HAZARDOUS WASTE MANAGEMENT IN SOUTHEAST ASIA

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Abstract

Rapid industrial growth in order to achieve higher economic development in developing countries of South East Asia has resulted in a serious problem of generation of enamorous quantity of hazardous waste. Outdated industries, unavailability of treatment plants, weak institutional and enforcing structures, inexperienced professionals, less public awareness, and lack of appropriate data are some of the barriers for effective hazardous waste management systems in these countries, and thus encouraging the industries to dispose the waste in natural environment without effective treatment. Lack of information on contaminated sites resulting from uncontrolled disposal of waste in past is one of the major problems. Waste trafficking is another important aspect to be controlled in order to protect the environment of poorer nations.

Introduction

The pressure from rapid population growth, combined with high population density and inadequate environmental sanitation facilities has resulted in the generation of severe negative impacts in most of the developing countries. Over exploitation of natural resources, on the other hand, has caused the unrecoverable depletion of the natural resources and threat for future generation. Disposal of waste in environment by growing number of industries has caused the rapid increase in pollution level of the world. Disposal of various non-degradable, slow degradable chemical and hazardous waste is making most of the water resources unacceptable for use without expensive advanced treatment and most of the land unsuitable for crop production and other productive use. The results of all these activities are environmental degradation and health hazards. This depletion of natural resources and environmental degradation is seen all over the world. Most of the industrialized countries are responsible for this rapid depletion of resources and environmental degradation. These countries are now in a position to control local situation by implementing stringent standards, by applying different economic instruments.

Asian countries in Asia Pacific Region are fastest growing countries in the world due to its faster industrialization rate, and international trade. During 1980 –1995, the share of industrial and service sector in the regions total GDP increased significantly, while agricultural sector declined as shown in Figure. 1. This was the result of shift from agro-based and small-scale labor intensive industries to manufacturing large scale and mechanized industries.

Singapore, Thailand, Indonesia, Malaysia, Taiwan and Hong Kong are some of the countries to achieve this faster growth. The leading industries are textile, electronic, and electrical, semiconductor, chemical and petrochemical, metal works and food processing as given in Table 1**.**

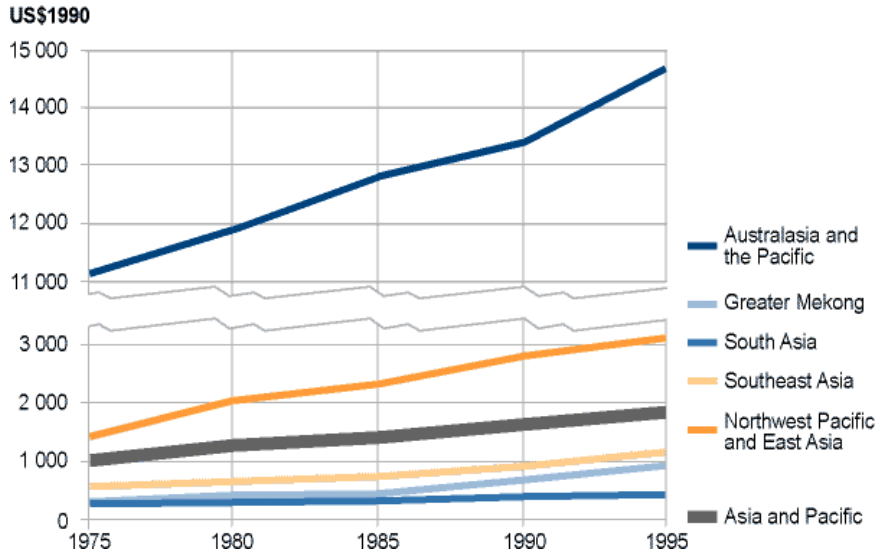

Figure 1. GDP per capita in selected countries in Asia and Pacific Region
(Source: GEO 2000)

Table 1: Volume and types of wastes generated in various countries

Country	Volume of Hazardous Waste Generation	Types of Hazardous waste
Hong Kong	120,000 t/y (1992)	Textile, electronic, plastic, metal parts, jewelry, watches, optical goods, shipyard repair.
Indonesia	200,000 t/y (1990)* 1,000,000 t/y (2010)*	Fabricated metal parts, machinery and equipment, food, beverage, tobacco, chemical, petroleum, coal, rubber and plastic, basic metal.
Malaysia	487,000 t/ y (1997)*	Metal finishing, electroplating, textile, industrial gas, foundry, and asbestos.
Philippines	80,000-150,000 m^3/ y***	Petroleum refinery, garments, electrical, electronic, handicraft manufacturing, basic metal, mineral, paper.
Singapore	42,000 m^3/y (1991)	Petroleum refinery, electrical, electronic, metal finishing.
Taiwan	1.6 million t/y **	Mining, manufacturing, chemical, electrical, electronics, machinery, transportation equipment, tannery, refinery.
Thailand	1.2 million t/y (1991)	Metal smelting and manufacturing, commercial, marine.

(Source: Cirillo et al, 1994)

* www.un.org, ** www.ban.org, *** Hay et al, 1994

Because size and type of industries vary from country to country, volume and qualities of waste also vary. The various problems related to hazardous waste management can be studied under the following areas; Source, type and quantity of hazardous waste; Distribution of industries and hazardous waste generation; Treatment options; Contaminated sites and waste invasion, and; Institutional and legislative aspects.

Taking benefits from government incapability to implement stringent regulations, industries are free to discharge their wastewater in natural water bodies, emit pollutants in the atmosphere and throw solid waste in land or open dumps. Although pollution by the hazardous waste in these countries has not reached critical level (with few exceptions), their amounts are rapidly increasing. If the generation and disposal of hazardous waste from these industries is not controlled, or the process of handling, transportation, or treatment and disposal is not done in a technically proven and

environmentally acceptable manner, the time is not far to observe a drastic environmental degradation in this region.

Public pressure and international and regional concerns over environmental protection has forced most of the countries to establish a separate government body to look after environmental issues, formulate policy, standards, regulations to protect the environmental degradation caused by hazardous waste. The countries in this region have made a dramatic progress in last 15-20 years in establishing a separate government body responsible for environmental protection. In some countries, industries producing high volume of hazardous waste are forced to install the hazardous waste treatment facilities. In spite of such strict rules available with the government, the weakness of enforcing mechanism, poor monitoring from government bodies; lower amount of penalties for offenders have encouraged the industries not to implement the environmental control system in their premises. Some of the large-scale multinational industries have installed the treatment equipment, but are not running satisfactorily.

Major problem for the industries in this region is the scale and location of industries. The traditional industries have outdated equipment, producing large amount of waste per unit volume of production. Because these industries operate in a small scale, each individual industry can not afford to install the in-site treatment facility. Construction of a central treatment facility by the government body can not be advantageous due to difficulties in handling operation, because these industries are scattered. Similarly, sustainability of these industries to run for longer period is low due to their market oriented nature. Because these industries are the backbone of economic development so government can not force to shut down their operation. The government control mechanism is also not sufficient to monitor numbers of such small-scale industries. So, these industries dispose their waste into natural bodies of water, mix with municipal waste, rather than onsite storage in limited area and wait for collector and handling person to pick the waste.

Government bodies are incapable to handle, treat, and dispose the hazardous waste into secured landfill. Treatment through single or a series of process such as physical, chemical, biological and thermal followed by landfilling of residual portion are generally accepted methods. But the governments are lagging behind with respect to adequate manpower, equipment, finance, and commitment. Separation, recycling and resource recovery are some options reducing hazardous waste. In some countries, private sector is also involved for treatment and disposal of industrial waste. If industries producing different types of wastes are located within an industrial area, waste exchange program can be much more effective to reduce the hazardous waste volume.

Existing institutional set up in many countries are not performing up to expected level. Lack of trained professionals, technicians and administrative staff are some reasons. Overlapping of responsibilities among the government authorities is another problem. This always brings the conflicts among the organizations and each will try to throw the responsibility to another. Less salary for the government professionals compared to private company always attracts the experts to move toward private organizations. Formulation of policy and standards alone can not change the behavior. It has to be implemented efficiently and enforcement unit should be equipped with

authority to charge penalties immediately. The penalty amount should be high enough to force the industries to choose treatment options rather than wait for the government to charge for offences.

There is a growing concern in the industrial sectors about implementation *of cleaner production and waste minimization*. Advantages from the cleaner production achieved by industrial sectors of developed countries are encouraging industries of these countries. So, construction of high capacity treatment facilities such as incinerator for projected hazardous waste quantity could be at risk due to less volume of waste production resulting from waste minimization techniques.

In most of the countries in Asia Pacific regions, the waste is directly dumped in open land, or natural watercourse, and ocean causing surface and groundwater pollution. There are many unidentified contaminated lands in this region. It should be identified and cleaned so that it can be used for productive applications. Transportation of hazardous waste from developed countries also causes land and water pollution. Due to the illegal transboundry movement of hazardous waste the actual data of contaminated site is not known.

Hazardous Waste Quality and Quantity

Different countries have different types of industries in their priority list. All the countries are moving from agro-based labour intensive industries to metal based manufacturing and fully mechanized industries. The waste quality and quantities also varies depending on the types of industries and production processes. In Malaysia, 30% of hazardous waste is generated from electroplating and metal industries, where as in Thailand, the largest hazardous waste is generated from metal smelting (47%) and manufacturing (33%) industries (Cirillo et al, 1994). In the current plan of activities, main emphasis is given for the development of agro-industries, textile, clothing, electronics, petrochemical and base metal related industries. Hong Kong has varieties of industries producing different qualities of hazardous waste. Major hazardous waste generated in Philippines and Papua New Guinea are from gold and copper industries, producing different toxic metals, acid and alkali wastes. Indonesia, once considered as one of the pioneer country with higher industrial development in the region is now facing economic crisis. But still the industrial activities produces higher amount of toxic chemicals. Two major regions namely Jabotlbek (Jakarta and surrounding) and GKS (Surabaya and surroundings) are major sources of industrial activity producing huge amount of different types of hazardous wastes. The main hazardous waste problem in Indonesia are pesticides and pharmaceutical residues and waste, lead sludge from battery manufacturing, phenol formaldehyde sludge, leather tanning and electroplating industries (Kusnoputranto, 1993). The industrial sector makes up more than one third of the Singapore economy with main industry being petro-refining operation with some electrical, electronic and metal base industries. Chemical and manufacturing industries are replacing agro-industries in a densely populated country of region, Taiwan, producing large amount of hazardous waste and disposing them into the environment.

Estimation of Quality and Quantity of Hazardous Waste

The estimation of quantity and quality of hazardous waste is important parameter to design the treatment and disposal system. Although the quantities of hazardous waste for different countries are given in Table 1, the actual scenario could be different from it, as this value is not reported on the basis of thorough quantitative and qualitative survey of hazardous waste generation from different industries. Since the number and size of the industry is growing rapidly in the region, it is not easy to estimate actual hazardous waste generated.

Determination of hazardous waste quantity is easy for countries like Thailand and some part of Indonesia where most of the industries are located in industrial estate. But it is very difficult to determine the actual quality and quantity of hazardous waste in a country like Hong Kong, Philippines, Malaysia and Papua New Guinea where there are numerous small-scale industries. And too, these industries are always reluctant to provide actual data of hazardous waste generated. For the similar industries, the quantity and quality of hazardous waste also differs, depending upon the production process, extent of regular maintenance and repair etc. Hence based on the theoretical knowledge the actual quality and quantity of the hazardous waste can not be accessed exactly.

Location of Industries:

Location of the industries also plays important role in treatment and final disposal of hazardous waste systems. Thailand and Indonesia have well-established industrial estate and can install central treatment unit within the industrial estate for treatment of hazardous waste. In such situations the waste exchange program can also be implemented within industrial estate, which can help to reduce the waste volume to be treated or landfilled. Industrial estate should be located outside the city boundary so that the public pressure and risk of any accident for the residential area can be minimized. This is difficult in industries in Hong Kong, where many small industries are scattered in areas within residential and commercial activities and same building with numerous small industries. The danger of any anticipated risk always exists in such situation. Small scale industries located in core area can not provide enough space for onsite storage and treatment, so they simply dump the waste in streets and discharge waste water in drain and river without any treatment as seen in Philippines, Taiwan, Malaysia and some part of Thailand.

Issues related to hazardous waste management

As mentioned earlier, one of the most significant hazardous waste problems in this region is the small scale nature of the majority of the industrial facilities, and inadequate space available for on-site storage of hazardous waste. Most of these industries are located in municipality areas, so they deposit their waste in street and MSW container, and discharge the wastewater into drain and sewer pipe. There is always a threat for the aquatic life by the wastewater discharged into river and pollution to the land if irrigated with this water. Seepage of leachate and percolation of surface water into ground can cause ground water pollution. Financial problem is always with all the countries to implement effective environmental pollution control system especially with the small scale industries in Hong Kong, Malaysia, Papua New

Guinea, and Philippines, who prefer to shut down the operation rather than installation of individual hazardous waste treatment facilities. Although the treatment equipments are installed in large-scale multinational industries, they are not operated properly as reported in some industries of Thailand. And too government body can not monitor regularly due to various constraints. Most of the industries are always having problems with the facilities like finance, technical, and infrastructure to deal with the waste problem.

Total treatment/disposal is not implemented in most of the countries. Although, incineration plant is installed for hazardous waste treatment, it is not sufficient and most of the hazardous waste is disposed into unsecured landfill. Co-disposal with MSW, incineration of more toxic compounds like PCBs (in Hong Kong), landfilling, stabilization and incineration (Indonesia) are some treatment facilities. In Malaysia, the hazardous waste not treated effectively, where as the most of the hazardous waste is either collected by municipality or dumped illegally in Manila. In Singapore, the handling, transportation and treatment are done by private sector. Singapore is one of the countries in this region to export hazardous waste to neighboring country.

Government / Legislation

Each country has a government body that is responsible for the control of environmental pollution. The formulation of policy and implementation of regulation vary from country to country depending on various factors. Some countries have stringent regulation and enforce it strongly; some have slow approach, where as some are still in primary stage of environmental protection. In some countries, the implementation part is very weak that it can not enforce the existing regulation effectively due to inexperienced manpower and financial constraints. Some countries are still concentrating on rapid economic development through industrialization at the cost of environment damage.

Some of the countries had environmental body in the government in 1970s to look for environmental protection. Initially it was concentrating on general environmental protection and there was not a specific regulation on specific type of waste and its control. Slowly it was realized by the government to establish and policy for control of hazardous waste. Table 2 summarizes the list of government bodies responsible for environmental protection and legislation for hazardous waste management. The hazardous waste management policy and regulation for each country also differs. Some have copied directly from the developed countries and some have modified based on the requirement and capability of the government to implement it.

Although most of the countries have the government body for hazardous waste management, its implementation part is ineffective. Establishment of institutional infrastructure and formulation of policy alone can not improve the situation, but it has to be amended according to the requirements and implemented and all actors playing role in this activity should show the commitment for its effective implementation. The various actors responsible for hazardous waste control are shown in Figure 2.

Similarly, no comprehensive survey or inventory of hazardous waste generation has been done to determine the quality and quantity of hazardous waste. Study on potential hazardous waste is essential for prioritizing the waste quality. The data

available is outdated and unreliable through some imaginations. In order to implement the effective waste management program, it is essential for the government authority to conduct a comprehensive survey for actual and reliable database.

Table 2: Government bodies for Environmental Protection and Legislation for Hazardous Waste Management and Status

Country	Government Body	Legislation	Status [1]
Hong Kong	Environmental Protection Department	The waste disposal ordinance, 1980. Waste disposal regulation (for chemical waste), 1992	**
Indonesia	Ministry of State for Population and Environment – (1983-1993) Ministry of Environment-1993	Hazardous and Toxic Waste Act-1994	**
Malaysia	Ministry of Science, Technology and Environment (MOSTE) Department of Environment (DOE)	Scheduled (Hazardous and Toxic) Waste Regulation – 1989 Toxic and Hazardous Waste regulation- 1993 Merchant Shipping Oil Pollution Act-1993	**
Papua New Guinea	Department of Environment and Conservation	Environmental Contamination Act 1993	*
Philippines	Department of Environment and Natural Resource (DENR) Pollution Adjudication board (PAB)	Pollution Control Law-1976 Toxic Substance and Hazardous and Nuclear Waste Act 1990	*
Singapore	Ministry of Environment (MOE)	Clean Air Act-1973 Green Plan 1991	***
Taiwan	Taiwan Environmental Protection Agency (EPA) 1987	Legislation in Hazardous Waste 1994 to look for Hazardous chemical Toxic chemical Hazardous material	
Thailand	Ministry of Science and Environment (MOSTE) Pollution Control Department (PCD)	Hazardous Substance Act 1992	**
* Minimal Coverage	** Moderate Coverage	*** Extensive Coverage	

(Source: Cirillo et al, 1994; SGS, 1997), ([1]ESCAP, 1995)

The institutional body should organize education and training program for all actors of hazardous waste management system. The main sufferers from environmental pollution are public. It is essential for the institution to make aware the public about the consequences of inefficient management of hazardous waste so that they can play major role in protesting against those industries and force the government to take appropriate action. A rise in total number of complain from 817 in 1989 to 1860 in 1993 in Malaysia indicates the effectiveness of public awareness activities (SGS, 1996). Overlapping of regulatory authority among government agency is another constraint as already discussed above. Countries with policies copied from developed countries are facing problems for its implementation due to unavailability of resources and equipment for governing body and unavailability of treatment equipment for the industry to establish. So sometime is wise enough not to enforce any strict

environmental requirement unless it is evident that control technologies are available as implemented in Singapore. And some time efforts to increase enforcement can result in stiff industrial opposition as seen in Thailand (SGS, 1996). Non-regulatory methods, such as rating systems and financial incentive method also work well to implement the environmental management plan. The *Proper Prokasih Index* is one of the methods implemented in Indonesia to improve the environmental pollution by large companies to create image in the society.

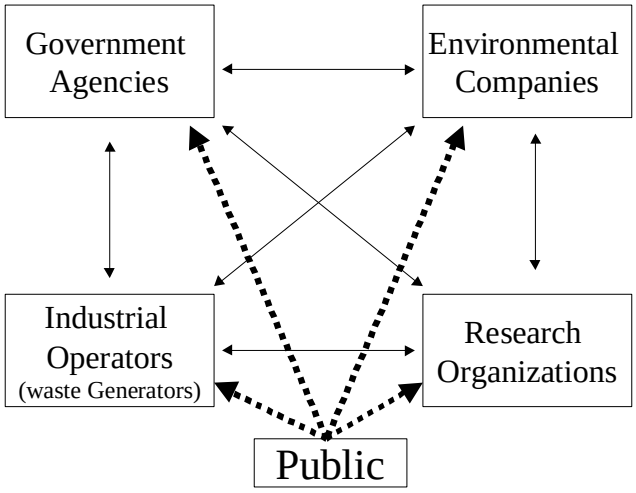

Figure 2: Various actors for hazardous waste management

Lack of experienced local experts is another problem in many countries. In most of the countries, the experts from developed countries try to implement their own regulation without knowing the existing situation. Now, the scenario is changing slowly with availability of local experts, who can understand the situation and capacity of the government. Government should encourage the private sector participation for handling of hazardous waste as practiced in Singapore. Cleaner Production technology is taking very rapid speed in industries of developed countries. This has attracted to the industries of developing countries and most of the multinational industries are in a position of implementing the cleaner production technology. Waste minimization and cleaner production technology along with waste exchange program can be the best alternatives for the industrial hazardous waste management. Large-scale treatment plants such as incinerators could be a failure in future if the waste minimization and cleaner production technology is adopted effectively.

Waste Trafficking and Land contamination

Contamination of land by hazardous waste disposal is one of the significant problems in this region. Most of the countries do not have any records on the area of contaminated site and extent of contamination. Lack of expert manpower for such activities is one of the main reasons. In some of the countries, industries are still throwing the hazardous waste in environment and increasing the area of contaminated sites. There are some cases of accidental release of toxic materials in environment and continue the contamination, constant and consistent release of oil although in smaller quantities from carrying ships, trucks and rail cars. There is a long term effects of these contaminated sites and contaminated water bodies (surface as well

groundwater), if the process of identification and redemption is not done in time. The reason for the continuing contamination could be lack of investigation, lack of expert manpower, and negligence by government for the contaminated resources considering useless. Although, public protest was observed at the early part of last decade in Indonesia, it was not taken so serious at that time and this has allowed the industries to continue to pollute the site. Contamination of groundwater in Malaysia is not taken so serious since the country is not relied on groundwater. Unavailability of sound guideline is also one of the reason for the government not to give much interest for such sites. Once the contaminated site is identified, three general approaches (physical, chemical and biological) can be applied for remediation.

Asia has developed a reputation as a dumping ground for more than 400 million tons of hazardous waste per year (www. ban. org/). Cambodia is the main country to accept along with other countries. Table 3 shows the Documented Toxic Waste Trade, Actual Shipment, By Country during 1990-1993.

Table 3: Documented Toxic Waste Trade, Actual Shipment, By Country during 1990-1993. (In metric tonnes)

Exporter	Australia	Canada	UK	USA	Germany	Total
Importer						
Hong Kong	2422	20311	15248	42899	2338	83218
Indonesia	13688	511	1563	20490	620	36864
Malaysia	239		3780	325		4344
Philippines	27235	57	1111	35932	50	64385
Singapore	170		2001	71	240	2482
Taiwan	129	16466	51492	198		68285
Thailand	1794		2559	93		4446

(Source: Greenpeace, 1994)

Table presents a picture of the recorded and legal trade of hazardous waste. There are many cases where the wastes are transported and dumped illegally. Within Asia, the waste from one country is transported to another countries and the rest is dumped illegally. It is estimated that only 30% of the hazardous waste generated is disposed on legal landfill in Taiwan with rest is transported to neighboring countries and dumped illegally causing increase in area of unidentified contaminated sites. All the countries should take strict action for the import and export of hazardous waste as implemented in Malaysia (RM 500,000 and a jail sentence up to 5 years.) against illegal transboundry movement, transport and disposal of hazardous waste (www.ban.org). Indonesia started to import the hazardous waste since 1970 is planning to ban completely the import of waste by 2003. (www.un.org). Public participation is important for putting pressure to the government to take action against the trade of hazardous waste. In Singapore the Greenpeace and Basal Action Network (BAN) is playing an effective role for the implementation of Basal Convention guideline. Since the many countries have signed the Basal Convention Agenda, the implementation side is quite slow. This has to be encouraged by the local and regional efforts.

Example of Evolutionary Approach

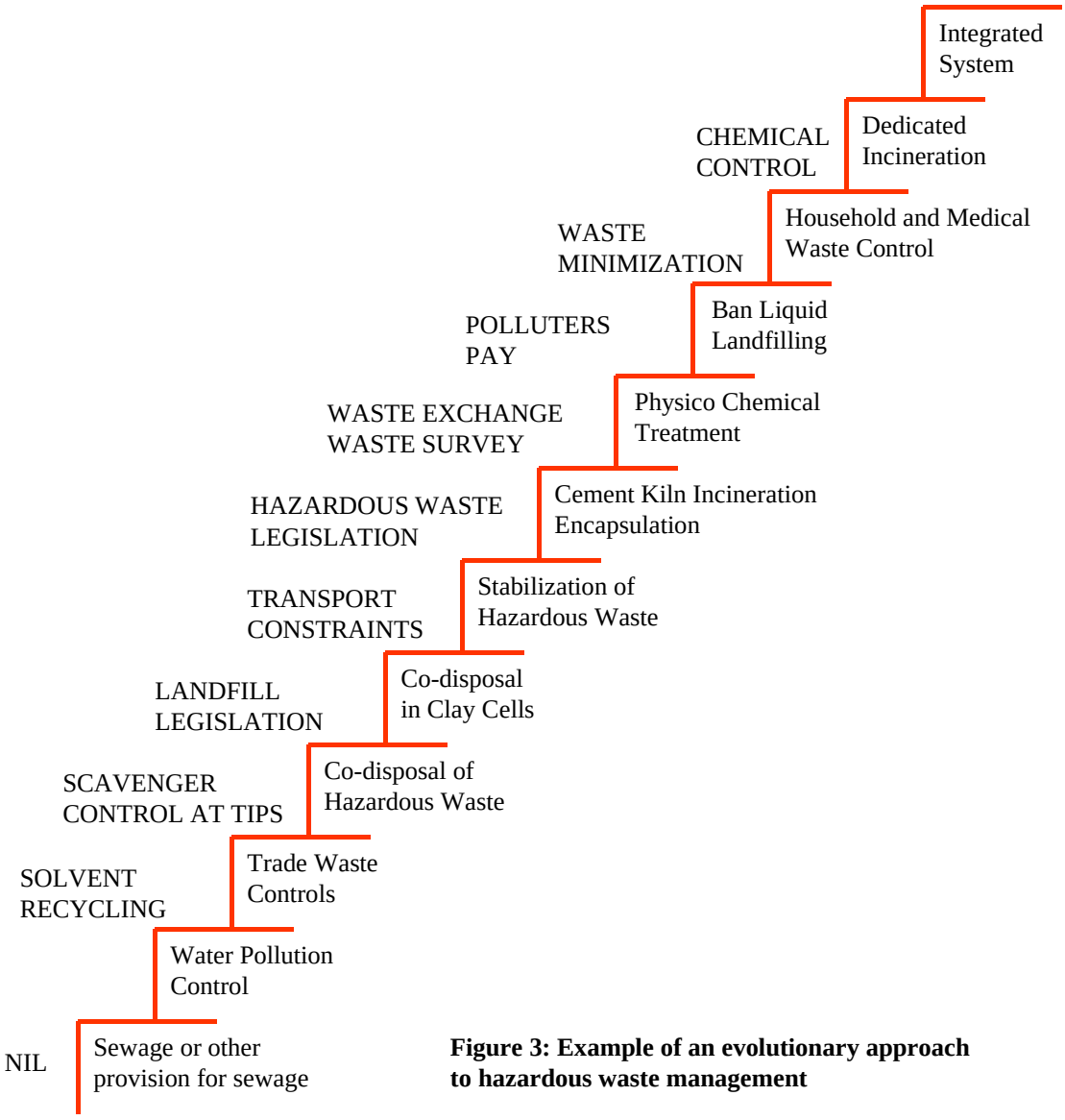

Figure 3: Example of an evolutionary approach to hazardous waste management

The process of hazardous waste management can not be achieved in one stretch. It could take time to achieve a complete control over hazardous waste problems. The ladder of evolutionary approach is shown in Figure 3. Some countries are still at its basic level and some have already started to move upwards. Singapore is in its highest level of hazardous waste management strategy as indicated above in Table 2.

Thailand, Malaysia, Taiwan are also making slow progress towards the improvement in hazardous waste management system. Box 1 shows the development in industrial hazardous waste treatment plant in Thailand. Similarly, in Singapore, an offshore refusal disposal site in Palau Semakau has been developed to meet the Singapore's solid and hazardous waste disposal requirements through the year 2030. The project covers an area of 350 ha landfill with capacity of 35 million cubic meters, facilities of transportation, transfer, shipping and ports and barge facilities.

Box 1 Industrial Treatment Plant in Thailand

GENCO: Industrial Waste Treatment Plant

Map Ta Phut Plant

Phase One:

Chemical Stabilization
Secure Landfill
Fuels Blending for Cement Kiln

Phase Two:

Physical - Chemical Treatment

Phase Three:

Incinerator or Thermal Treatment

Capacity:

500 tons per day; 125,000 tons per year on one shift basis
1,000 tons per day by the year three

Samedum/Ratchaburi Plant

Treatment Methods:

Physical - Chemical Treatment (primarily wastewater)
Stabilization and Landfill

Capacity:

100,000 tons per year liquids
25,000 tons per year solids

Conclusion:

The effects of hazardous waste management problem are one of the growing concerns in most of the developing countries. This is more important for the countries of transition, which are concentrating their activities only on rapid industrial growth. Various types and quantities of wastes are produced in these countries, the fate of which is not well documented. Disposal into natural environment has caused both short term and long term effects in the environment and have left these site totally contaminated. Production of hazardous waste from domestic industrial activities and transportation of hazardous waste from developed countries are sources of hazardous waste in developing countries. Lack of strict enforcement authority, experienced manpower, and less public awareness resulting less number of protests are causing problems for government authority to control the hazardous waste. In addition to this continuous increase in number of industries in this region is increasing the burden for the government to control it. Existence of small scale industries, scattered profile of industrial development and profit oriented nature of industries are some other reasons. Unavailability of actual data on volume and characteristic of industrial hazardous waste is another important factor. Lack of information on contaminated sites is more serious for the long term effects. Less awareness among public is the most important factor for the identification of the problem and implementation of solution.

The identification of the problem and the implementation of the solution is step by step process, which should be started in time to avoid further contamination. Government body is equipped with adequate authority and enforcement mechanisms so that it can handle the work to identify the problem and enforce the regulation. Phase out or shift of small scale and scattered industries is one of the best solutions.

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