation works in rural areas and carry out similar works in urban areas on behalf of the local authorities.

Website : http://www.water.gov.my
Consulting/support services : Provides technical support to government agencies including local government.
Fees : None or at very low cost

11. Environmental Systems Information Center (ENSIC, Thailand)

Asian Institute of Technology
P.O. Box 4
Klong Luang
Thailand

Tel : +66 2 524-5863
Fax : +66 2 524-5870
Email : enreric@ait.ac.th
Contact : Manager
Information Centers

Description : ENSIC facilitates dissemination, evaluation and discussion of research, case studies, and field experiments related to environmental policy, management and engineering, in the following issues – solid waste, wastewater, hazardous waste, air and noise pollution, soil pollution, land management, water supply, clean technology, biological resources management, health and sanitation, environmental impact assessment, and environmental economics. It publishes technical reports and papers, manuals, guidebooks and newsletters in English.

Website : -
Consulting/support services : AIT undertakes contract research and consulting services.
Fees : ENSIC membership rates are US$130 for institutions, US$80 for individuals

12. Hanoi Sewerage Drainage Company (HSDC, Vietnam)

8 Van ho
Hanoi
Vietnam

Tel : +84 49 762245
Fax : +84 49 762663
Email : urencohn@netnam.or.vn
Contact : Le Minh Chau, Director

Description: HDSC is responsible for the implementation, operation and maintenance of the drainage and sewerage system. The agency reviews and amends existing environmental framework as necessary. It recommends and provides fiscal instruments for pollution abatement and improvement of environmental capacity in government, the private sector and communities. It publishes reports, books, technical papers, newsletters, manuals, and handbooks mainly in Vietnamese.

Website : -
Consulting/support services : Undertakes contract construction, operation and maintenance of the sewage system
Fees : none or at very low cost.

13. Hanoi Urban Environment Company (URENCO, Vietnam)
18 Cao Ba Quat Street, Hanoi, Vietnam

Tel : +84 823 0062
Fax : +84 4 823 2566
Email : none
Contact : Nguyen Duc Hoa
Deputy Director

Description : URENCO deals with Municipal Solid Waste Management, mainly in Hanoi including collection, transfer, and disposal of MSW and special wastes such as construction/demolition debris and hospital wastes. It supervises the picking of recyclables, operates and maintains landfills and composting facilities. URENCO also sets guidelines and provides skills development training for MSWM personnel. It's reports guidelines, and pamphlets are mainly in Vietnamese.

Website : -
Consulting/support services : Undertakes contract MSWM services
Fees : Materials are available at cost

14. Industrial Technology Development Institute
Department of Science and Technology, Philippines
DOST Compound, Gen. Santos Ave.,
Bicutan, Taguig Metra Manila, Philippines 1631

Tel : +63 2 837 2071
Fax : +63 2 837 3167
Contact : Dr. Nuna E. Almanzor
Office of the Director
E-mail : nea@dost.gov.ph
Engr. Severino T. Bernardo
Deputy Director, R&d
E-mail : verber@dost.gov.ph

Description : The Department of Science and Technology (DOST) is the country's leading agency in science and technology with the twin mandate of providing central direction, leadership and coordination of all scientific and technological activities, and of formulating policies, programs and projects to support national development. It has adopted the vision of a competent and competitive science and technology community with a social conscience geared towards national economic growth. The Industrial Technology Development Institute (ITDI) is one of the agencies of DOST and is the country's premier research and development institute. ITDI's major functions are: research and development, technology transfer and contract projects, test, analyses and calibration, industry training and skill development, technical information, design and fabrication, use of laboratory and pilot plant facilities and technology business incubators. It is implementing a project on Ecological Solid Waste Management, and is also implementing the Integrated Program on Cleaner Production Technologies (IPCT), one of the flagship programs of DOST. The Implementers's Guidebook on Solid Waste Management Technologies is currently being prepared.

Website : http://dost.gov.ph
http://mis.dost.gov.ph/itdi
http://cptech.dost.gov.ph
Consulting/support services : -
Fees : -

15. Manila Waste Sewer System (MWSS, Philippines)
Katipunan Road
Balara, Quezon City
Philippines

Tel : +63 2 922 3757
Fax : +63 2 921 2887
Email : MWSSrvea@info.com.ph
Contact : Dr. Raynaldo B. Ves
General Director

Description : MWSS owns the entire assets of infrastructure from sourcing through treatment and transmission to distribution in the Manila Areas. Reports, code of practice, manuals and guidebooks are published in English

Website : -
Consulting/support services : Gives technical advise to government agencies
Fees : None

16. Ministry of Construction (Vietnam)
Vietnam Consultant on Water Supply Sanitation and Environment
37 Le Dai Hanh Street,
Hanoi, Vietnam

Tel : +84 4 9760734
Fax : +84 4 9762153
Email : viwase@hn.vn
Contact : Dr. Nguyen Nhu Ha, General Director

Description : A government owned company responsible for management of scientific research, technology and consultant on water supply, solid waste and waste water treatment. Provides technical reports and scientific/technical papers in local and international journals, mainly in Vietnamese.

Website : -
Consulting/support services : Provides consulting and support services to municipalities and other government bodies.
Fees : Depend on project, often low

17. Ministry of Public Works (Indonesia)

Jaalan Raden Patah T/1
Annex Building, 2nd Floor
Keb Baru, Jakarta 12110
Indonesia

Tel : +62 21 739 7792
Fax : +62 21 739 7792
Email : -
Contact : Ir. Dr. Darmawan Saleh, Director of
Directorate of Environmental Sanitation and Director General
of Directorate of Human Settlement

Description : A government body responsible for the planning, development and administration of infrastructure and public amenities. The Directorates study and assess development projects subject to environmental impact assessment, evaluate pollution control systems, provide environmental input to development agencies, carry out enforcement on pollution sources, review regulations, and disseminate environmental information to the public. Reports, pamphlets, code of practice, regulations and human resource development guidebooks and manuals are published mainly in Indonesian with some in English and other languages.

Website : -
Consulting/support services : Give technical advice and expertise to local authorities and other government agencies.
Fees : Free to government and libraries, low cost to the public.

18. Ministry of Science, Technology and Environment (Thailand)

60/1 Soi Phibun Wattana 7
Rama VI Road
Bangkok 10400
Thailand

Tel : +66 2 279 0129
Fax : +66 2 279 0672
+66 2 246 8016
Email : -
Contact : Dr. Pakit Kisaranit, Director General of
Pollution Control Department

Description : Ministry proposes and enforces environmental laws and regulations, develops national networks of monitoring systems, and disseminates environmental information to the public to enhance environmental awareness and education. It provides funds and trainers for various projects and educational activities. It publishes reports, codes of practice, laws and regulations, pamphlets, manuals and guidebooks for training and public education, mainly in Thai. Editions in English and other languages may be available.

Website : -
Consulting/support services : Provides technical support services to local authorities and other government agencies.
Fees : None

19. Ministry of Natural Resources and Environment (NRE, Malaysia)
Block C5
Federal Government Administration Complex
62502 Putrajaya
Malaysia

Tel : +60 3 88858034
Fax : +60 3 88892973
Email : nadzriy@nre.gov.my
Contact : Dr. Nadzri Yahaya, Deputy Director,
Conservation and Environmental Management Division

Description : Responsible for conservation and management of the quality of the natural environment in the context of sustainable development. It also acquires, sustains and applies science and technology for national economic and social development. Publications include policies and action plans.

Website : http://www.nre.gov.my
Consulting/support services : Develops, coordinates, popularizes and conducts research, and advises the government on matters pertaining to R & D of science and technology and the environment.
Fees : None

20. Ministry of Housing and Local Government (Malaysia)
Level 3 - 7, Block K,
Pusat Bandar Damansara, P.O. Box 12579
50782 Kuala Lumpur
Malaysia

Tel : +60 3 2094 7033
Fax : +60 3 2094 9720
Email : pro@kpkt.gov.my, pentadbiran@kpkt.gov.my
Contact : Secretary General

Description : Planning corporate policy, coordinating and evaluating development programs of the Ministry and its Departments. Issues housing developers' licences.

Website : http://www.kpkt.gov.my
Consulting/support services : Provides information and advisory services and guidelines to existing developers and potential developers and to consumers on complaints concerning housing. Information provided is in Malay and English.
Fees : None for information and guidelines

21. Ministry of State for Population and the Environment (Indonesia)
15 B Jalan Merdeka Barat
Jakarta 10110
Indonesia

Tel : +62 21 374 563
Fax : +62 21 385 7578
Email : -
Contact : Mr. M. S Kismadi, Special Assistant

Description : Formulates policies, promulgates laws and regulations. Reviews and amends existing framework as necessary. It recommends and provides fiscal instruments for pollution abatement and improvement of environmental management capacity in government, the private sector and in communities. It publishes laws and regulations, code of practice, reports, guidebooks, pamphlets, and information fact sheets on environment and waste management, mainly in Indonesian, with some editions in English and other languages.

Website : None
Consulting/support services : Provides fund and technical support to government agencies and communities.
Fees : Materials are available free or at very low cost.

22. The Municipal Department of Public Works and Transport (Cambodia)

Description : Sewage system management

23. National Centre for Scientific Research of Vietnam
Nghia do
Tu liem
Hanoi
Vietnam

Tel : +84 47 562763
Fax : +84 48 354076
Email : -
Contact : Pham van Luc, Leader of the Environment Department

Description : A government body involved in research and development in various issues including waste management. It helps formulate facilities, plans and monitoring systems. It advises government bodies on environmental issues and policy. Produces reports, books, technical papers, newsletters, manuals and handbooks mainly in Vietnamese, with some publications in other languages.

Website : -
Consulting/support services : Undertakes R & D projects and provides technical support services to government bodies.
Fees : None or at very low cost

24. National Environment Agency (Singapore)
Environment Building #13-00
40 Scotts Road
Singapore 228231
Resource Conservation Department (Singapore)

Tel : +65 6731 9157 (Vaneeta Bhojwani – Waste minimisation/recycling)
Email : Vaneeta_Bhojwani@nea.gov.sg
Tel : +65 6731 9198 (Ng Tiong Wei – Refuse collection/dsiposal)
Email : Ng__Tiong_Wei@nea.gov.sg

Pollution Control Department (Singapore)
Tel : +65 6731 9670 (Mr. P. Jothieswaran)
Email : Jothieswaran_poobalasingam@nea.gov.sg
Tel : +65 6731 9652 (Mr. Leong Kwai Yin)
Email : Leong_Kwai_Yin@nea.gov.sg

Description: The National Environment Agency (NEA) was formed under the Ministry of the Environment and Water Resources (MEWR) on 1 July 2002 to focus on the implementation of environmental policies.
Website: www.nea.gov.sg

25. National Environmental Protection Agency (Vietnam)
67 Nguyen Du Street,
Hanoi
Vietnam

Tel : +84 04 942 4581
Fax : +84 04 822 3189
E-mail : pcsdl@nea.gov.vn

Contact : Nguyen Ngoc Sinh, Director

Description : The Department of Pollution of this agency is involved in all aspects of pollution control including solid waste management and enforcement of regulations on pollution. The Agency is responsible for strategic planning, development of appropriate legislation, applied research for environmental management, environmental monitoring and planning, and is involved in the development of waste disposal facilities. Publications of reports, handbooks, manuals and codes of practice are in Chinese with some editions in other languages.

Website : www.nea.gov.vn
Consulting or support services : Provides technical support services to various government bodies.
Fees : Materials are free or available at very low cost.

26. Office of Solid Waste and Hazardous Substances Management (Cambodia)
#48, Samdech Preah Sihanouk
Tonle Bassac, Chamkarmon
Phnom Penh, Cambodia

Tel : +855 12 926108
Fax : + 855 23 987880
Email : moelab@bigpond.com.kh
Contact : Mr. Yem Dararath, Chief

Description : Controls/monitors slid waste disposal and landfill management, controls/ monitors wastewater discharging from pollution sources and evaluating the pollution level, based on analytical results.

27. Policy and Planning Department (Thailand)
Division of Infrastructure and Environment
Bangkok Metropolitan City Hall
Bangkok 10200
Thailand

Tel : +66 2 224 2978, +66 2 224 4683
Fax : +66 2 225 7947, +66 2 224 2988
Email : -
Contact : Br-Ing Ksemsan Suwarnarat
Mr. Chanchai Pavasuthikam

Description: The Department formulates policies, plans and strategies for waste management; evaluates and conducts R & D in environmental management, monitoring and control. It plans waste disposal facilities, code of practice, and human resource development programs. It publishes reports, handbooks, manuals, and code of practice on specific issues mainly in Thai.

Website : -
Consulting/support services : Provides technical supporting service to municipalities and government bodies.
Fees : None or at very low cost

28. Public Utilities Board (PUB, Singapore)
111 Somerset Road #15-01
Singapore 238164

Tel : +65 6731 9525 (Mr. Lim Eng Chuan - Municipal wastewater)
Email : Lim_Eng_Chuan@pub.gov.sg
Tel : +65 6731 9608 (Mr. Tan Yok Gin – Municipal wastewater)
Email : Tan_Yok_Gin@pub.gov.sg
Tel : +65 6731 9918 (Mr. Lim Meng Check – Flood management)
Email : Lim_Meng_Check@pub.gov.sg
Tel : +65 6731 7526 (Mr. Ngaim Hai Guan – Stormwater collection)
Email : Ngaim_Hai_Guan@pub.gov.sg
Fax : +65 6731 3020
Website : www.pub.gov.sg

29. UNEP International Environmental Technology Centre (IETC, Japan)

Osaka Office
2-110 Ryokuchi-koen
Tsurumi-ku
Osaka 538-0036
Japan

Tel : +81 6 6915 4581
Fax : +81 6 6915 0304

Shiga Office
1091 Oroshimo-cho, Kusatsu City
Shiga 525-0001
Japan

Tel : +81-77-568-4581
Fax : +81-77-568-4587
Email : ietc@unep.or.jp
Contact : Ms. Lilia Casanova, Deputy Director

Description : UNEP IETC promotes environmentally sound technologies (ESTs), including their transfer and utilization. IETC has published a Source Book on ESTs in municipal solid waste management and have comprehensive database on ESTs. It has undertaken a survey of 400 organizations involved in EST information dissemination in 1995. IETC's reports, newsletters and training materials are available in English.

Website : http://www.unep.or.jp
Consulting/support services : Provides advisory services to government upon request.
Fees : None

30. United Nations Centre for Regional Development (UNCRD, Japan)

1-47-1 Nagono, Nakamura-ku
Nagoya 450
Japan

Tel : +81 52 5619377
Fax : +81 52 561 9375
Email : environment@uncrd.or.jp
Contact : Choudhury Rudra Charan Mohanty

Description: UNCRD is a research and training institution dealing with regional (sub national) and urban development planning. It has conducted research projects and meetings on different aspects of MSW management, including partnerships in cooperation with some ASEAN government institutions. The Center disseminates MSWM information in developing countries through its newsletter, "SWM Info" and includes MSWM topics in its international training course in Regional Development Planning, which is held April-May each year. Its publications are in English and Japanese.

Website : www.uncrd.or.jp
Consulting/support services : Provides training and collaborative research for public institutions and technical cooperation agencies upon requests by the Directors of requesting institutions.
Fees : Mostly free, but some can be purchased.

31. Environmental Management & Research Association of Malaysia (ENSEARCH)
No. 30-3Jalan PJU 5/16, Dataran Sunway
Kota Damansara, 47810 Petaling Jaya

Tel : 603-6156 9807/8
Fax : 603-6156 9803
E-Mail : ensearch@tm.net.my

Description : To promote and advance the practice and research in environmental

REFERENCES

1) Environmentally Sound Technologies for Wastewater and Storm water Management. An international Source Book. Compiled by UNEP International Environmental Technology Centre (IETC) in collaboration with Murdoch University Environmental Technology Centre (METC), 2002

2) State of the Environment in Asia and the Pacific 2000, Economic and Social Commission for Asia and the Pacific (ESCAP) and Asian Development Bank (ADB)

3) United Nations Conference on Environment and Development Agenda 21, 1992

4) Malaysian Environmental Quality Report 2001

5) The Malaysian Environmental Market: A Beacon for the 21st Century, RIET, 2000

6) 8th Malaysia Development Plan

7) Environmental Technology Assessment Workshop Report 2000, UNEP, ILMC, CDG

8) Dealing with the Malaysian Civil Service, 1993

9) Responses to Questionnaire on Integrated Waste Management 2002

10) Various website references on “storm water management” and “waste management” 2002

11) Website for ASEAN-Japh the

LIST OF KEY WEBSITES

1) Asia Pacific Roundtable for Cleaner Production
   http://www.aprcp.org
2) Asian Development Bank
   http://www.adb.org
3) Asian Society for Environmental Protection (ASEP, Bangkok)
   http://www.asepinfo.org
4) Department of Environment and Natural Resources (DENR, Philippines)
   http://www.denr.gov.ph, http://www.emb.gov.ph
5) Department of Environment (DOE, Malaysia)
   http://www.doe.gov.my
6) Drainage and Irrigation Department (DID, Malaysia)
   http://www.water.gov.my
7) United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP)
   http://www.unescap.org
8) Industrial Technology Development Institute, Department of Science and Technology, Philippines.
   http://dost.gov.ph, http://mis.dost.gov.ph/itdi, http://cptech.dost.gov.ph
9) Ministry of Natural Resources and Environment (NRE, Malaysia)
   http://nre.gov.my
10) Ministry of Housing and Local Government (Malaysia)
    http://www.kpkt.gov.my
11) National Environment Agency (Singapore)
    http://nea.gov.sg
12) National Environmental Protection Agency (Vietnam)
    http://nea.gov.vn
13) Public Utilities Board (PUB, Singapore)
    http://pub.gov.sg
14) UNEP International Environmental Technology Centre (IETC, Japan)
    http://www.unep.or.jp
15) United Nations Centre for Regional Development (UNCRD, Japan)
    http://www.uncrd.or.jp
16) Environmental Management & Research Association of Malaysia (ENSEARCH)
    http://www.ensearch.org

LIST OF ACRONYMS AND ABBREVIATIONS USED

ADB	-	Asian Development Bank
ASEAN	-	Association of South East Asian Nations
AWGMEA	-	ASEAN Working Group for Multilateral Environmental Agreements
CBO	-	Community-Based Organisation
CETEC	-	Centre for Environmental Technologies
CIDA	-	Canadian International Development Agency
DEPC	-	Department of Environmental Pollution Control, Cambodia
DOE	-	Department of Environment, Malaysia
EMB	-	Environmental Management Board
GEO	-	Global Environment Outlook
IETC	-	International Environmental Technology Centre
INWENT	-	Capacity Building International, Germany
IWM	-	Integrated Solid Waste Management
JICA	-	Japan International Cooperative Agency
MAWAR	-	Malaysian Agenda for Waste Reduction
MSW	-	Municipal Solid Waste
NGO	-	Non-Governmental Organisation
NIMBY	-	Not-In-My-Backyard Syndrome
SEA	-	South East Asia
SIDA	-	Swedish International Development Corporation Agency
UNDP-GEF	-	United Nations Development Programme - Global Environment Facility
UNEP	-	United Nations Environment Programme
UNESCAP	-	United Nations Economic and Social Commission
UWEP	-	Urban Waste Expertise Programme
WASTE	-	Advisors on Urban Environment and Development

PROFILES

The UNEP - DTIE International Environmental Technology Centre

Established in April 1994, the International Environmental Technology Centre (IETC) is an integral part of the Division of Technology, Industry and Economics (DTIE) of the United Nations Environment Programme (UNEP). It has offices at two locations in Japan - Osaka and Shiga.

The Centre's main function is to promote the application of Environmentally Sound Technologies (ESTs) in developing countries and countries with economies in transition. IETC pays specific attention to urban problems, and to freshwater management.

IETC is supported in its operations by two Japanese foundations: The Global Environment Centre Foundation (GEC), which is based in Osaka and handles urban environmental problems; and the International Lake Environment Committee Foundation (ILEC), which is located in Shiga Prefecture and contributes accumulated knowledge on sustainable management of fresh water resources.

IETC's mandate is based on Agenda 21, which came out of the UNCED process. Consequently IETC pursues a result-oriented work plan revolving around three issues, namely: (1) Improving access to information on ESTs; (2) Fostering technology cooperation, partnerships, adoption and use of ESTs; and (3) Building endogenous capacity.

IETC has secured specific results that have established it as a centre of excellence in its areas of speciality. Its products include: an overview on existing information sources for ESTs; a database of information on ESTs; a regular newsletter, a technical publication series and other media materials creating public awareness and disseminating information on ESTs; advisory services; action plans for sustainable management of lake/reservoir basins; training needs assessment surveys in the field of decision-making on technology transfer and management of ESTs; design and implementation of pilot training programmes for adoption, application and operation of ESTs; training materials for technology management of large cities and fresh water basins; and others.

The Centre coordinates its activities with substantive organisations within the UN system. IETC also seeks partnerships with international and bilateral finance institutions, technical assistance organisations, the private, academic and non-governmental sectors, foundations and corporations.

UNEP Division of Technology, Industry and Economics

The mission of the UNEP Division of Technology, Industry and Economics is to help decision-makers in government, local authorities, and industry develop and adopt policies and practices that:
- are cleaner and safer;
- make efficient use of natural resources;
- ensure adequate management of chemicals;
- incorporate environmental costs;
- reduce pollution and risks for humans and the environment.

The UNEP Division of Technology, Industry and Economics (UNEP DTIE), with the Division Office in Paris, is composed of one centre and five branches:

The International Environmental Technology Centre (Osaka), which promotes the adoption and use of environmentally sound technologies with a focus on the environmental management of cities and freshwater basins, in developing countries and countries in transition.

Production and Consumption (Paris), which fosters the development of cleaner and safer production and consumption patterns that lead to increased efficiency in the use of natural resources and reductions in pollution.

Chemicals (Geneva), which promotes sustainable development by catalysing global actions and building national capacities for the sound management of chemicals and the improvement of chemical safety world-wide, with a priority on Persistent Organic Pollutants (POPs) and Prior Informed Consent (PIC, jointly with FAO).

Energy and OzonAction (Paris), which supports the phase-out of ozone depleting substances in developing countries and countries with economies in transition, and promotes good management practices and use of energy, with a focus on atmospheric impacts. The UNEP/RISØ Collaborating Centre on Energy and Environment supports the work of the Unit.

Economics and Trade (Geneva), which promotes the use and application of assessment and incentive tools for environmental policy and helps improve the understanding of linkages between trade and environment and the role of financial institutions in promoting sustainable development.

Coordination of Regional Activities Branch, which coordinates regional delivery of UNEP DTIE's activities and ensures coordination of DTIE's activities funded by the Global Environment Facility (GEF).

UNEP DTIE activities focus on raising awareness, improving the transfer of information, building capacity, fostering technology cooperation, partnerships and transfer, improving understanding of environmental impacts of trade issues, promoting integration of environmental considerations into economic policies, and catalysing global chemical safety.

For more information contact:
UNEP, Division of Technology, Industry and Economics
39-43, Quai André Citroën
75739 Paris Cedex 15, France
Tel: 33 1 44 37 14 50; Fax: 33 1 44 37 14 74
E-mail: unep.tie@unep.fr; URL: http://www.uneptie.org/

UNEP