What a Waste:
Solid Waste Management in Asia

May 1999

Urban Development Sector Unit
East Asia and Pacific Region
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This paper was prepared by Daniel Hoornweg, researched by Laura Thomas and overseen by Keshav Varma (EASUR). Information and comments were supplied by many World Bank and UNDP staff, particularly George N. Plant, L. Panneer Selvam, and Richard W. Pollard, and Carl Bartone of the Transport, Water, and Urban Development Department. Melissa Fossberg, Gabriela Boyer, Beth Rabinowitz, and Laura Lewis edited and prepared the paper.
WHAT A WASTE:

Solid Waste Management in Asia

Recommendations and Conclusions

• Solid waste data is largely unreliable. This report contains one of the most comprehensive compilations of municipal solid waste data in Asia; yet, due to inconsistencies in data recording, definitions, collection methods, and seasonal variations, the data can only be considered approximate, albeit more accurate than most. For planning purposes, however, the data presented in this report should be sufficient.

• The urban areas of Asia now spend about US$25 billion on solid waste management per year; this figure will increase to at least US$50 billion in 2025. Today’s daily waste generation rate is about 760,000 tonnes. By 2025, this rate will be increased to about 1.8 million tonnes per day.

• Japan spends about ten times more for waste disposal than collection costs (mostly incineration costs). Total waste management costs in low income countries are usually more than 80 percent for collection costs. Lower cost landfilling is usually a more practical waste disposal option than incineration.

• Municipal governments are usually the responsible agency for solid waste collection and disposal, but the magnitude of the problem is well beyond the ability of any municipal government. They need help. In addition to other levels of government, businesses and the general community need to be more involved in waste management.

• Generally, solid waste planners place too much emphasis on residential waste; this waste represents only about 30 percent of the overall municipal waste stream but often receives the lion’s share of attention.

• The waste components requiring priority attention in Asia are organics and paper.

• Indonesia and the Philippines as well as parts of China and India are the Asian countries facing the greatest waste management challenge, based on projected waste generation rates and relative affluence to deal with the problem.

• In terms of waste management trends, no region of the world faces a greater need to break the inextricable link between waste generation rates and affluence than Asia. For example, if Asia follows life style trends of the US and Canada (as Hong Kong already seems to be doing) versus the more typical European urban resident, the world would need to supply about 500 million tonnes more resources in 2025.

• Asia should pursue regional approaches to many solid waste management problems, e.g., packaging regulations and import/export rules.

• Urban residents generate two to three times more solid waste than their fellow rural citizens.

• Municipalities should charge for waste disposal, and possibly collection, based on generation rates.

• Industrialized countries contain 16 percent of the world’s population but use about 75 percent of the world’s paper supply. Residents of India, Indonesia, and China, for example, are aspiring to be as affluent as more industrialized nations. This would require a doubling of the world’s current level of paper production.
1. INTRODUCTION: SOLID WASTE MANAGEMENT IN ASIA

As urbanization and economic development increases in Asia, nowhere is the impact more obvious than in society’s “detritus,” or solid waste. Today, the urban areas of Asia produce about 760,000 tonnes of municipal solid waste (MSW) per day, or approximately 2.7 million m$^3$ per day. In 2025, this figure will increase to 1.8 million tonnes of waste per day, or 5.2 million m$^3$ per day. These estimates are conservative; the real values are probably more than double this amount.

Local governments in Asia currently spend about US $25 billion per year on urban solid waste management. This amount is used to collect more than 90 percent of the waste in high income countries, between 50 to 80 percent in middle income countries, and only 30 to 60 percent in low income countries. In 2025, Asian governments should anticipate spending at least double this amount (in 1998 US dollars) on solid waste management activities.

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

This paper reviews the broad trends related to solid waste management in Asia.$^1$ “The big picture” projects regional urban MSW quantities and compositions in 2025. The forces of these trends are analyzed, and preliminary suggestions for reducing the impact of these trends are provided. The paper also briefly discusses possible policies and budget requirements for dealing with this burgeoning waste stream.

This paper contains one of the most comprehensive collections of solid waste generation data. In compiling these data, the authors identified shortcomings with terminology used and sampling methods and built-in problems with consistency. In Annex 1, recommendations are made to help overcome these limitations and for improving solid waste data collection and presentation. Annex 2 presents waste generation rates for selected Asian cities.

It is beyond the scope of this paper to venture into the debate on “the limits to growth” vis-a-vis resource consumption or the negative environmental impacts that will occur from wastes generated by an increasingly consumeristic one billion urban Asians. The fear about these effects, however, is warranted, particularly since nearly 95 percent of environmental damage occurs before a product is discarded as

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$^1$ Asia in this report is limited to China, Japan, Hong Kong, Republic of Korea, Mongolia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, Bangladesh, India, Nepal, and Sri Lanka.
solid waste. This paper discusses the concern about environmental effects associated with solid waste management as well as the escalating costs that solid waste management consumes from local government budgets and how to handle these increases.

This paper focuses on waste management only as it pertains to urban environments, based on (1) projections that in 2025 about 52 percent of Asia’s population will reside in urban areas, and (2) evidence that urban residents generate at least two times more waste per capita than their rural counterparts. Although urban waste management data may be inconsistent and unreliable, rural solid waste management data are virtually nonexistent and are derived only from assumptions regarding purchasing habits. Given these factors, it is clear that solid waste management efforts must target priority urban areas.

This paper does not review “where the waste goes.” A follow-up study that reviews composting rates (existing and potential), recycling (existing programs, potential markets), number and working conditions of waste pickers, would be a valuable contribution to municipal waste management planning.

2. WASTE CHARACTERIZATION

Solid waste streams should be characterized by their sources, by the types of wastes produced, as well as by generation rates and composition. Accurate information in these three areas is necessary in order to monitor and control existing waste management systems and to make regulatory, financial, and institutional decisions.

Annex 1 discusses in detail reliability issues and compositions of waste data. Better consistency in definition and methodology is needed. Although this paper contains one of the most comprehensive compilations of MSW data for Asia, readers must exercise caution in interpreting the data. Severe under-recording of waste quantities is typical, and total waste generation is usually much higher than that reported by government agencies.

One important observation shown in Annex 1 is that apart from localized anomalies, such as the use of coal for cooking and heating, urban waste generation rates are generally consistent vis-a-vis local economic activity and residential wealth. Because waste characterization studies are relatively expensive to conduct, the general “rules of thumb” provided in this paper should provide sufficient direction for the purposes of waste management planning.

In the context of this paper, waste is defined as any unwanted material intentionally thrown away for disposal. However, certain wastes may eventually become resources valuable to others once they are removed from the waste stream. This definition of waste may differ somewhat from definitions used by other international data sources.

Knowledge of the sources and types of waste in an area is required in order to design and operate appropriate solid waste management systems. (See Figure 1.) There are eight major classifications of solid waste generators: residential, industrial, commercial, institutional, construction and demolition, municipal services, process, and agricultural.

MSW includes wastes generated from residential, commercial, industrial, institutional, construction, demolition, process, and municipal services. However, this definition varies greatly among waste studies, and some sources are commonly excluded, such as industrial, construction and demolition, and municipal services. Often only residential waste is referred to as MSW, and in high income countries, only 25 percent to 35 percent of the overall waste stream is from residential sources. It is important to define the composition of the municipal waste stream in a clear and consistent fashion. For example, if this municipal waste stream includes construction and demolition waste, the quantity of waste is doubled. Far too often,

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2 Personal Communication: Region of Vancouver, 25 percent residential (Linda Shore); Copenhagen, 30 percent residential (Helmer Olsen); Toronto, 35 percent residential (excluding construction and demolition - Tim Michael); Osaka, 37 percent residential (excluding industrial waste - Mr. Sawachi).
waste management decisions are based disproportionately on residential waste, which accounts for an increasingly small fraction of the waste stream as an area industrializes.

2.1 WASTE GENERATION RATES

Waste generation rates are affected by socioeconomic development, degree of industrialization, and climate. Generally, the greater the economic prosperity and the higher percentage of urban population, the greater the amount of solid waste produced. Figure 2 gives urban MSW generation rates, as a weighted average of the waste data available from various cities. Waste generation rates for various Asian cities are in Annex 2.

<table>
<thead>
<tr>
<th>Source</th>
<th>Typical waste generators</th>
<th>Types of solid wastes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>Single and multifamily dwellings</td>
<td>Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes</td>
</tr>
<tr>
<td>Industrial</td>
<td>Light and heavy manufacturing, fabrication, construction sites, power and chemical plants</td>
<td>Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes</td>
</tr>
<tr>
<td>Commercial</td>
<td>Stores, hotels, restaurants, markets, office buildings, etc.</td>
<td>Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes</td>
</tr>
<tr>
<td>Institutional</td>
<td>Schools, hospitals, prisons, government centers</td>
<td>Same as commercial</td>
</tr>
<tr>
<td>Construction and demolition</td>
<td>New construction sites, road repair, renovation sites, demolition of buildings</td>
<td>Wood, steel, concrete, dirt, etc.</td>
</tr>
<tr>
<td>Municipal services</td>
<td>Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants</td>
<td>Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge</td>
</tr>
<tr>
<td>Process</td>
<td>Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing</td>
<td>Industrial process wastes, scrap materials, off-specification products, slag, tailings</td>
</tr>
</tbody>
</table>

All of the above should be included as “municipal solid waste.”

Agriculture           | Crops, orchards, vineyards, dairies, feedlots, farms | Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides) |
Figure 2: Waste Composition of Low, Middle, and High Income Countries

**Current Waste Quantities and Composition**
- **High Income Countries: Current**
  - Total waste = 85,000,000 tonnes per year
  - Organic 28%
  - Paper 36%
  - Plastic 9%
  - Metal 8%
  - Others 12%

- **Middle Income Countries: Current**
  - Total waste = 34,000,000 tonnes per year
  - Organic 58%
  - Paper 15%
  - Plastic 11%
  - Metal 3%
  - Others 11%

- **Low Income Countries: Current**
  - Total waste = 158,000,000 tonnes per year
  - Organic 41%
  - Paper 5%
  - Plastic 2%
  - Metal 1%
  - Others 47%

**2025 Waste Quantities and Composition**
- **High Income Countries: Year 2025**
  - Total waste = 86,000,000 tonnes per year
  - Organic 33%
  - Paper 34%
  - Plastic 10%
  - Metal 5%
  - Others 11%

- **Middle Income Countries: Year 2025**
  - Total waste = 111,000,000 tonnes per year
  - Organic 50%
  - Paper 20%
  - Plastic 9%
  - Metal 5%
  - Others 13%

- **Low Income Countries: Year 2025**
  - Total waste = 480,000,000 tonnes per year
  - Organic 60%
  - Paper 15%
  - Plastic 6%
  - Glass 3%
  - Metal 4%
  - Others 12%

Note: Approximate scale only.
Low income countries have the lowest percentage of urban populations and the lowest waste generation rates, ranging between 0.4 to 0.9 kg per capita per day. All of the countries that have a GNP per capita less than US $400 produce under 0.7 kg per capita per day. As GNP increases toward the middle income range, the per capita waste generation rates also increase, ranging from 0.5 to 1.1 kg per day. As predicted, the high income countries show the greatest generation rates, which vary from 1.1 to 5.07 kg per capita per day.

Hong Kong generates enormous quantities of construction and demolition waste, which explains their exceptionally high per capita MSW generation rate in comparison to other countries. Hong Kong’s waste generation rate better reflects the true quantities of waste produced by all activities within the municipality than some of the other countries. Although Singapore and Japan report significantly lower generation rates than other high and middle income countries, the figures for these countries do not represent all municipal solid wastes. The Singapore generation rate considers only residential wastes, whereas the Japanese data include only wastes produced from households and general wastes from business activities. For both countries, total waste quantities would be much higher if industrial, commercial, institutional, construction and demolition, and municipal services wastes were also included.

Comparing generation rates for various countries is problematic. As demonstrated by Hong Kong, Singapore, and Japan, global inconsistencies in the way municipal solid waste is defined and quantified can lead to significant differences among the “official” waste generation rates.

As mentioned previously, very little information about rural waste generation rates in Asian countries is available; however, one can assume that rural populations will generate less waste because these areas have lower per capita incomes. Urbanization and rising incomes, which lead to more use of resources and therefore more waste, are the two most important trends that factor into rising waste generation rates. Figure 4 exemplifies this trend. Individuals living in Indian urban areas use nearly twice as many resources per capita than those living in a rural setting. Because they consume and generate more solid waste, they have higher waste generation rates.

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Income</td>
<td>490</td>
<td>27.8</td>
<td>0.64</td>
</tr>
<tr>
<td>Nepal</td>
<td>200</td>
<td>13.7</td>
<td>0.50</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>240</td>
<td>18.3</td>
<td>0.49</td>
</tr>
<tr>
<td>Myanmar</td>
<td>240*</td>
<td>26.2</td>
<td>0.45</td>
</tr>
<tr>
<td>Vietnam</td>
<td>240</td>
<td>20.8</td>
<td>0.55</td>
</tr>
<tr>
<td>Mongolia</td>
<td>310</td>
<td>60.9</td>
<td>0.60</td>
</tr>
<tr>
<td>India</td>
<td>340</td>
<td>26.8</td>
<td>0.46</td>
</tr>
<tr>
<td>Lao PDR</td>
<td>350</td>
<td>21.7</td>
<td>0.69</td>
</tr>
<tr>
<td>China</td>
<td>620</td>
<td>30.3</td>
<td>0.79</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>700</td>
<td>22.4</td>
<td>0.89</td>
</tr>
<tr>
<td>Middle Income</td>
<td>1,410</td>
<td>37.6</td>
<td>0.73</td>
</tr>
<tr>
<td>Indonesia</td>
<td>980</td>
<td>35.4</td>
<td>0.76</td>
</tr>
<tr>
<td>Philippines</td>
<td>1,050</td>
<td>54.2</td>
<td>0.52</td>
</tr>
<tr>
<td>Thailand</td>
<td>2,740</td>
<td>20.0</td>
<td>1.10</td>
</tr>
<tr>
<td>Malaysia</td>
<td>3,890</td>
<td>53.7</td>
<td>0.81</td>
</tr>
<tr>
<td>High Income</td>
<td>30,990</td>
<td>79.5</td>
<td>1.64</td>
</tr>
<tr>
<td>Korea, Republic</td>
<td>9,700</td>
<td>81.3</td>
<td>1.59</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>22,990</td>
<td>95.0</td>
<td>5.07</td>
</tr>
<tr>
<td>Singapore</td>
<td>26,730</td>
<td>100</td>
<td>1.10</td>
</tr>
<tr>
<td>Japan</td>
<td>39,640</td>
<td>77.6</td>
<td>1.47</td>
</tr>
</tbody>
</table>

1 World Bank, 1997b
2 United Nations, 1995
*estimated GNP

See Figure 7 for comparison to 2025.
waste, the Indian urban population is expected to produce far more waste per capita than its rural population. This difference between rural and urban waste generation rates also exists in other Asian countries, such as in Bangladesh, where the rural population generates only 0.15 kg per capita per day, while their urban counterparts generate 0.4 to 0.5 kg per capita per day (World Bank, 1998a).

2.2 Waste Composition

Waste composition is also influenced by external factors, such as geographical location, the population’s standard of living, energy source, and weather. Figure 3 presents the current average urban waste compositions for low, middle, and high income Asian countries. The percentages are based on a weighted average of the compositions for individual countries, which are located in Annex 2. Although the definitions and methodologies for determining composition were rarely discussed in waste studies, the compositions for municipal solid waste are assumed to be based on wet weight.

Generally, all low and middle income countries have a high percentage of compostable organic matter in the urban waste stream, ranging from 40 to 85 percent of the total. China and India diverge from this trend because they traditionally use coal as a household fuel source. The ash that is subsequently produced is very dense and tends to dominate the waste stream in terms of weight. Ash is included in the “others” category and makes up 45 and 54 percent of India and China’s waste composition, respectively. Figure 5 shows the degree to which the preference of coal over gas in a Chinese city increases the percentage of inorganics in the waste stream. This increase obviously has considerable implications for these countries as income levels increase.

Figure 2 shows that the compostable fraction in high income countries, which ranges between 25 and 45 percent, is significantly lower than for low and middle income countries.
middle income countries. The percentage of consumer packaging wastes increases relative to the population’s degree of wealth and urbanization. The presence of paper, plastic, glass, and metal becomes more prevalent in the waste stream of middle and high income countries.

2.3 Waste Trends

Waste quantities are inextricably linked to economic activity and resource consumption. Over the next 25 years, poverty in Asia is expected to continue declining (despite recent economic performance). If the pace of capital accumulation and productivity growth continues, then the wages of unskilled workers in all countries and regions are expected to increase substantially (World Bank, 1997c). Besides economic growth, Asian countries are also experiencing urban growth rates of approximately 4 percent per year; a trend that is expected to continue for several decades. By 2025, the Asian population is projected to be about 52 percent urban. Cities in developing countries are experiencing unprecedented population growth because they provide, on average, greater economic and social benefits than do rural areas (World Resources Institute, 1996). In fact, rural-to-urban migration is estimated to account for 40 to 60 percent of annual urban population growth in the developing world (McGee and Griffiths, 1994).

The economic and population growth experienced by many Asian countries follows similar material consumption trends as those found in the United States and other industrialized countries over the past century. As shown in Figure 22, the overall consumption rates in the United States dramatically increased as the economy prospered, despite periods where Americans experienced economic hardships such as the Great Depression in the early 1930’s and the energy crisis of the mid-1970’s.

Japan has experienced waste trends comparable to the United States over the past two decades. Waste quantities were rising until 1970, declined temporarily after the 1973 energy crisis, and then rose again slightly. As the economy prospered in the late 1980’s, waste quantities increased sharply. However, since 1990, generation rates have stabilized due to an economic slow-down and the implementation of waste reduction policies (Japan Waste Management Association, 1996).

China is also experiencing rapid population and economic growth. Consequently, municipal solid waste is increasing in excess of 10

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**Figure 6: Variations in Waste Generation and Composition by Affluence: Beijing, China**

Waste quantities and compositions vary not only between countries, but also between individual cities, and communities within a city. The figure below illustrates the differences between the waste compositions of two different residential areas in Beijing. The wealthier households produce significantly higher percentages of paper, plastic, metal, and glass wastes, most likely from packaging materials. Compostable matter, such as food, horticultural, and ash waste, are predominant in single-story residential waste streams. The high ash and dirt content is from coal since gas is not yet as widespread among the population (Beijing Environmental Sanitation Administration, 1996).
percent per year. Wuhan City, the capital of Hubei province, with a population of more than 6.8 million, has an extensive industrial base comprised of metallurgical industries, manufacturing, textiles, transport manufacturing, oil processing, pharmaceuticals, electrical equipment, construction materials, and food industries. According to the Environmental Protection Department for Wuhan City, MSW quantities have increased from 1.19 million tonnes in 1985 to 1.50 million tonnes in 1993 (Wei et al, 1997). Not only are the quantities of waste increasing commensurate with the growing economy and expanding population; the composition is also shifting towards plastic and paper packaging (see Figure 21), a reflection of improved living standards.

Historical waste generation patterns of both developed and developing countries, economic trends, and population predictions, and per capita municipal solid waste generation rates and compositions are estimated for Asian countries in 2025. (See Figure 7.) These estimates are conservative, but they demonstrate that most Asian countries, particularly the low and middle income countries, will have to deal with enormous quantities of urban waste with a changing composition in the years to come. Figure 2 compares and contrasts the urban waste composition and the total amount of waste generated by the current and future populations for these same countries.

The urban per capita waste generation rate for most of the low income countries will increase by approximately 0.2 kg per day because these countries have relatively high annual GNP growth rates and urban population growth rates. As China, India, and Mongolia become more prosperous and move away from coal as the traditional fuel, the ash composition will greatly decrease and the percentage of compostable organic matter will increase slightly. Packaging wastes, such as paper, plastic, and glass, will become more predominant in the waste stream as the economies increase and the population becomes more urbanized.

By contrast, the middle income countries should anticipate a per capita increase of about 0.3 kg per day since their economies are predicted to grow at the highest rates and will experience significant growth.
population growth in the urban sector. Indonesia and the Philippines will be producing significant quantities of waste, which will require management with a still relatively small per capita GNP. Although Thailand and Malaysia will have the highest per capita waste production rates, they should have stronger economies and more resources to begin implementing integrated solid waste management plans. Overall, the waste composition is predicted to become even more variable as the percentage of compostable matter declines, and packaging wastes, especially paper and plastic, increase.

As a whole, urban populations from low and middle income countries will triple their current rate of municipal solid waste generation over the next 25 years. Nepal, Bangladesh, Myanmar, Vietnam, Lao PDR, and India can each expect their urban waste quantities to increase by about four to six times the current amount. By 2025, the low income countries will generate more than twice as much municipal waste than all of the middle and high income countries combined—approximately 480 million tonnes of waste per year. Such a dramatic increase will place enormous stress on limited financial resources and inadequate waste management systems.

The per capita municipal solid waste generation rate in high income countries is expected to remain stable or even decrease slightly due to the strengthening of waste minimization programs. The total amount of waste generated in 2025 will increase by a relatively small amount—about 1 million tonnes per day—compared to the current waste quantities. Construction activity in Hong Kong is expected to continue. No immediate proposals are underway regarding how to reduce construction and demolition wastes. Thus, wastes from this sector will remain high and keep contributing significantly to the municipal waste generation rate. Singapore and Japan both have the lowest waste generation rates of all the high income countries and even some of the middle income countries. However, their rates may reflect definition inconsistencies rather than waste minimization practices. Although these two countries have implemented integrated solid waste management plans, it is unlikely that they will significantly reduce their waste quantities below current levels. The overall MSW composition for high income countries is predicted to be relatively stable; only a slight decrease is expected in metal and glass wastes and increases should occur in plastic, paper and compostable wastes.

A different trend emerges when comparing waste amounts in terms of volume. Figure 8 shows average waste densities of 500 kg/m³, 300 kg/m³, and 150 kg/m³ were used to calculate the volume of waste generated for low, medium, and high income countries, respectively. Whereas the low income countries
currently produce the highest quantity of waste on a mass basis, the high income countries generate the most waste on a volumetric basis. This increase in volume is a result of paper, plastics, bulky wastes, and other multi-material packaging prevalent in the waste streams of wealthier and more urbanized countries. Low and middle income countries have a larger percentage of high density organic matter and ash residues in their waste streams which weigh more, but do not take up as much space, as discarded packaging materials and household goods.

In 2025, the high income countries are expected to generate about the same quantity of wastes, in terms of both mass and volume. Low income countries will be the largest generator of wastes on a mass basis, and will also surpass the total volume of waste produced by the high income countries. The increasing percentage of plastic and paper materials in the waste stream will contribute to the growing waste volume. In the next 25 years, both low and middle income countries will experience about a three-fold increase in their overall waste quantities and volumes, while South Korea, Hong Kong, Singapore, and Japan will stay relatively constant.

There is little doubt that the low and middle income countries of Asia are following a development path similar to the United States. (See Figure 2.) Compounding this is the fact that much of Asia’s urban growth is occurring in very large cities, which exacerbates waste disposal and collection problems.

### 3.0 Consumer Societies

Industrialized countries comprise only 16 percent of the world’s population, but they currently consume approximately 75 percent of global paper production. As shown in Figure 9, India, Indonesia, and China are three of the world’s four most populous countries and among the lowest consumers of paper per capita. However, as their GNP and urban populations grow, their paper consumption and related packaging wastes will also increase. If they follow industrialized countries, their paper requirements will be enormous.

According to a 1992 study by the Indonesian Environmental Forum (Djuweng, 1997), Indonesian per capita paper consumption rose by 11.2 percent between 1981 and 1989. To meet local and international market demands and to fulfill its intention of becoming the world’s largest pulp and paper producer,
Indonesia is planning to produce 13.2 million tonnes of pulp and 32.7 million tonnes of paper annually by 2000.

As countries become richer and more urbanized, their waste composition changes. The substantial increase in use of paper and paper packaging is probably the most obvious change. The next most significant change is a much higher proportion of plastics, multimaterial items, and “consumer products” and their related packaging materials.

More newspapers and magazines (along with corresponding increases in advertising), fast-service restaurants, single-serving beverages, disposable diapers, more packaged foods, and more mass produced products are all byproducts of widespread increases in local “disposable incomes.” A negative side of greater affluence is that it brings with it more waste, of higher volume (making waste more expensive to collect). Often, increased use of plastic waste and food packaging results in a related rise in the amount of litter.

The rate of change in MSW quantities and composition in Asia is unprecedented. As lifestyles rapidly change, the related conveniences and products—mobile phones, electronics, polyvinyl chloride plastic (PVC) plastic, disposable diapers—pose special waste disposal challenges. Even more problematic is the fact that in most low and middle income countries, development of waste management systems woefully lags behind the realities of a quickly changing waste stream.

In addition, newly mobilized consumers and their market-savvy suppliers rarely consider the potential waste management problems that go hand in hand with changing lifestyles. The Coca-Cola Company is one telling example of how a multinational company may endeavor to increase its market share—in this case in China, India, and Indonesia. (See Figure 10). In its 1996 Annual Report, Coca-Cola reported to shareholders that two of its four key objectives were to increase volume and expand its share of beverage sales worldwide by “...investing aggressively to ensure our products are pervasive, preferred....”

In another part of the report, the President of the company was quoted as saying “When I think of Indonesia—a country on the Equator with 180 million people, a median age of 18, and a Moslem ban on alcohol—I feel I know what Heaven looks like” (Barnet and Cavanagh, 1994). If the per capita consumption of Coca-Cola goes up by just one serving a year in China, India, and Indonesia, 2.4 billion containers would be added to the waste stream.

McDonald’s Corporation has a similar expansion goal:

“The sun never sets on McDonald’s, whether we’re serving customers in the world’s great metropolitan centers or near the picturesque rice fields carved into the landscape of the Indonesia island of Bali, McDonald’s is at home everywhere.” (McDonald’s Corporation, 1997 Annual Report). In fact, McDonald’s is actively expanding in Asia, and the company announced plans to triple its presence in China over the next three years. (See Figure 11.)
4.0 BUSINESS INVOLVEMENT IN WASTE MANAGEMENT

4.1 INCREASED PARTNERSHIPS

McDonald’s and Coca Cola were mentioned previously as examples of companies that represent the overall shift toward a “consumer society.” In pursuit of expansion, multinational corporations, with global marketing programs, undoubtedly change and increase the overall waste stream. On the positive side, many of the larger multinational corporations—such as McDonald’s, Coca-Cola, and Unilever—often have progressive programs that address their specific, as well as the overall, waste stream.

By contrast, however, local national firms (e.g., bottled water vendors in Indonesia) are often even more prolific waste generators than their international counterparts. However, the larger multinational companies, with their global expertise, can also become powerful allies to local governments in the fight against waste. CEMPRE, which originally started in Brazil, is a good example of this type of collaborative partnership. (See Figure 12.)

More and more, governments are realizing that they can not handle waste management alone. To respond to the call, many progressive companies are working as equal partners with governments in developing comprehensive waste management programs.

4.2 EXTENDED PRODUCT RESPONSIBILITY

Extended product responsibility (EPR) is a voluntary measure, which places the onus upon the manufacturer to reduce the environmental impacts of their product at each stage of the product’s life cycle—that is from the time the raw materials are extracted, produced and distributed, through the end use and final disposal phases. EPR does not consider only the manufacturers accountable for environmental impacts; this responsibility is extended to all those involved in the product chain, from manufacturers, suppliers, retailers, consumers, and disposers of products.
In the last few years, the governments of Germany, the Netherlands, and Sweden have each begun to develop comprehensive frameworks for EPR. In Germany, the Ecocycle Waste Act of 1994 sets general environmental goals for manufacturers. It provides guidelines for goods that are long-lived as well as those that can be re-used: regarding their reusability and recyclability; for using secondary materials in production; for indicating when products contain hazardous materials; and for returning products to suppliers at the end of their useful lives. The Dutch government implemented a new policy that requires distribution of life cycle assessment information at each stage for manufactured products. In 1994, Sweden designed a new law to promote more efficient use of resources in the production, recovery, and reuse of waste. The Swedish Ministry of the Environment and Natural Resources issued ordinances requiring increased return and recycling of consumer packaging, scrap paper, old automobiles, and used tires. In addition, Swedish battery manufacturers have voluntarily agreed to develop a recycling program for nickel-cadmium batteries (Davis et al., 1997).

4.3 Environmental Labeling

Environmental labeling of consumer products has helped raise environmental consciousness and momentum throughout Organisation for Economic Co-operation and Development (OECD) countries. Under environmental labeling programs, businesses voluntarily label their products to inform consumers and promote products determined to be more environmentally friendly than other functionally and competitively similar products. Environmental labeling can help achieve a number of goals, including improving the sales or image of a labeled product; raising consumers’ environmental awareness; providing accurate, complete information regarding product ingredients; and making manufacturers more accountable for the environmental impacts of their products. Labeling programs are becoming more popular. These programs have been established in numerous OECD countries: Germany, Canada, Japan, Norway, Sweden, Finland, Austria, Portugal, and France (OECD, 1991).

In practice, however, the operation of labeling programs is more difficult than initially anticipated. Problems include the difficulty in assessing the entire life cycle of the product in a comprehensive way; becoming self-financed; or establishing product categories. Despite these difficulties, labeling of consumer products has become more widespread in recent years.
products has grown among countries and may potentially serve as an effective tool for environmental protection. To date, no studies quantify the effect of environmental labels on product sales or the subsequent environmental impact. However, a qualitative study of the German labeling program conducted by Environmental Data Services, Inc., in 1988 concluded that the environmental label fostered environmental awareness among consumers, expanded consumers’ choice of environmentally friendlier products, stimulated the development of products with lesser environmental impact, and thus reduced waste, pollution, and domestic waste quantities (OECD, 1991).

4.4 Waste Exchanges

Waste exchanges provide another practical way for businesses and industries to divert waste from disposal to a beneficial use. More than 50 waste exchanges exist in major centers across North America—such as New York, Chicago, and Toronto—and in most cases are provided as a free service to industries. Waste lists are published three to four times a year, some are updated monthly, and most exchanges have web sites on the Internet with links to other exchanges. Through waste exchanges, companies save thousands of dollars in avoided disposal costs or in obtaining raw materials at reduced prices. According to Dr. Bob Laughlin, former director of the oldest waste exchange in North America, the Canadian Waste Materials Exchange, materials listed on the exchange have a 20 percent chance of becoming diverted for useful purposes. It is also clear that Internet exposure is helping to increase the exchange rates (Buggeln, 1998).

Waste exchanges and industry response to projected waste quantities suggest that East Asian countries may benefit from working cooperatively in establishing secondary materials markets and from instituting consistent product and packaging design standards.

4.5 Pulp and Paper

Perhaps the next most important area for strengthened partnerships between business and government is in the pulp and paper industry. Businesses are undoubtedly aware of the huge potential Asian market. The pulp and paper industry should not be expected to reduce the growth of their products voluntarily; indeed, these industries have a natural desire to expand their markets. To meet the needs of business, Asian governments should aim for judicious use of legislation and market reforms to reduce resource consumption and waste generation rates, without impinging on economic growth. Paper is a good place to start.

Countries such as China, Indonesia, and the Philippines are well positioned to adopt more progressive tax measures because their government revenue bases are still relatively new. For example, in the United States, (a country that has a more established tax regime that is more difficult to modify), every tax dollar that is shifted from income and investment and placed toward resource use and pollution generation enables the economy to gain an additional 45 to 80 cents beyond the revenue replaced in the form of additional work and investment and in environmental damage averted (Sitarz, 1998).

<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage of respondents who said a great deal or a fair amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>94</td>
</tr>
<tr>
<td>China</td>
<td>93</td>
</tr>
<tr>
<td>Hungary</td>
<td>92</td>
</tr>
<tr>
<td>Chile</td>
<td>88</td>
</tr>
<tr>
<td>South Korea</td>
<td>88</td>
</tr>
<tr>
<td>Peru</td>
<td>87</td>
</tr>
<tr>
<td>Poland</td>
<td>84</td>
</tr>
<tr>
<td>Italy</td>
<td>83</td>
</tr>
<tr>
<td>Ukraine</td>
<td>80</td>
</tr>
</tbody>
</table>

(Anderson and Smith, 1997)
Urban regions in Asia should begin to view their “urban ore” as an opportunity, as much as the disposal liability it now represents. For example, the Beijing or Jakarta regions in 2025 will produce more paper and metal than the world’s largest manufacturing facilities. Robust, fair, and long-term partnerships should be sought with receptive resource manufacturers to incorporate these materials.

5.0 ENVIRONMENTAL AND HEALTH IMPACTS OF IMPROPER SOLID WASTE MANAGEMENT

Improper solid waste management causes all types of pollution: air, soil, and water. Indiscriminate dumping of wastes contaminates surface and ground water supplies. In urban areas, solid waste clogs drains, creating stagnant water for insect breeding and floods during rainy seasons. Uncontrolled burning of wastes and improper incineration contributes significantly to urban air pollution. Greenhouse gases are generated from the decomposition of organic wastes in landfills, and untreated leachate pollutes surrounding soil and water bodies. These negative environmental impacts are only a result of solid waste disposal; they do not include the substantial environmental degradation resulting from the extraction and processing of materials at the beginning of the product life cycle. In fact, as much as 95 percent of an item’s environmental impact occurs before it is discarded as MSW.

Health and safety issues also arise from improper solid waste management. Human fecal matter is commonly found in municipal waste. Insect and rodent vectors are attracted to the waste and can spread diseases such as cholera and dengue fever. Using water polluted by solid waste for bathing, food irrigation, and drinking water can also expose individuals to disease organisms and other contaminants. The U.S.
Public Health Service identified 22 human diseases that are linked to improper solid waste management (Hanks, 1967. Cited in Tchobanoglous et al., 1993). Waste workers and pickers in developing countries are seldom protected from direct contact and injury; and the co-disposal of hazardous and medical wastes with municipal wastes poses serious health threat. Exhaust fumes from waste collection vehicles, dust stemming from disposal practices, and open burning of waste also contribute to overall health problems.

People know that poor sanitation affects their health, and nowhere is this link more apparent than in low income countries. Perhaps surprisingly, low income countries are also the most willing to pay for environmental improvements. Environics International Ltd. surveyed 24 countries, asking whether respondents believed that their health was affected by environmental problems. (See Figure 14.) India, China, and South Korea ranked among the top five countries that indicated their health was affected a great deal or a fair amount, with a response of 94, 93, and 88 percent, respectively. (Other Asian countries were not included in the survey). Figure 14 shows that these same countries also showed the highest positive response to the question of whether they would agree to contribute part of their income if they were certain the money would be used to prevent environmental pollution.

6.0 INTEGRATED SOLID WASTE MANAGEMENT

Integrated solid waste management (ISWM) is defined by Tchobanoglous et al. (1993) as the selection and application of appropriate techniques, technologies, and management programs to achieve specific waste management objectives and goals. Understanding the inter-relationships among various waste activities makes it possible to create an ISWM plan where individual components complement one another. The UNEP International Environmental Technology Centre (1996) describes the importance of viewing solid waste management from an integrated approach:

- Some problems can be solved more easily in combination with other aspects of the waste system than individually;
- Adjustments to one area of the waste system can disrupt existing practices in another area, unless the changes are made in a coordinated manner;
- Integration allows for capacity or resources to be completely used; economies of scale for equipment or management infrastructure can often only be achieved when all of the waste in a region is managed as part of a single system;
- Public, private, and informal sectors can be included in the waste management plan;
- An ISWM plan helps identify and select low cost alternatives;
- Some waste activities cannot handle any charges, some will always be net expenses, while others may show a profit. Without an ISWM plan, some revenue-producing activities are “skimmed off” and treated as profitable, while activities related to maintenance of public health and safety do not receive adequate funding and are managed insufficiently.

Waste hierarchies are usually established to identify key elements of an ISWM plan. The general waste hierarchy accepted by industrialized countries is comprised of the following order:

- reduce
- reuse
- recycle
- recover waste transformation through physical, biological, or chemical processes (e.g., composting, incineration)
- landfilling
## Figure 15: Comparison Of Typical Solid Waste Management Practices

<table>
<thead>
<tr>
<th>Activity</th>
<th>Low income</th>
<th>Middle income</th>
<th>High income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source reduction</td>
<td>No organized programs, but reuse and low per capita waste generation rates are common.</td>
<td>Some discussion of source reduction, but rarely incorporated in to any organized program.</td>
<td>Organized education programs are beginning to emphasize source reduction and reuse of materials.</td>
</tr>
<tr>
<td>Collection</td>
<td>Sporadic and inefficient. Service is limited to high visibility areas, the wealthy, and businesses willing to pay.</td>
<td>Improved service and increased collection from residential areas. Larger vehicle fleet and more mechanization.</td>
<td>Collection rate greater than 90 percent. Compactor trucks and highly mechanized vehicles are common.</td>
</tr>
<tr>
<td>Recycling</td>
<td>Most recycling is through the informal sector and waste picking. Mainly localized markets and imports of materials for recycling.</td>
<td>Informal sector still involved, some high technology sorting and processing facilities. Materials are often imported for recycling.</td>
<td>Recyclable material collection services and high technology sorting and processing facilities. Increasing attention towards long-term markets.</td>
</tr>
<tr>
<td>Composting</td>
<td>Rarely undertaken formally even though the waste stream has a high percentage of organic material.</td>
<td>Large composting plants are generally unsuccessful, some small-scale composting projects are more sustainable.</td>
<td>Becoming more popular at both backyard and large-scale facilities. Waste stream has a smaller portion of compostables than low and middle income countries.</td>
</tr>
<tr>
<td>Incineration</td>
<td>Not common or successful because of high capital and operation costs, high moisture content in the waste, and high percentage of inerts.</td>
<td>Some incinerators are used, but experiencing financial and operational difficulties; not as common as high income countries.</td>
<td>Prevalent in areas with high land costs. Most incinerators have some form of environmental controls and some type of energy recovery system.</td>
</tr>
<tr>
<td>Landfilling</td>
<td>Low-technology sites, usually open dumping of wastes.</td>
<td>Some controlled and sanitary landfills with some environmental controls. Open dumping is still common.</td>
<td>Sanitary landfills with a combination of liners, leak detection, leachate collection systems, and gas collection and treatment systems.</td>
</tr>
<tr>
<td>Costs</td>
<td>Collection costs represent 80 to 90 percent of the municipal solid waste management budget. Waste fees are regulated by some local governments, but the fee collection system is very inefficient.</td>
<td>Collection costs represent 50 to 80 percent of the municipal solid waste management budget. Waste fees are regulated by some local and national governments, more innovation in fee collection.</td>
<td>Collection costs can represent less than 10 percent of the budget. Large budget allocations to intermediate waste treatment facilities. Upfront community participation reduces costs and increases options available to waste planners (e.g., recycling and composting).</td>
</tr>
</tbody>
</table>
WHAT A WASTE: SOLID WASTE MANAGEMENT IN ASIA

Despite progress in a few countries, fundamental environmental, financial, institutional and social problems still exist within all components of the waste systems in low and middle income countries of Asia. Recognizing that each country, region, and municipality has its own unique site-specific situations, general observations are delineated in Figure 15.

Common to all countries is an increasing awareness about the linkages between waste generation and resource consumption vis-a-vis sustainable development; greater involvement of the business community in recycling; and the increasing awareness of the value of source separation and marketability of good quality compost. Incineration is mainly used for volume reduction and its high costs will continue to inhibit its use. Siting for landfills is difficult, which often causes sites to be established in inferior locations. In addition, increasing attention is focused on reducing greenhouse gas emissions from waste.

6.1 SOLID WASTE MANAGEMENT COSTS

MacFarlane (1998) highlights a relationship between per capita solid waste management costs and per capita GNP. As shown in Figure 16, cities in both developing and industrialized countries generally do not spend more than 0.5 percent of their per capita GNP on urban waste services. The 0.5 percent GNP value can be used by low and middle income countries as a general guideline to prepare waste management budgets and for planning. These costs, however, are only about one-third of the overall total. Additional costs are paid by businesses and residents, exclusive of municipal taxes and fees, Hoornweg (1992).

In Japan, municipal governments are responsible for solid waste management services and spent about 2,280 billion

<table>
<thead>
<tr>
<th>City, Country</th>
<th>Year</th>
<th>Per Capita Expenditure on SWM (US $)</th>
<th>Per capita GNP (US $)</th>
<th>% GNP Spent on SWM</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York, USA</td>
<td>1991</td>
<td>106</td>
<td>22,240</td>
<td>0.48</td>
</tr>
<tr>
<td>Toronto, Canada</td>
<td>1991</td>
<td>67</td>
<td>20,440</td>
<td>0.33</td>
</tr>
<tr>
<td>Strasbourg, France</td>
<td>1995</td>
<td>63</td>
<td>24,990</td>
<td>0.25</td>
</tr>
<tr>
<td>London, England</td>
<td>1991</td>
<td>46</td>
<td>16,550</td>
<td>0.28</td>
</tr>
<tr>
<td>Kuala Lumpur, Malaysia</td>
<td>1994</td>
<td>15.25</td>
<td>4,000</td>
<td>0.38</td>
</tr>
<tr>
<td>Budapest, Hungary</td>
<td>1995</td>
<td>13.80</td>
<td>4,130</td>
<td>0.33</td>
</tr>
<tr>
<td>Sao Paulo, Brazil</td>
<td>1989</td>
<td>13.32</td>
<td>2,540</td>
<td>0.52</td>
</tr>
<tr>
<td>Buenos Aires, Argentina</td>
<td>1989</td>
<td>10.15</td>
<td>2,160</td>
<td>0.47</td>
</tr>
<tr>
<td>Tallinn, Estonia</td>
<td>1995</td>
<td>8.11</td>
<td>3,080</td>
<td>0.26</td>
</tr>
<tr>
<td>Bogota, Colombia</td>
<td>1994</td>
<td>7.75</td>
<td>1,620</td>
<td>0.48</td>
</tr>
<tr>
<td>Caracas, Venezuela</td>
<td>1989</td>
<td>6.67</td>
<td>2,450</td>
<td>0.27</td>
</tr>
<tr>
<td>Riga, Latvia</td>
<td>1995</td>
<td>6</td>
<td>2,420</td>
<td>0.25</td>
</tr>
<tr>
<td>Manila, Philippines</td>
<td>1995</td>
<td>estimate 4</td>
<td>1,070</td>
<td>0.37</td>
</tr>
<tr>
<td>Bucharest, Romania</td>
<td>1995</td>
<td>2.37</td>
<td>1,450</td>
<td>0.16</td>
</tr>
<tr>
<td>Hanoi, Vietnam</td>
<td>1994</td>
<td>predict 2</td>
<td>250</td>
<td>0.80</td>
</tr>
<tr>
<td>Madras, India</td>
<td>1995</td>
<td>1.77</td>
<td>350</td>
<td>0.51</td>
</tr>
<tr>
<td>Lahore, Pakistan</td>
<td>1985</td>
<td>1.77</td>
<td>390</td>
<td>0.45</td>
</tr>
<tr>
<td>Dhaka, Bangladesh</td>
<td>1995</td>
<td>1.46</td>
<td>270</td>
<td>0.54</td>
</tr>
<tr>
<td>Accra, Ghana</td>
<td>1994</td>
<td>0.66</td>
<td>390</td>
<td>0.17</td>
</tr>
</tbody>
</table>

(MacFarlane, 1998)
yen in 1993 on general waste services, accounting for approximately 5 percent of general municipal budgets. The breakdown of the country’s waste expenditures is shown in Figure 17. Approximately 45 percent of the total budget is spent on intermediate treatment facilities, namely, incineration plants, compared to only 4 percent allocated towards collection and 6 percent for final disposal.

Compared to high income countries, municipalities in low and middle income countries allocate the majority of their solid waste management budget to collection and transportation services. Final disposal costs are minimal because disposal is usually accomplished through open dumping. In Malaysia, about 70 percent of the MSW budget is spent on the waste collection (Sinha, 1993). The City of Ahmedabad, India, spends about 86 percent of its solid waste budget on collection, 13 percent on transportation, and only 1 percent on final disposal (Jain and Pant, 1994). Typically, 90 percent of Indonesian solid waste management budgets is allocated for activities related to collection: street sweeping, transportation, and vehicle operation and maintenance. If a sanitary landfill is used for final disposal, collection costs decrease to about 80 percent (Cointreau-Levine et al., 1994).

Per capita and per ton waste management expenses of municipal governments have increased every year in Japan, as shown in Figure 18. According to a 1992 Japanese survey of about 3,250 municipalities, 35 percent of the respondents imposed charges for general waste management services and 636 municipal governments have adopted a fee structure, whereby the charges increase in relation to the amount of waste disposed. Revenues from waste fees cover only 4 percent of the total management expenses.

<table>
<thead>
<tr>
<th>Figure 17: Japanese Expenditures for Solid Waste Management Services (1993)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction and repair expenses</strong></td>
</tr>
<tr>
<td>Intermediate treatment Facilities Final disposal plants Others Research</td>
</tr>
<tr>
<td>828,712 108,300 26,274 18,672</td>
</tr>
</tbody>
</table>

(Japan Waste Management Association, 1996)

In low and middle income countries, some municipalities attempt to directly charge residents and commercial enterprises for waste services. Waste fees are often regulated by the local government and officially collected through a variety of forms, such as a general household sanitation fee, environment fee, or included in the water and electricity bill. Household and commercial waste service fees vary between cities and countries, as shown in Figure 19. Certain cities collect fees based on the amount of waste generated. Others only charge a flat rate per month or year. By contrast, some cities do not collect any fees at all; they completely subsidize solid waste services through general funds. Even when waste fees or taxes are imposed by the local government, waste managers often complain that fees are inadequate to cover the costs of waste services, the fee collection system is inefficient or unsupervised and subject to
illegal practices, or that collected money is not transferred directly to the waste management department, or that money is used for purposes other than solid waste management.

All residential areas in Jakarta are required to pay for primary waste collection, even if wastes are not adequately or regularly collected. The waste collection fees are configured based upon the community’s affluence as well as the desired quality of service. The system places poorer residents at a disadvantage because the quality of their primary collection service suffers from the small revenues generated. Local governments also collect retribution fees to cover the costs of transportation and final disposal. Although regulations are in place to mandate the amounts to be paid by various waste-generating sources, the retribution fees actually collected are very low. In

<table>
<thead>
<tr>
<th>City, Country</th>
<th>Household and Commercial Fees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ulaanbaatar, Mongolia¹</td>
<td>US $0.15 to 0.25/apartment/month US $0.50 to 0.85 peri-urban household/month Two main hotels each pay $8.10 and $18.77 per month per occupant, average 30 occupants</td>
</tr>
<tr>
<td>Hanoi, Vietnam²</td>
<td>US $0.55/person/year</td>
</tr>
<tr>
<td>Dhaka, Bangladesh³</td>
<td>Less than US $0.63/person/year, residents pay a Conservancy Tax for solid waste management</td>
</tr>
<tr>
<td>Vientiane, Laos⁴</td>
<td>US $12 to 216/household/year US $360 to 960/non-governmental commercial organization/year</td>
</tr>
<tr>
<td>Chennai (Madras), India⁵</td>
<td>Residents and businesses do not pay any direct waste fees, pay only property tax. Some households pay NGOs about Rs 15 to 20 per month for primary collection services.</td>
</tr>
<tr>
<td>Delhi, India²</td>
<td>Proposed system where homeowner has to pay a fixed amount of Rs 15 to 20 per month for collection services.</td>
</tr>
<tr>
<td>Beijing, China⁴</td>
<td>US $3 to 7.20/household/year</td>
</tr>
<tr>
<td>Shanghai, China⁴</td>
<td>Residents do not pay any direct waste fees.</td>
</tr>
<tr>
<td>Hong Kong⁵</td>
<td>Private and commercial establishments do not pay any direct waste fees.</td>
</tr>
<tr>
<td>Jakarta, Indonesia⁴</td>
<td>US $1.80 to 9.60/household/year</td>
</tr>
<tr>
<td>Denpasar, Indonesia⁴</td>
<td>US $6/household/year</td>
</tr>
<tr>
<td>Yangon, Myanmar⁷</td>
<td>Waste disposal tax is paid.</td>
</tr>
<tr>
<td>Thailand⁸</td>
<td>Public Health Act (1992) empowers local authorities to set up solid waste collection fees for households, commercial enterprises, markets, and industry according to fees announced in the Act.</td>
</tr>
</tbody>
</table>

¹World Bank, 1998c
²URENCO, 1995
³World Bank, 1998a
⁴UNDP/World Bank Water and Sanitation Program, 1998
⁵Environmental Resource Management (ERM) India, 1998
⁶Johannessen, 1998
⁷Tin et al., 1995
⁸Public Health Act (1992) B.E. 2535, Thailand
Jakarta, only 1 percent of the waste fees is transferred to the Cleansing Agency. To make up the difference in missing fees, the city uses its general fund to pay for this stage of waste management. The Cleansing Agency tries to collect door-to-door, but the system is seriously flawed because:

- collectors are few and part-time
- collectors lack incentive
- money passes through the hands of at least six agencies
- Cleansing Agency does not automatically keep the revenues (Porter, 1996)

Even if fees are imposed on the public for waste management services, they are usually priced on the basis of direct costs for limited activities, such as collection and landfill operations. Full cost accounting attempts to cover externalities and includes all waste management costs that are often only partially accounted for, or altogether ignored, such as:

![Figure 20: Reducing Waste Quantities Through User Fees](image)

The City of Guelph, Canada increased its landfill tipping fees gradually from no charge in 1985 to Can $92 per tonne in 1991. The figure below shows a corresponding decrease in the waste generation rates as the residents attempted to avoid disposal fees. Illegal tipping was not a cause of the reduction; rather, a greater awareness and corresponding change in business practices were the main reasons quantities decreased. The City of Date-shi, Japan reported a similar decrease of municipal waste quantities once disposal fees were introduced. The purpose of the new system was to gain financial resources to build new disposal facilities. Initially the authorities met with public opposition, but are now receiving cooperation from the local residents who have succeeded in reducing their waste quantities.

(Japan Waste Management Association, 1996)
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• disposal site selection studies and procedures
• public hearings, approvals, and permits
• design work
• capital costs
• operating costs
• development of infrastructure to support disposal facilities (e.g., access roads)
• social costs (e.g., declining real estate values, traffic congestion)
• closure and post-closure costs
• environmental costs (e.g., air and water pollution, noise) (Resource Integration Systems Limited et al., 1992)

7.0 SOLID WASTE MANAGEMENT COMMON VALUES

In order to help solid waste management practitioners, a few “common values,” or strategies, can be proposed. There is a striking degree of similarity in municipal waste management needs and constraints across Asia.

1. Developing waste disposal facilities such as landfills and incinerators often generates tremendous concern—both warranted and reactionary. However, it is possible to reduce opposition to new facilities by involving the community and following a technically sound and transparent site selection process, and, wherever possible, using local conditions to ameliorate potential environmental impacts and costs, e.g., siting landfills in geotechnically superior locations. Waste disposal facilities, which often have a useful life in excess of 25 years, need to be well integrated within a sound master plan that reflects regional requirements, standard operating procedures, and financing mechanisms. Sound technical justification and a transparent planning process that respects the general public’s valid concerns may not eliminate public opposition, but it is the best way to minimize it.

2. Local governments should minimize residential waste collection frequency to a maximum of twice per week, which is adequate from a public health perspective, but requires social acceptance. Citizens should be encouraged to place their waste in containers that enhance collection efficiency.

3. Local governments should focus primarily on residential waste collection, especially from poor and densely populated areas, and empower the private sector to pick up waste from non-residential sources. Commercial, institutional, and industrial waste collection can usually be self-financing. Local governments should license private haulers to generate revenues and to ensure proper collection and disposal.

4. Waste collection and disposal fees should be based on waste generation rates. Direct user charges and waste fee collection should begin with the business community.

5. An integrated approach toward solid waste management needs to be followed. Municipal waste managers should opt for the least technically complex and most cost-effective solution (e.g., limited mechanization and incineration). Waste diversion should be maximized.

6. All levels of government, including multi-national agencies and transnational corporations, must play a role in long-term program development, e.g., extended product responsibility, life-cycle analysis, waste exchanges, natural resources tax regimes.

7. Local governments must honestly and respectfully gauge the public’s willingness and ability to participate in the design and implementation of waste management programs. Through good partnerships, progressive programs can be developed in a complementary manner. These programs include community-based operations, micro-enterprise development, waste separation for increased recycling and composting, and reduced collection frequency.
8. All levels of government should promote the hierarchy of waste management (i.e., reduce, reuse, recycle, recover) and encourage waste separation to maximize flexibility to deal with future changes. Wherever appropriate, governments should view solid waste as a resource, rather than just a “local problem.”

9. Although waste collection, treatment, and disposal costs often place a large burden on local government finances, improper disposal is far more expensive in the long run, with costs accruing over many years.

10. Local governments are usually in the best position to assume key responsibility for municipal solid waste collection and disposal. However, sustainable financing and sustainable service provision still needs to be defined by a broader set of stakeholders. Local governments need the assistance of all levels of government to provide waste management services efficiently. Regional approaches to waste disposal, e.g., shared landfills are especially important.
Figure 21: Wuhan City Waste Composition

Figure 22: United States Material Consumption Trends, 1900-89