



SEMINARIO INTERNACIONAL
GESTIÓN INTEGRAL DE RESIDUOS SÓLIDOS Y PELIGROSOS, SIGLO XXI

SOLID WASTE MANAGEMENT IN ASIA

Luis F. Diaz, George M. Savage, and Linda L. Eggerth
CalRecovery, Inc.
Concord, California USA

Solid Waste Management in Asia

November 1999

*International Fair and Seminar,
Solid and Hazardous Waste Integral
Management -- XXI Century
Medellín, Colombia*

**Luis F. Diaz, George M. Savage,
and Linda L. Eggerth
CalRecovery, Inc.
Concord, California USA**

CalRecovery, Inc.

Outline

- Background
- Waste generation
- Waste composition
- Waste collection
- Waste disposal practices
- Issues impacting solid waste management

Background

- The urban population in Asia is increasing substantially
- By the year 2020, an additional 1.5 billion people will be added to Asia's urban centers
- This population increase will require the establishment of proper infrastructure and facilities
- Present and future quantities of solid waste will require proper management

Total and Urban Population in Some Asian Cities in 1990

Country	Population (in thousands)		% of Population in Urban Areas	
	Total	Urban	1950	1990
China	1,155,305	302,690	11.0	26.2
Japan	123,537	95,321	50.3	77.2
Republic of Korea	42,869	31,658	21.4	73.8
Bangladesh	108,118	16,942	4.2	15.7
India	850,638	217,216	17.3	25.5
Nepal	19,253	2,104	2.3	10.9
Pakistan	121,933	39,029	17.5	32.0
Sri Lanka	17,225	3,680	14.4	21.4
Indonesia	182,812	55,923	12.4	30.6
Malaysia	17,891	8,909	20.5	49.8
Philippines	60,779	29,657	27.1	48.8
Thailand	55,583	10,408	10.5	18.7
Vietnam	66,689	13,258	11.6	19.9

Source: United Nations, *World Urbanization Prospects: The 1994 Revision*, Population Division, New York, 1995

CalRecovery, Inc.

Climatic Conditions

- The majority of cities in Asia have a tropical climate, with relatively high temperatures as well as high levels of rainfall and humidity
- This situation complicates the storage, collection, and final disposal of solid waste
- The hot and humid climate limits the amount of time that the waste can be stored
- The high levels of rainfall lead to sizeable problems in the operation of landfills and in the management of surface water and of leachate

Social and Cultural Behavior

- Asian countries, like most Latin American countries, have a tradition of recycling at all levels
- The levels and types of recycling are closely tied to the degree of economic development of the country or region
- Recycling begins at the households and continues during waste collection through final disposition
- Waste that reaches the final disposal sites rarely contains bulky items and electrical appliances, as found in industrialized countries
- Recycling and scavenging generally are sources of employment to those who, for a number of reasons, are unable to find other (legal) types of employment
- Some cities in Asia have begun to license the scavengers at the disposal sites in order to control the practice

GNP Per Capita and Waste Generation

- In 1995, the GNP per capita ranged from as low as US\$200 in Nepal to more than US\$39,000 in Japan
- The total population varied from about 2.5 million in Mongolia to more than 1.2 billion in China
- The generation of municipal solid waste varies from about 0.5 kg/cap-day in Bangladesh to more than 5 kg/cap-day in Hong Kong
- The unusually high quantity of waste generated in Hong Kong is due to the large quantities of construction and demolition debris included in the waste stream

Generation of Urban Solid Waste in Asia

Country	GNP per capita (1995 US\$)	Current Urban Population (% of total)	Urban MSW Generation (kg/cap/day)
Low income	490	27.8	0.64
Nepal	200	13.7	0.50
Bangladesh	240	18.3	0.49
Myanmar	240	26.2	0.45
Vietnam	240	20.8	0.55
Mongolia	310	60.9	0.60
India	340	26.8	0.46
Lao PDR	350	21.7	0.69
China	620	30.3	0.79
Sri Lanka	700	22.4	0.89
Middle income	1,410	37.6	0.73
Indonesia	980	35.4	0.76
Philippines	1,050	54.2	0.52
Thailand	2,740	20.0	1.10
Malaysia	3,890	53.7	0.81
High income	30,990	79.5	1.64
Republic of Korea	9,700	81.3	1.59
Hong Kong	22,990	95.0	5.07
Singapore	26,730	100.0	1.10
Japan	39,640	77.6	1.47

Source: The World Bank

CalRecovery, Inc.

Composition of Urban Solid Waste in Low-income Asian Countries

Component	Nepal	Bangladesh	Myanmar	Lao PDR	India	Sri Lanka	China
Year	1994	1992	1993	1998	1995	1993-1994	1991-1995
Type of waste	MSW	Dom	Dom, Com	Dom, IC&I	MSW	Dom, Com	Dom, Com, MSW
Compostables	80.0	84.37	80	54.3	41.8	76.4	35.8
Paper	7.0	5.68	4	3.3	5.7	10.6	3.7
Plastic	2.5	1.74	2	7.8	3.9	5.7	3.8
Glass	3.0	3.19	0	8.5	2.1	1.3	2.0
Metal	0.5	3.19	0	3.8	1.9	1.3	0.3
Others	7.0	1.83	14	22.5	44.6	4.7	54.3

CalRecovery, Inc.

Composition of Urban Solid Waste in Middle-income Asian Countries

Component	Indonesia	Philippines	Thailand	Malaysia
Year	1993	1995	1995-1996	1990
Type of waste	MSW	na	na	na
Compostables	70.2	41.6	48.6	43.2
Paper	10.9	19.5	14.6	23.7
Plastic	8.7	13.8	13.9	11.2
Glass	1.7	2.5	5.1	3.2
Metal	1.8	4.8	3.6	4.2
Others	6.2	17.9	14.2	14.5

CalRecovery, Inc.

Composition of Urban Solid Waste in High-income Asian Countries

Component	Singapore	Japan	Hong Kong
Year	1990	1993	1995
Type of waste	MSW	na	Dom
Compostables	44.4	26	37.2
Paper	28.3	46	21.6
Plastic	11.8	9	15.7
Glass	4.1	7	3.9
Metal	4.8	8	3.9
Others	6.6	12	17.6

CalRecovery, Inc.

Characteristics and Rates of Waste Collection in Some Cities in Asia

City	Total Weight (tonnes/day)	Generation Rate (kg/person/day)	Bulk Density (tonnes/m ³)	Estimated Rate of Collection (%)
Bangkok	8,000	0.90	0.25	75
Songkla	na	0.89	0.42	46
Kuala Lumpur	348	na	na	80
Penang	5,000	0.75	0.25	70
Jakarta	4,625	0.50	0.33	70
Manila	2,650	0.65	na	70
Mumbai	5,800	0.55	0.33	86
Calcutta	3,500	na	na	55
Delhi	3,880	na	na	62
Dhaka	3,000	0.50	na	50
Colombo	750	0.75	0.35	90
Karachi	4,500	0.55	na	33

Source: UNESCAP, 1995

CalRecovery, Inc.

Waste Collection

- Estimates indicate that a substantial number of people in Asian cities are not provided with waste collection services
- The estimated rate of collection varies from as high as 90% in Colombo to as low as 33% in Karachi
- Waste collection in the major urban areas, and in particular in the center of the cities, is daily
- Frequency of collection in medium and small municipalities fluctuates from three times per week to once per week
- Typically, waste is collected in old, open trucks without the use of compaction mechanisms

Waste Disposal Practices

- As shown by the GNP, countries in Asia have tremendously diverse conditions
- In addition to the level of economic development, Asia has very different social and cultural conditions
- However, based on the authors' experiences and data collected from some sources, it can be stated that the most common method for managing the wastes is land disposal
- Most of the land disposal sites are operated as open dump sites with minimum care and control

Disposal Methods for MSW in Some Asian Countries

Country/ Territory	Disposal Method (%)			
	Land Disposal	Incineration	Composting	Others
Bangladesh	95	--	--	5
Brunei Darussalam	90	--	--	10
India	70	--	20	10
Indonesia	80	5	10	5
Japan	22	74	0.1	3.9
Republic of Korea	90	--	--	10
Malaysia	70	5	10	15
Philippines	85	--	10	5
Singapore	35	65	--	--
Sri Lanka	90	--	--	10
Thailand	80	5	10	5

CalRecovery, Inc.

Issues Impacting Solid Waste Management in Asia

- Economic considerations
- Technical feasibility
- Social acceptability
- Environmental considerations
- Human resources
- Lack of national policy and regulatory framework