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WASTE MANAGEMENT (HAZARDOUS AND SOLID WASTES)

(Item 4(b) of the provisional agenda)

SETTING THE SCENE: WASTE GENERATION, IMPACTS, AND CHALLENGES

1. Population in Asia-Pacific region has crossed 4 billions and that makes more than 60% of the world population (ESCAP 2008). The most populous countries of the world are also in this region as China and India shares the first two places with 1.3 and 1.2 billion people respectively and only these two countries is the home of more than 60% of the population of the region. The population growth has been slowed down at about 1.1 per cent per annum; however, urban population has been growing rapidly at about 2.3 per cent annually (ESCAP 2008). On the economic growth front, GDP of the region has almost doubled during last two decades. The GDP growth has remained over 5 per cent as the most populous countries like such as China, India and Indonesia are enjoying higher GDP growth rates despite of global financial slowdown.

2. These two factors, population and economic growth, are the major indicators for enormous amounts of waste generation and its rapid growth during the last decade.

Waste generation trends

(a) Current trends

3. The Asia-Pacific region has seen a very rapid growth in terms of waste[1] generation during last decade, especially in the wake of overall population, rapidly growing urban population, and

[1] The scope of this paper is limited to solid waste, hazardous waste and wastewater as the summary paper by the Secretary General of United Nations. Solid waste and hazardous waste s again limited to municipal waste, non-hazardous industrial waste, construction and demolition, and agricultural waste. Hazardous waste covers all these sectors as well as healthcare sector. The largest contributor for hazardous waste is industrial sector. The waste from mining sector and munitions waste are not included.

economic growth mainly due to industrialization. For waste, one the crucial challenges is the availability of accurate and up-to-date data due to the cost, time and technical capacity required to collect and analyze the data on waste. Nevertheless, a review of available scattered data provides some important insights in waste generation trends.

4. At global level, during 2006, total amount of municipal solid waste (MSW) reached 2.02 billion tones, representing a 7% annual increase since 2003 (Global Waste Management Market Report 2007). It is also estimated that between 2007 and 2011, global generation of municipal waste will rise by 37.3%, equivalent to roughly 8% increase per year.

5. In the Asia-Pacific region, as per the World Bank estimates the waste generation in urban areas is between 450,000 and 760,000 tons per day and by 2025, this would reach at about 1.8 million tons per day (World Bank 1999, UNESCAP 2007). However, this region is the most diversified region in terms of demographic and socio-economic characteristics. Hence the waste generation rates vary from sub region to sub region, from country to country and from urban to rural areas within a same country. International Panel on Climate Change (IPCCC 2006) indicates that municipal solid waste (MSW) generation in Eastern Asia is about 0.37 tons/capita/year, while MSW generation in South-Central Asia is about 0.21tons/capita/year. In terms of country-specific differences, Japan and South Korea generates around 0.4 tons/capita, while countries like the Philippines and India generate little more than 0.1 tons/capita/year (Lacoste and Chaimin 2007). An indicative comparison of the waste generation across the countries based on GDP per capita is shown in Table 1 and for cities is shown in Table 2.

Table 1: Indicative comparison of waste generation across the countries

GDP $/capita/year	< $5,000	$5,000 - $15,000	> $20,000
Average consumption of paper/cardboard per inhabitant kg/capita/year	20	20 - 70	130 - 300
Municipal waste kg/capita/year	150 - 250	250 - 550	350 - 750
Collection rate	< 70%	70 % - 95 %	> 95%
Waste regulations	No National Environmental strategy; Regulations practically nonexistent; No statistics	National Environmental Strategy; National Environmental Agency; Environmental legislation; Few statistics	National Environmental Strategy; National Environmental Agency; Strict and complex regulations; Statistics
Composition of municipal waste %			
Food/Putrescible waste	50 - 80	20 - 65	20 - 40
Paper and cardboard	4 - 15	15 - 40	15 - 50
Plastics	5 - 12	7 - 15	10 - 15
Metals	1 - 5	1 - 5	5 - 8
Glass	1 - 5	1 - 5	5 - 8
Humidity	50% - 80%	40% - 60 %	20% - 30%
Heating value kcal/kg	800 - 1,100	1,100 - 1,300	1,500 - 2,700
Waste treatment	Unauthorized deposits > 50%; Informal recycling 5% - 15%	Landfills > 90%; Start of selective collection; Organized recycling 5%	Selective collection; Incineration; Recycling > 20%

Source: Lcoste and Chalmin (2007)

Table 2: Indicative comparison of waste generation across the cities

	Group A	Group B	Group C
City	Dhaka, Kathmandu, Ulaanbaatar, Bhopal, Yangon	Cebu, Nonthaburi, Chongqing, Surabaya	Fukuoka, Kitakyushu, Macao
GDP (USD)	1000 to 3000	3000 to 10000	Over 10000
Waste generation (kg/person · day)	0.3 to 0.6	0.7 to 1.1	1.4 to 1.5
Collection rate (%)	Less than 70	80-90	Approximately 100
Treatment fees (USD/Person · Year)	Less than 1	1-3	38-220
Rate of expenditure in total budget (%)	15.4 to 38	6 to 23.2	1.6 to 5
Recycling	Informal (Metal, grass, plastic, composting)	Formal + Informal (Metal, grass, plastic, composting)	Formal (Metal, grass, plastic, furniture, clothing)
Incineration treatment rate (implementing cities / total cities)	0 / 5	1 / 4	3 / 3

Source: Kitakyushu Initiative (2003)

6. The Basel Convention estimated that about 318 and 338 million tons hazardous and other waste were generated for 2000 and 2001 respectively[2], based on incomplete reports from the parties to the Convention. Healthcare waste is classified as sub-category of hazardous wastes in many countries. WHO estimates that in many low-income countries, total health-care waste per person per year is between 0.5 to 3 kg[3].

7. In the Asia-Pacific region, comprehensive data at regional, sub-regional and country level on industrial waste and hazardous waste is not available. Some of the current studies show that for non-hazardous industrial waste, South Korea is on a very high end with about 2 tons/capita/year followed by Japan at about 0.7 tons/capita/year. In terms of absolute amount of industrial waste,

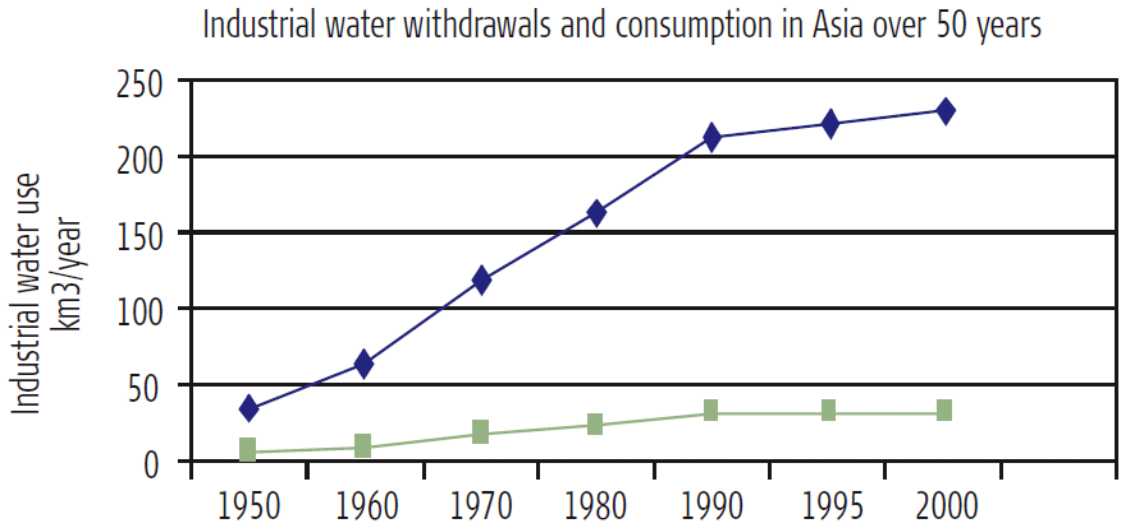
[2] http://maps.grida.no/go/collection/collectionid/17F46277-1AFD-4090-A6BB-86C7D31FD7E7

[3] http://www.who.int/mediacentre/factsheets/fs253/en/

China is leading in terms of total amount of non-hazardous and hazardous waste generated at about 45 million and 10 million metric tons/year respectively (Lacoste and Chaimin 2007).

8. Data for wastewater generation is not readily available as the wastewater collection and treatment levels are quite low especially with respect to. In urban areas, demand for water has been increasing steadily, owing to population growth, industrial development, and expansion of irrigated peri-urban agriculture (Aoki and Memon 2006). In Asia, the industrial growth has put enormous pressure on water resources as shown in Figure 1. This also reflects that industrial wastewater discharges are rapidly increasing. For municipal water supply, the progress for water supply and sanitation under Millennium Development Goal (MDG) 7 is not lacking behind as shown in Table 3. From these figures it is evident that with increasing efforts to meet MDG, the water supply and sanitation rates will rapidly increase during coming few years. This will result in enormous amount of municipal wastewater discharges.

Figure 1: Industrial water withdrawals and consumption



Source: UN World Water Development Report 2, Water: A shared Responsibility (2006)

Table 3: Drinking water and sanitation coverage for Asia

	Year	Population			Water Supply Coverage (%)						Sanitation Coverage (%)					
		Total	Urban	Rural	Total		Urban		Rural		Total		Urban		Rural	
		('000)	(%)	(%)	Total Access	Household Connections	Total Access	Household Connections	Total Access	House Connections	Total Access	Sewer Connections	Total Access	Sewer Connections	Total Access	Sewer Connections
Asia and the Pacific	1990	3,263,921	33	67	74	38	95	70	64	22	34	13	70	33	16	2
	2002	3,838,218	39	61	82	43	94	73	75	24	49	16	75	37	33	3
East and Northeast Asia	1990	1,349,962	33	67	74	55	99	85	62	40	32	10	71	28	12	1
	2002	1,502,315	42	58	80	64	94	92	70	43	50	20	73	43	33	3
North and Central Asia	1990	215,178	65	35	91	71	96	86	82	42	82	64	92	83	63	26
	2002	217,858	63	37	91	72	98	90	79	40	79	63	90	84	59	26
Pacific	1990	26,672	70	30	89	67	100	93	63	6	90	54	99	77	69	0
	2002	31,828	73	27	87	69	99	92	53	8	87	55	98	75	57	0
South and Southwest Asia	1990	1,232,183	28	72	71	21	90	56	64	7	23	9	58	29	9	1
	2002	1,550,605	31	69	85	26	94	54	80	13	39	10	69	27	25	3
Southeast Asia	1990	439,926	32	68	73	14	91	37	65	3	48	2	67	6	39	0
	2002	535,612	41	59	79	23	91	45	70	8	61	3	79	7	49	0

Source: Figures dervived from data in *Meeting the MDG drinking water and sanitation target: A mid-term assessment of progress*. WHO and UNICEF. 2004. United Nations, New York.

Source: http://www.adb.org/Water/Indicators/MDG-7/Table-02.pdf

(b) Future trends

9. Projections into the future are little complex for the Asia-Pacific region due to the following factors:

10. Firstly, for MSW, the waste generation per capita is still quite low in comparison to the developed countries. If we directly correlate waste generation levels with per capita GDP, then in coming decades this region will be facing huge amounts of MSW. The scenario could get challenging, if we also take into the consideration the urban population growth rates with an assumption that urbanization rates will be touching beyond 70 per cent of total population as is the case in many developed countries and countries in transition. About 3 billion people would be living in urban areas in Asia by 2005 and taking the average waste generation rates of about 0.5 kg/capita/day, it could be estimated that about 150 million tons per day or 5.5 billion tons per year of waste would be available.

11. Secondly, for industrial waste generation, if business as usual is followed, the growth rates will be far more than MSW as there is a rapid industrialization in most of the countries in the region. Even in China and India, there will be huge industrialization in the coming years; moreover, this would be coupled with the relocation of industries within a same country and across the countries. So far, it is difficult to make accurate projections; however, keeping in view the potential growth and relocation of industries, it could be said the there will be multifold growth in industrial activities resulting into huge amounts of non-hazardous and hazardous waste.

12. Thirdly, the major challenge for hazardous waste would be in terms of waste from healthcare facilities. Currently, the number of hospital beds per capita in quite low in the region. Japan stands highest in the region at 14.3 hospital beds per 1,000 people, while Nepal is lowest at 0.2 beds per 1000 people and the world's weighted average is 3.4 beds per 1000 people[4]. Keeping in view the total population, rapid urbanization and economic growth, the coverage of healthcare including new hospitals will increase rapidly in coming years. This will likely to increase waste from healthcare facilities.

13. Fourthly, the most complex projections will be for wastewater generation. On the one hand, keeping in view the shortfalls of coverage of sanitation and wastewater services as well as the future demand for water could lead to huge increase in waste generation levels. However, on the other hand, scarcity of freshwater resources would lead to develop and implement water efficiency measures including segregation of different wastewater streams for reuse. Nevertheless, keeping in view the current levels of waste water and future demand and commitments, it would safe to assume that wastewater generation levels will also rise substantially.

[4] http://www.nationmaster.com/graph/hea_hos_bed_per_1000_peo-beds-per-1-000-people

Emerging and re-emerging waste streams

14. In addition to the conventional waste streams, various waste streams are emerging and re-emerging. To support the food demand of huge populations, agricultural activities are on the rise in almost all the countries in the region. This is resulting into a large amount of agricultural waste which is mainly disposed of through open burning or let to rotten. It is estimated that globally about 140 billion metric tons of biomass[5] is generated every year from agriculture which is equivalent to approximately 50 billion tons of oil[6]. The Asia-Pacific region has seen enormous increase in the agricultural activities to meet demand for food and cash crops. This is resulting into generation of substantial amounts of waste agricultural biomass.

15. Furthermore, improved life styles coupled with technology development has led to production of various electronic and electrical equipment. The increased affordability and rapid changes in the electronics are the major reasons for accelerated generation rates of waste electrical and electronics equipment (WEEE) or E-waste. Waste Electrical and electronic Equipment (WEEE) or E-waste is one of the fastest growing waste streams in the world. In developed countries, it equals 1% of total solid waste on an average. It is expected to grow to 2% by 2010. In developing countries, it ranges from 0.01% to 1% of the total municipal solid waste generation. In countries like China and India, though annual generation per capita is less than 1 kg, it is growing at an exponential pace. The increasing "market penetration" in developing countries, "replacement

[5] Biomass wastes include agricultural wastes, such as corn stalks, straw, sugarcane leavings, bagasse, nutshells, and manure from cattle, poultry, and hogs; forestry residues, such as wood chips, bark, sawdust, timber slash, and mill scrap; municipal waste, such as waste paper and yard clippings.

[6] Concept Paper, Using Agricultural Biomass Waste for Energy and Materials: Resource Conservation and GHG Emission Reduction, A Biomass Assessment and Compendium of Technologies Project, UNEP August 2007

market" in developed countries and "high obsolescence rate" make WEEE/E-waste one of the fastest waste streams.

16. The composition of WEEE/ E-waste is very diverse and differs in products across different categories. It contains more than a 1,000 different substances, which fall under "hazardous" and "non-hazardous" categories. Broadly, it consists of ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items. Iron and steel constitutes about 50% of the WEEE followed by plastics (21%), non ferrous metals (13%) and other constituents. Non-ferrous metals consist of metals like copper, aluminum and precious metals like silver, gold, platinum, palladium etc. The presence of elements like lead, mercury, arsenic, cadmium, selenium, and hexavalent chromium and flame retardants beyond threshold quantities in WEEE / E-waste classifies them as hazardous waste (UNEP 2007).

Emerging issues of waste management - urban growth and sustainability

17. Urbanization is one of the critical results of economic growth and industrialization in the Asia-Pacific region. The major issue is the informal urban settlements as urban growth in most of the cities is not following the proper city planning and land-use practices resulting into huge slums and a mix of residential and industrial areas. This complex urban growth is creating major challenges for managing municipal services including solid waste and wastewater.

18. As indicated above the, urban growth rates are beyond 2 per cent in most of the countries. The influx of people in search of employment and basic services including healthcare and education is a continuing phenomenon in the cities. However, mainly due to capacity constraints, the city planning and implementation of land-use by laws is limited. The people, with low income and bigger families to support, cannot afford to live in properly developed areas and they end up

living in slums. Most of these slums do not have proper roads to facilitate solid waste collection and proper drainage system for wastewater collection; thus, waste and waster is being dumped in the nearby open dumps and rivers.

19. Industrial activities in the slums further complicate the situation as hazardous waste and industrial wastewater make its way in the streets and water bodies. Toxic levels in the air, soil and water bodies are at alarming level in most of the slums with industrial activities. This phenomenon in slums creates huge impact in terms of environment and public health and increases the sick episodes resulting into loss of income for the people. This is a vicious circle against sustainability in urban areas.

Regional view of issues and public health, environmental, social and economic impacts

20. Increase in amount and hazard of wastes has severe impacts on global and local environment, natural resources, public health, local economy and living conditions, thus threatens the attainment of relevant millennium development goals. Various diseases including cancers result from exposure to hazardous emissions mainly from open burning and substandard incineration of wastes. Communities living near dumps are suffering from littering, odour, insects and rats. Scavengers are at even greater health risks. Waste content in many developing countries is mixed and consists of fecal matter, blood, body fluids, animal flesh, hazardous chemicals and heavy metals, volatile organic and greenhouse gases, pressurized gas containers, munitions and so on.

21. Relative health risk for solid waste workers is much higher as Cointreau (2006) indicates that they have 6 times more relative risk of infectious disease, 2.6 and 1.4 times more for allergic and non-allergic pulmonary diseases respectively, 2.5 more for chronic bronchitis, 1.2 more for hepatitis, 3 times more for parasites, 10 times more for acute diarrhea, 2 times more for coronary

disease, 1.3 times more for inury, 5.6 to 10 times more for accidents, 1.9 more for musculoskeletal problems.

22. Wastes accumulated over decades and leachate from unmanaged landfills and wastes dumps have contaminated groundwater and soil across the world. Waste dumping into rivers, lakes and sea has caused damages threatening agriculture, water supply and people's livelihood depending on these aquatic systems. Wastes choke sewage and irrigation systems, which leads to damage on infrastructure and local economy. Another major issue is flash floods caused by the inability of solid waste clogged natural and man-made drains to remove storm water. Urban floods could be drastically reduced and their impact could be minimized if proper solid waste management system and wastewater disposal waste is in place.

23. Substandard landfills and waste dumps emit primarily methane, a major greenhouse gas of concern for climate change. Promoting modern waste management in countries can contribute in a significant way to GHG reduction on the global level. Similarly, construction and building waste also represent a lost opportunity for GHG emission reduction. UN ESCAP (2007) estimates that untreated organic solid wastes generate around 75 million tons of CO2 every year. IPPCC guidelines suggest that it is around 100 million tons per year. Being inflammable, methane emission has also caused repeated accidents of fires, explosion and collapses at landfill and dumps. For example, more than 200 people died and hundreds were injured when Payatas dumpsite in Philippines collapsed in 2000[7].

24. For certain fractions of the waste streams (like plastics, metals, glass etc.) as well as for certain waste streams themselves (like e-waste) the environmental impacts do not only come from

[7] http://www.iges.or.jp/en/pub/pdf/asia2000/e-12.pdf

the waste treatment and disposal itself but also from the indirect impacts due to resources getting lost from the economy loop. This means that these resources have to be produced again from virgin materials (often non-renewable) thus not only depleting the valuable natural resources but also resulting in the whole environmental rucksack once again. The resultant ever-increasing demand of resources makes waste management a global issue.

25. Sanitation related health impacts are well documented over the years as indicated in Table 4. The studies also show that small interventions in water and sanitation could bring substantial gains in public health as shown in Box 1.

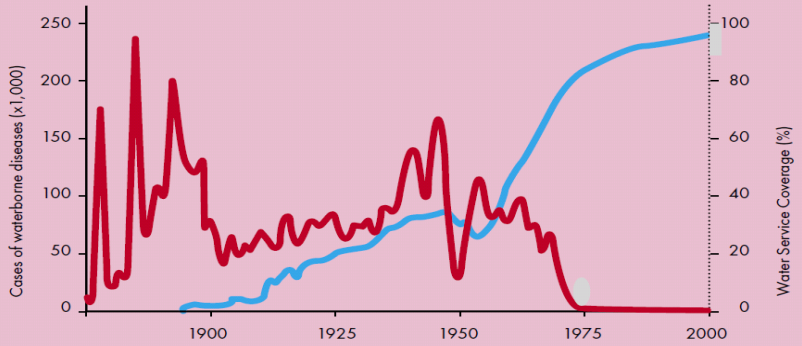
Table 4: Water and sanitation related health impacts

Sickness	Morbidity (Episodes/year)	Mortality (Death/year)
Diarrhea	1,000,000,000	3,300,000
Malaria	400,000,000	1,500,000
Schistosomiasis	200,000,000	200,000
Infection (helminthes)	1,500,000,000	100,000
Dengue Fever	1,750,000	20,000
Trypanosomiasis	275,000	130,000
Onchocerciasis	17,700,000	40,000
Bancroftian Filariasis	72,800,000	-

Source: World Health Organization statistics 1996

Box 1: Relationship between public health and water related interventions

As shown in the Figure below, the number of outbreaks of water-related infectious diseases has dramatically decreased, particularly since the mid-1970s. This demonstrates that the development of waterworks played a significant role in public health improvement.



Source: Japan Water Works Association. Outline of Water Supply 2001, 30 August 2001.

INTERNATIONAL COMMITMENT TO WASTE MANAGEMENT

26. **Local agenda 21:** During first UN Earth Summit in 1992, the governments agreed to implement Local Agenda 21 (LA21). LA21 promotes a participatory, long-term, strategic planning process that helps municipalities identify local sustainability priorities and implement long-term action plans.1 Local Agenda 21 processes aim at involving all stakeholders in the community in decision-making in sustainability planning and management at the local level. These processes offer great opportunities for participatory learning as groups debate their future direction based on working in partnership with government, industry and other community groups. Waste and sanitation are considered as local issues; hence there is an international commitment to strengthen the capacity of municipalities for improved level of services including waste and wastewater management.

27. **Millennium development goals:** In September 2000, building upon a decade of major United Nations conferences and summits, world leaders came together at United Nations Headquarters in New York to adopt the United Nations Millennium Declaration, committing their

nations to a new global partnership to reduce extreme poverty and setting out a series of time-bound targets - with a deadline of 2015 - that have become known as the Millennium Development Goals (MDGs). The Goal 7 on Environmental Sustainability also includes the target on coverage of sanitation and improved lives of urban slum dwellers.

28. **Inter-governmental decisions:** Currently, the governments took a decision during Governing Council of United Nations Environment Programme (UNEP) requesting the Executive Director of UNEP to increase the support and efforts for integrated waste management (GC 25/8). The governments reaffirm this decision through a Declaration at Convention of Parties (COP) under Basel Convention in Bali.

29. **Multilateral environmental agreements (MEAs):** There are various MEA related with waste. Some of the important among these are Basel Convention for hazardous waste, Stockholm Convention on persistent organic pollutants, Vienna Convention for protection of ozone layer, and Rotterdam Convention on the Prior Informed Consent, Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. The countries which are parties to these conventions are working are undertaking various measures to comply with these conventions.

30. **International agencies:** The main actors in international waste management with respect to Asia-Pacific region, be it at regional, national and local level, are UNEP and some of the UNEP administered conventions, namely the Basel convention, the Stockholm convention on Persistent Organic Pollutants (POPs), Vienna convention/Montreal Protocol on Ozone Depleting Substances as well as some of the established UNEP action programmes, including Global Programme of Actions (GPA) and the Regional Seas Programme. Other UN agencies working on various aspects of waste management include UNDP, FAO, WHO, IMO, UN Habitat, UN Centre for Regional

Development (UNCRD) and UNIDO, and UN ESCAP. Among other international organizations, the OECD is a key actor. Further, various international financing institutions have work related to waste management, namely the World Bank Group (IBRD, IDA, IFC, GEF and the Prototype Carbon Fund (PCF)) and Asian Development Bank (ADB). UN ESCAP, in addition to its direct work on waste management, also works through various initiatives and programmes such as Kitakyushu Initiative and CITYNET. UN ESCAP is currently implementing a USD 104 million multi-year project on "Pro-poor and sustainable solid waste management in secondary cities and small towns."

REVIEW OF IMPLEMENTATION

31. At international level, the key actors that are active on different aspects of waste management needs are summarized in the following tables based on information from their web-sites. Pending more information directly from these actors, it is very likely that some activities crosscut multiple categories and stages of the waste chain. We have analyzed the work being implemented or planned along two lines: 1) Pre-generation stage of waste chain (before resources actually appear as waste) covering waste minimization, CP and 3R (Table 5 and Table 6) Post-generation stage of waste (after the waste has been generated) covering waste treatment and disposal (Table 2). Further a distinction has been made of actions at different geographical scale – global, regional/national and local[8].

32. Within the countries and cities, many decades back management of solid waste was not a major issue as the population was small and the land available for the assimilation of wastes was large (Tchobanoglous et al. 1993). Furthermore, the impact of waste and public health was not yet fully realized. However, after the outbreak of worst public health impacts, especially in Europe,

[8] http://www.chem.unep.ch/mercury/GC25/K0842742_GC-25-5-Add-2_final.pdf

removal of waste became one of the top priorities for public health. This was not only applicable to biodegradable wastes, which produce disease related vectors, but this was also applicable to non-biodegradable wastes, which were accumulating and resulting into urban flooding and were affecting sanitary conditions.

Table 5: Agencies having existing/planned activities at **Pre-generation Stage** of waste

Level **Aspect of needs**	**Global**	**Regional / National**	**Local**
Policy & regulatory	UNEP, SBC	OECD, UNEP, UNIDO, UN ESCAP, UNCRD	UN ESCAP,
Technical	WB	OECD, UNIDO, UNEP UN ESCAP,,	UN ESCAP, UNIDO, UNEP
Financial	--	IADB UN ESCAP,,	UN ESCAP,
Social	UNEP	UNEP, UN ESCAP, UNCRD, NGOs	UN ESCAP, NGOs
Institutional	WB, UNEP, UNIDO	UNEP, UNIDO, UNCRD, UN ESCAP	UN ESCAP,

Table 6: Agencies having existing/planned activities at **Post-generation Stage** of waste

Level **Aspect of needs**	**Global**	**Regional /National**	**Local**
Policy & regulatory	UNEP, SBC, IMO	OECD, SBC, UNDP, UNEP, WB, ADB, UN ESCAP, UN-Habitat, UNCRD	UNEP, UNDP, UN ESCAP, UN-Habitat
Technical	SBC, IMO, UNEP	OECD, WB, ADB, UN ESCAP,UNDP, UNEP, UN-Habitat	UNDP, UNEP, UN ESCAP, UN-Habitat,
Financial	--	WB, OECD, UN ESCAP,	WB-PCF, UN ESCAP
Social	UNEP, SBC	UNEP, UNDP, UNESCs, ADB, UN ESCAP,	UNEP, UN ESCAP, NGOs,
Institutional	UNEP	OECD, SBC, GEF, WB, ADB, UN ESCAP,, UN-	UNEP, UNDP, UN ESCAP,

		Habitat, UNEP, UNDP,	UN-Habitat

33. The initial success, of maintaining public health by removing waste from cities and dumping outside, did not last for long as open dumps and open burning started having its impact on public health and on natural environment. Leachate from dumps started seeping into water resources and into agricultural fields resulting into contamination of water and food. Local air pollution from burning of waste increased the incidence of various diseases.

34. This led the public and governments to give a serious thought to manage solid waste in proper way, so it may not affect public health and natural environment directly and indirectly. Solid waste management (SWM) became a priority public service for local governments. At this point of time, SWM service was mainly considered for municipal solid waste (MSW); thus, municipal solid waste (MSWM) was a common terminology with varying definition in different parts of the world. Hester and Harrison (2002) indicate that depending on the country, the definition of MSW can include some or all of household wastes including hazardous wastes, bulky wastes, street sweeping and litter, parks and garden wastes and wastes from institutions, commercial establishments and offices.

35. Industrial waste management became the responsibility of waste generators (industries) as well as national governments. The countries, with increased decentralization such as Japan and China, local governments were also responsible to regulate and monitor industrial waste management.

36. Since then, new types of waste are emerging such as wastes from healthcare services, wastes from discarded electronic equipment including computers (e-waste), waste from end of life

vehicles (ELV), wastes from urban agriculture, huge waste quantities from construction and demolition activities and from unfortunate events such as urban floods and earthquakes.

37. For national and local governments, waste management is one of the costliest public services. Conventional response for collection, transportation, treatment and disposal of waste in an environmental friendly way became a burden due to rapid increase in waste generation levels as a result of urbanization and economic growth. The developing countries were in the worst situation as most of the modern waste collection, treatment and disposal equipment is imported and the revenue base to support waste management was very small. Table 1 and Fig 1 show the expenditures on MSW Management by selected countries and cities. The financial burden started getting critical with an increase in energy and land prices. The waste collection rates in many developing countries were affected badly due to rapid increase in the costs. It became very difficult to find land near a town for landfill, and transportation costs and environmental impacts became major constraint to construct landfills at a distant place.

38. For effective waste management, the governments have started taking various steps. The concept of integrated solid waste management based on 3R (reduce, reuse and recycle) is being supported by Firstly, the most vital response was to reduce the amount of waste. Reduced quantities of waste would decrease the burden on collection services as well as on treatment and final disposal facilities. Various strategies, including technological and policy based, were introduced to reduce the amount of waste at generation point. Cleaner production (CP) is being introduced to minimize the waste generation at industries, while awareness raising campaigns and waste collection fees were introduced to motivate residents, institutions, commercial entities and others to check their waste generation levels.

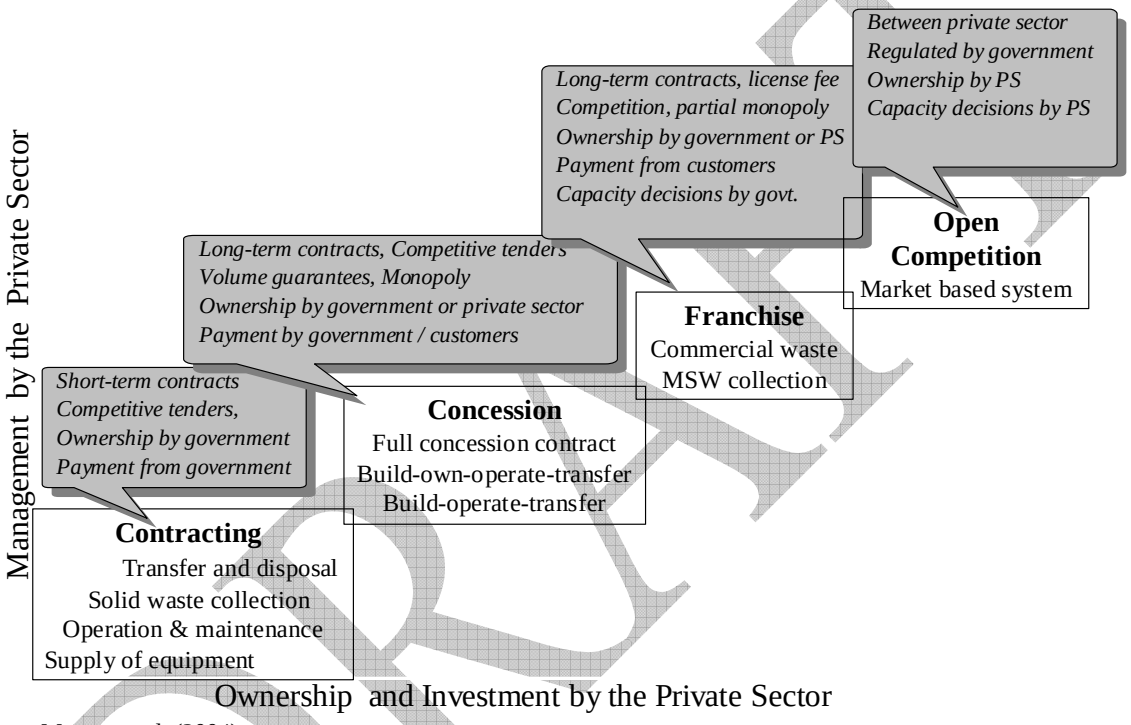
39. Secondly, to divert most of the waste for material and resource recovery, private sector including community enterprises are being involved based on local business models. Solid waste management chain comprises of various stages including collection, transportation, material recovery, treatment and resource recovery and final disposal. The World Bank estimates that in developing countries, it is common for municipalities to spend 20-50 per cent of their available budget on solid waste management, even if only 30-60 per cent of all the urban solid waste is uncollected and less than 50 per cent of the population is served. In most developing countries, open dumping with open burning is the norm[9].

40. In low-income countries, collection alone drains up 80-90 per cent of municipal solid waste management budget. In mid-income countries, collection costs 50-80 per cent of total budget. In high-income countries, collection only accounts for less than 10 per cent of the budget, which allows large funds to be allocated to waste treatment facilities. Upfront community participation in these advanced countries reduces the collection cost and facilitates waste recycling and recovery.

41. To improve the situation community enterprises were encouraged to set up door-to-door or primary collection system, while major private companies were involved in secondary collection and transportation of waste. Formal and informal sector got involved in material recovery. In some countries, the treatment (thermal and biological) is being managed by private sector to increase the efficiency of the system and to optimize the resource recovery such as energy from thermal treatment and biogas and compost from biological treatment. Moreover, setting of final disposal system including sanitary and controlled landfills is a costly activity and private sector is being involved to bring investment, technology and management skills. The models for private sector engagement vary in line with their level of involvement as shown in Figure 2.

[9] http://www.worldbank.org/urban/

Figure 2: Management and Ownerships in Various Forms of Private Sector Participation



Source: Memon et al. (2004)

42. To make private sector participation a success, continuous efforts are required as many countries are not yet fully ready to involve major private sector due to conventional policies on public goods as well as due to lack of legal and technical capacity to develop and implement major contracts. International agencies such as international financing institutions can play an important role to build local capacity and assist the governments in creating enabling environment for private sector participation. Moreover, the markets for carbon credits could also be explored as waste management has a direct impact on climate change due to the methane emissions from dumps and

carbon dioxide emissions from open burning. Alternative energy from waste could be an additional aspect to gain carbon credits.

43. Thirdly, the budget for waste management varies in line with the economic situation and affordability as shown in Table 7 and Figure 3.

Table 7: Expenditures on MSW

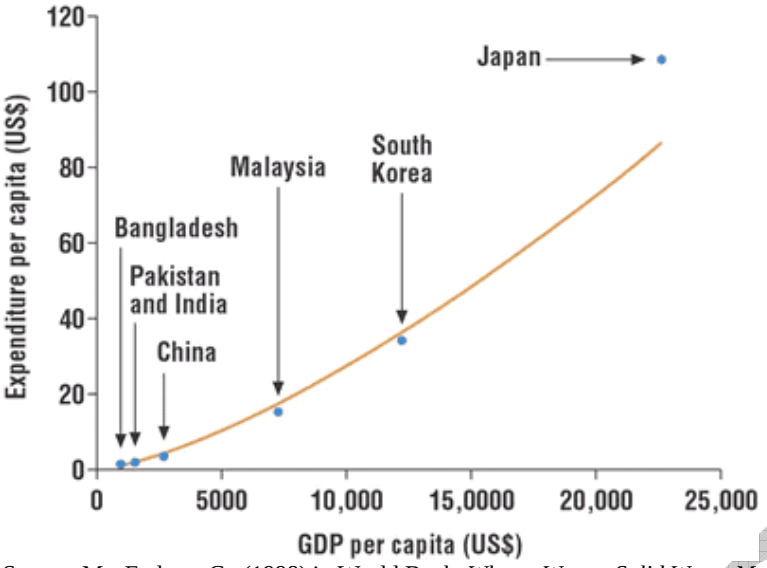
Figure 16: Municipal Urban Waste Services Expenditures

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

(MacFarlane, 1998)

Source: MacFarlane, C., (1998) in World Bank, *What a Waste: Solid Waste Management in Asia*, Washington DC: 1999

Figure 3: Expenditures on MSW



Source: MacFarlane, C., (1998) in World Bank, *What a Waste: Solid Waste Management in Asia*, Washington DC: 1999

44. However, the amount of waste is increasing and the cost of technology in developing countries is much higher as most of the equipment and spare parts is imported from overseas. In Asia, most of the waste is being left in open dumps (Table 8) as governments do not have enough funding to construct proper collection system as well as sanitary and controlled landfills.

Table 8: Waste Management Practices

	Sanitary Landfill %	Incineration %	Opendump %	Recycling %	Open Burning %	Other %
Africa	29.3	1.4	47	3.9	9.2	8.4
Asia	30.9	4.7	50.9	8.5	1.7	4.5
Europe	27.6	13.8	33	10.7	11.8	4.4
North America	91.1	0	0	8.1	0	0
Latin America	60.5	2	34	3.2	5.5	2

Source: United Nations Human Settlements Programme (UN Habitat): Global Report on Human Settlements 2003

45. For developing countries, a critical challenge is “informal sector,” as it is involved almost in all the stages of waste management starting at primary disposal point to fir final disposal point. Most of times children are involved as informal recyclers as they collect of recyclable materials at community disposal points, transfer stations and landfills. Many efforts in the past have been resisted on the pretext of “livelihood” for “informal sector.” However, formalisation of this “informal” sector could be helpful to improve their occupational health and income as well as it

was seen from the case study of composting activities of Waste Concerns in Dhaka (Bangladesh) where informal sector was given work at the compost plant with proper safety gear and better income (Memon 2003).

STRATEGY TO TRANSFORM CHALLENGES INTO OPPORTUNITIES

46. Based on the above discussions, the major challenges for waste management could be categorized under policy and regulatory, technical, financial, social and institutional. These challenges could be transformed into opportunities at national and local level through following steps:

i. Attitudinal change

(i) Awareness on the public health, environmental and economic impacts of solid waste and wastewater

(ii) Political will to tackle waste management on high priority and include this issue in the political and national agenda

(iii) Awareness and education on turning waste into a material/energy resource to support local and national economic growth and employment – UN ESCAP terms this phenomenon as “Trash is Cash.”

(iv) Awareness for waste generators on waste minimization, source segregation and proper disposal

(v) Awareness and training for service providers on proper collection and transportation, treatment and disposal

(vi) Awareness raising and training for recyclers for managing recycling properly especially with respect to occupational health, public health and secondary contamination aspects.

ii. Policy and regulatory

(i) Greater conceptual clarity for developing waste management system supported by practical application-strategies is required to enable synergy between resource augmentation through waste management. Awareness raising and capacity building is required in areas like waste prevention, 3R (reduce, reuse and recycle), cleaner production etc.

(ii) National policy frameworks need to be strengthened and expanded to shift the emphasis from end-of-pipe approach to an integrated resource management approach. At local level integrated waste management strategy and action plan for municipalities, especially in developing countries needs to be developed and implemented.

(iii) Effective implementation of waste-related multilateral agreements and guidelines is needed at national level. Corresponding laws, regulations and standards need to be developed and their enforcement strengthened both at national level as well as at local level.

iii. Technical

(i) Enhanced access to cutting edge, waste management technologies and strengthening capacity for technology assessment and selection is required.

Simultaneously, research and development is required to adapt these technologies to suit local conditions (e.g. with respect to locally available skills, resources, climatic conditions, culture etc.).

(ii) Technical guidelines, case studies, demonstration and pilot projects for integrated waste management especially in developing countries are needed

(iii) Local level capacity to implement and operate waste management technologies needs to be built / strengthened.

iv. Financial

(i) Availability of resource for developing, implementing and operating waste management systems in developing countries needs to be enhanced. Need to develop and implement appropriate economic instruments to raise funds for waste management and make it economically attractive.

(ii) Public-private partnership needs to be further explored to raise availability and access to financial resources, to meet growing demand for construction and operation of waste management systems.

v. Social

(i) Need to change the attitude and raise awareness at all levels and among all waste generators to promote waste minimization, source segregation, proper disposal of waste.

(ii) In developing countries, waste management needs to find ways to incorporate and improve employment and working conditions of vulnerable sections of society, e.g. scavengers and rag-pickers;

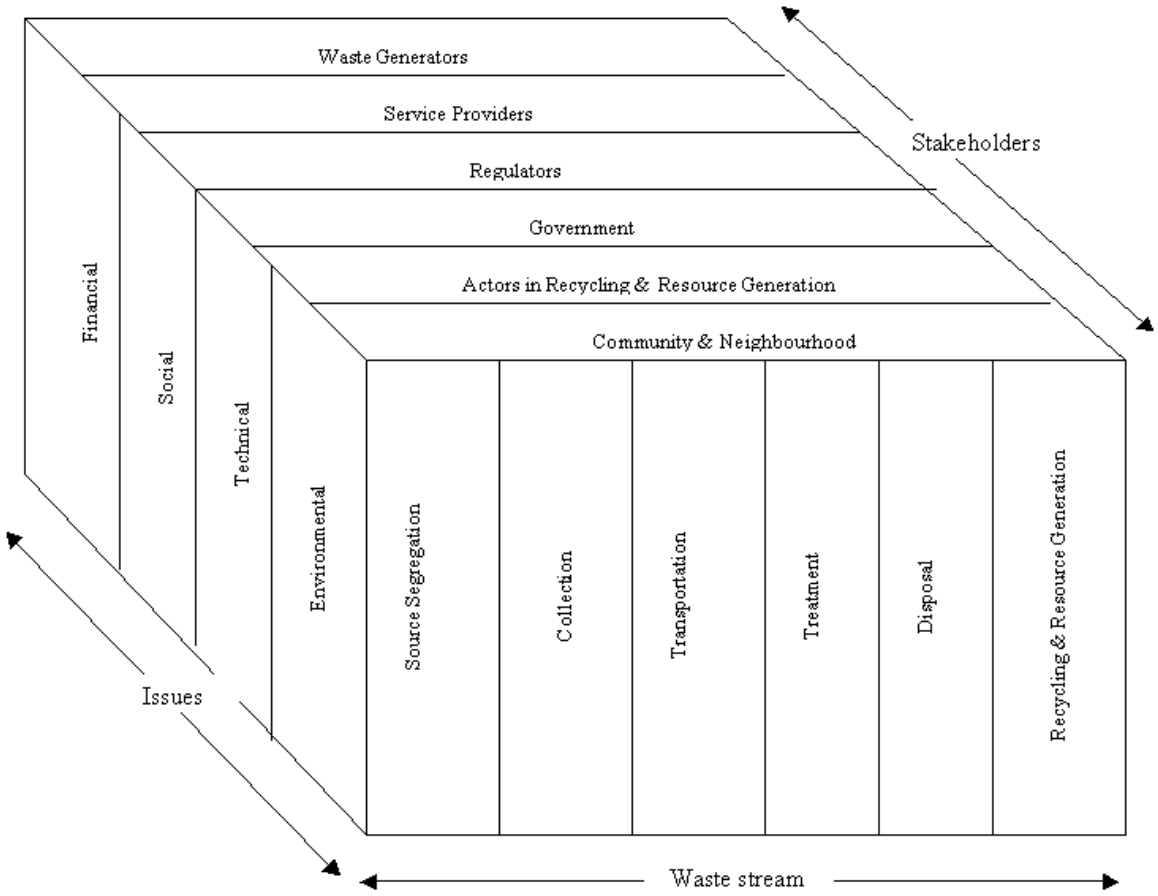
(iii) Involvement of private sector and local communities in developing, building and running of waste management system needs to be strengthened and made more effective.

vi. Institutional

(i) Institutional strengthening and capacity building required at national level to enable work at policy, technical, financial and social aspects.

(ii) At local level, institutional capacity needs to be built / strengthened to raise awareness and develop human resources for waste management.

Figure 4: Areas for interventions in waste management



Source: http://www.unep.or.jp/Ietc/Publications/spc/ISWMPlan_Vol3.pdf

47. Specific steps are required to address specific waste streams including WEEE/E-waste, waste biomass and wastewater. For WEEE/E-waste, the manufacturers, consumers and recyclers may be located at a distance and in many cases across the national borders. However, management of WEEE/E-waste strategy requires an active participation of all the actors as recycling of various parts could not be technically and economically viable without the support of manufacturers. Therefore, some mechanisms could be laid down and one of the important mechanisms could be "extended producer's responsibility (EPR)." Under EPR, the manufacturers could be liable to collect back and properly recycle the goods. The implementation of EPR may require the support from international and regional agencies due to cross-border issues. The other mechanism could be "corporate social responsibility (CSR)," where manufacturing companies support these efforts as part of their image building in the society.

48. Co-benefits of waste management have become evident as the new technologies are becoming cheaper and easily available. Municipal solid waste contains yard waste, paper and plastics and these can be converted in various types of fuel, preferably solid fuel through available technologies for RDF (refuse derived fuel) or RPF (refuse derived paper and plastics densified fuel). With little modifications at the kilns, for example at cement factory, most of the waste could be directly used as fuel. This, in addition to savings in terms of cost of fuel, also saves the costs for final treatment and disposal of waste.

49. Waste biomass and wastewater has a great potential for carbon financing due to level of GHG emissions as well as due to the potential of converting waste biomass and sludge into energy source. Waste biomass with point sources such as sugar and rice industry, animal farming, and wastewater treatment plants could be the easy starting points to develop and implement the projects on converting waste biomass into a resource. One of the major challenges is to generate initial funding to start these projects and to get these validated under clean development mechanism (CDM) or programmatic CDM to market their carbon credits.

50. To choose the scale and type of the system, the local socio-economic and technical characteristics play a vital role. In some cities, due to narrow roads, smaller collection vehicles, involving community enterprises, could be useful for primary collection while in other cities or in the other parts of the same city, bigger vehicles involving private companies may be a viable solution. For example, in Dhaka, community enterprises run door-to-door collection system in various wards and there is decentralized composting as well. Similar trends are seen for wastewater management system. For example, in Orangi, one of the biggest slums in Karachi (Pakistan), a very successful decentralized drainage system was established based on the

community help through micro financing. Nevertheless, holistic approach should be applied to link the decentralized systems as wastewater collected through the drains in Orangi may end up in river or sea, if it is not connected with wastewater treatment plan.

CONCLUSION

51. Waste management is one of the most crucial challenges for the governments to control the worst impacts in terms of public health, environmental resources and climate change. It is high time for the stakeholders (international and regional agencies, national and local governments, private sector, community enterprises, and waste generators) to set up proper and integrated waste management system at local and national level. Most of the waste could be converted into a resource to reduce final volumes of waste and subsequently the cost of final disposal of the waste. Waste prevention and minimisation is another aspect to reduce the waste management costs and negative impacts of waste. The strong linkages between climate change and waste management could also be utilized to develop the projects with carbon financing to reduce the dependency on national and international lenders for developing waste management system. Private sector participation, whether be community enterprises or local private companies, could be appropriately utilised to improve the efficiency of waste management system.

52. The system for waste management could be designed based on business principles boost economic activities, to generate employment, promote local enterprises and recover materials and energy to further supporting the economic development. However, the success of integrated waste management based on 3R approach depends on the partnerships among all the stakeholders including international agencies, national and local governments, private sector including recyclers, and waste generators. Change in attitudes as well as technical, financial, legal and institutional

capacity is vital to support these partnerships and to maximize the impact of the efforts for waste management. A proper strategy for this capacity building and fostering partnerships is the key to turn current vicious circle of waste management into virtuous circle of integrated solid waste management based on 3R.

53. This waste management system could also improve the food and energy security. On the one hand, awareness and policies on waste minimization could improve the energy efficiency and reduce wastage of food. On the other hand, by converting waste into compost and energy could increase the agricultural production and reduce the dependency on the imported fertilizer and energy.

54. The type and size of solid waste management and wastewater management could be in line with local criteria, as it has been seen that in some places, centralized and big system may work very well, while at other places smaller and decentralized system could be successful.

55. Last but not the least, the economic, environmental and social benefits of waste management could easily surpass its initial costs. We can learn from available experiences from other countries in the areas of policy, institutional set up, financing mechanisms, technology and infrastructure, roles and responsibilities of stakeholders, and political will and awareness. An active South-South and South-North cooperation would be vital to accelerate the learning process and to share the international and regional resources to assist countries and their cities to develop effective and efficient solid waste and wastewater management system based on 3R approach.

References

Aoki, C. and Memon, M.A. (eds.) (2006), *Wastewater Reuse*, UNEP

Cointreau, S. (2006), *Occupational and Environmental Health Issues of Solid Waste Management: Special Emphasis on Middle and Lower-Income Countries*, Urban Papers, The World Bank, Washington D.C. (http://siteresources.worldbank.org/INTUSWM/Resources/up-2.pdf)

Hester, R.E. and Harrison, R.M. (ed.) (2002), *Environmental and Health Impact of Solid Waste Management Activities: Issues in Environmental Science and Technology*, The Royal Society of Chemistry, Manchester (UK)

Kitakyushu Initiative (2003), *General Overview of Solid Waste Management*, at http://kitakyushu.iges.or.jp/successful_practices/solid_waste_management.html accessed on 26 Sepetember 2009

Lacoste, E. and Chalmin, P. (2007), *From Waste to Resource: 2006 World Waste Survey*, Economica, Paris

MacFarlane, C., (1998) in World Bank, *What a Waste: Solid Waste Management in Asia*, Washington DC

Memon, M.A., Imura, H. and Shirakawa, H. (2006), *Reforms for Managing Urban Environmental Infrastructure and Services in Asia*, The Journal of Environment and Development, Vol. 15, No. 2, pp. 138-157

Memon, M. A. (2004), Public Participation in Solid Waste Management: Learning from the International Experiences. *Emerging Issues in Solid Waste Management in Thailand: Sharing Practices and Developing Actions*, 29-30 April 2004, Bangkok

Memon, M.A. (2003), *Innovative Ways to Promote Community-Based Composting in Dhaka*, IGES available at http://www.iges.or.jp/APEIS/RISPO/inventory/db/pdf/0052.pdf accessed on 29 September 2009

Tchobanoglous, G., Theisen, H., and Vigil S.A. (1993), *Integrated Solid Waste Management: Engineering Principles and Management Issues*, McGraw-Hill, Singapore

UN ESCAP (2007), *An Innovative Approach to Municipal Solid Waste Management in Least Developing and Low-Income Developing Countries*, Quy Nhon City, Vietnam