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TRENDS IN SOLID WASTE MANAGEMENT: ISSUES, CHALLENGES AND OPPORTUNITES

(Plenary Session 1(a) of the Provisional Programme)

Final Draft

This background paper was prepared with inputs from Mr. Surya P. Chandak, Deputy Director, UNEP-DTIE-IETC, for the International Consultative Meeting on Expanding Waste Management Services in Developing Countries ahead of the eighteenth session of the Commission on Sustainable Development. The views expressed herein are those of the authors only and do not necessarily reflect the views of the United Nations.

1. Introduction

Waste is a complex and often a neglected issue. Everywhere, whether habitated or not, one can find waste-prints of humans. Littered streets, waste dumps, smoking waste piles are becoming more and more common sights. From small villages and towns to cities and large megapolises, waste has become a major environmental and health issue. It causes all sorts of problems. Unscrupulous dumping of waste is a breeding ground for vermin and vectors. Apart from odor and visual aesthetics, waste could release harmful substances into the soil and water bodies thus polluting them. Open burning of waste, a common practice in many developing countries, releases toxic gases, including highly carcinogenic dioxins and furans.

Waste is an underlying issue throughout most of the Chapters of Agenda 21 – either as a cause of a number or environmental problems, or as a result/output of human activities. While Chapters 20, 21 and 22 deals specifically and directly with waste issues, other chapters deal with the impact and effect of waste on other environmental issues. The Chapter III of Johannesburg Plan of Implementation lays emphasis on "Develop waste management systems, with the highest priority placed on waste prevention and minimization, reuse and recycling, and environmentally sound disposal facilities, including technology to recapture the energy contained in waste, and encourage small-scale waste-recycling initiatives that support urban and rural waste management and provide income -generating opportunities, with international support for developing countries."

2. Trends in waste volume, recycling and disposal.

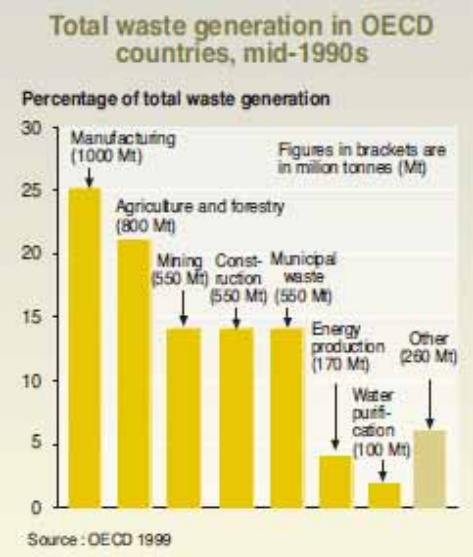
Definitions of waste vary from country to country and accordingly the reporting mechanisms as well as the reliability of reported data also varies. In the absence of scientific data collection mechanisms, quite often data are reported on 'estimation' basis. Such data should be taken as indicative of trends rather than relying on absolute values. Relatively reliable data on waste is available mainly from OECD countries. In developing countries waste quantity is generally assessed based on per capita waste generation factors and sometimes supported with some basic studies. Generally, the assessment of hazardous waste, particularly industrial hazardous waste, is better due to reporting requirements for Basel Convention. The data on waste streams like waste agricultural biomass, construction & demolition waste is generally the weakest.

2.1. Waste volumes

It is estimated that we produce as much "economic" waste (i.e. officially recorded) each year as cereals (2 billion tons) and steel (1 billion tons). However, exact quantification of the amount of waste being generated on a global scale is besieged with several problems; lack of reporting by many countries, inconsistencies in methods of reporting, differences in definitions and surveying methods employed by countries etc. The data presented below should therefore be used with caution.

The total waste generation in OECD countries is given in graph below.

Figure 1



The very notion of waste "production" is ambiguous and practically unmanageable[1]. The data reported refers to 'collection phase', i.e. the time when waste enters the economic stream. While relatively reliable data are available for municipal waste (limited to urban populations in emerging and developing countries), assessments of industrial wastes (both hazardous and non-hazardous) may include random factors even in developed countries. Estimated quantity of industrial and municipal waste collected in selected countries ranges from 2.5 to 4.0 billion tons annually.

The collection of municipal waste in different regions is given below.

Table 1: Worldwide Municipal waste collection (estimated figures for 2004)

Country	Municipal waste collected in million tons
OECD Countries	620 (1)
CIS (Baltic states excluded)	65 (2)
Asia (except OECD countries)	300 (3)
Central America	30 (4)
South America	86 (5)
North Africa and Middle East	50 (6)
Sub-Saharan Africa	53 (7)
TOTAL	1,204

Source: Lacoste and Chalmin 2007

(1) Statistics gathered
(2) Extrapolation of data from 10 new EU member countries
(3) Statistics gathered and extrapolated for Vietnam, Bangladesh and Indonesia
(4) Extrapolation from Mexican data
(5) Extrapolation from Brazilian and Argentinean data

[1] *Lacoste and Chalmin 2007*

(6) Extrapolation from Egyptian data
(7) Extrapolation from Kenyan data

Extrapolations are calculated based on GDP/inhabitant, the consumption of paper and paper based products/inhabitant, the rate or urbanization and the total population. For emerging and developing countries only the amount of urban waste was estimated.

The characteristics of municipal waste grouped as per countries in three income levels are given in table below.

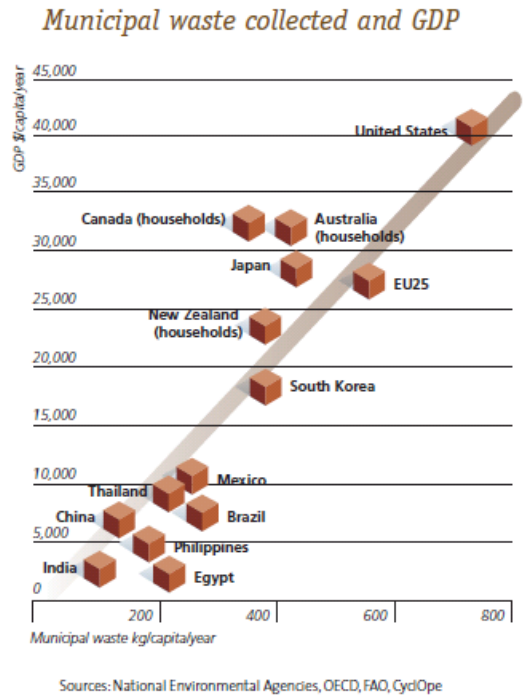
Table 2: Typologies of municipal waste collection and treatment by country income

	Low Income countries	Medium Income countries	High Income countries
GDP $/capita/year	< $5000	$5000-15,000	>$20,000
Average consumption of paper/cardboard per inhabitant/Kg/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 non-existent, no statistics	National Environmental Strategy, National Environmental Agency, Environmental legislations, few statistics	National Environmental Strategy, National Environmental Agency, Strict and complex regulations, statistics
Composition of municipal waste: Food/putrescible waste Paper and cardboard Plastics Metals Glass	 50-80 4-15 4-12 1-5 1-5	 20-65 15-40 7-15 1-5 1-5	 20-40 15-50 10-15 5-8 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	Unauthorised deposits>50%; informal recycling 5-15%	Landfills> 90%, start of selective collection, organized recycling 5%	Selective collection, Incineration, Recycling >20%

Source: Lacoste & Chalmin 2007

There is generally a correlation between the amount of municipal waste and the GDP of the country. Higher the GDP of a country, higher is the quantity of waste produced. Such relationship is illustrated in figure below.

Figure 2



Sources: National Environmental Agencies, OECD, FAO, CyclOpe

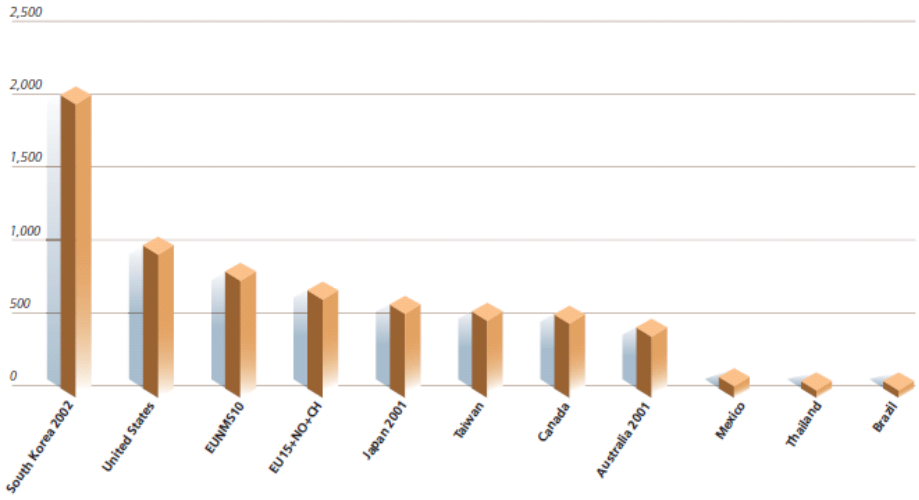
Municipal waste has a high economic value. The municipal waste market in OECD countries is estimated at approximately US $ 120 billion.

The industrial waste is difficult to estimate. Mostly data is available for EU, USA, Canada, Japan, South Korea, Australia, Mexico, etc. Data from Russia is not available which leaves a large gap. Even for China, different sources give different figures; OECD estimated it to be 315 million tons in 2002, while a recent estimate issued by the Chinese authorities is about 1 billion tons.

Few estimates on non-hazardous industrial waste are given below.

Figure 3

Estimated non-hazardous industrial waste per capita (kg/inhabitant)

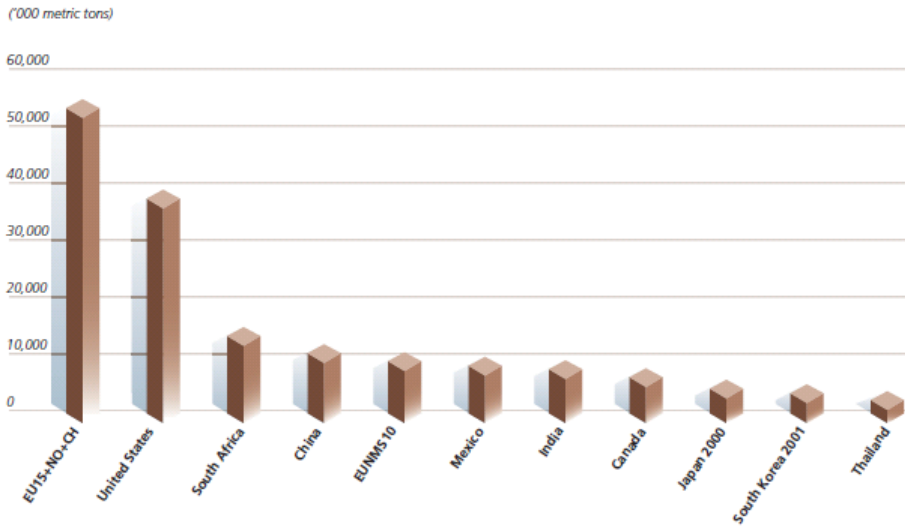


Sources: National Environmental Agencies, OECD, Eurostat, CyclOpe

Hazardous waste is even more difficult to estimate, exacerbated by lack of standard definitions and methods of quantification in different countries. The estimated hazardous waste in selected countries is given in figure below.

Figure 4

Estimated hazardous waste in a selected number of countries (total 150 million metric tons)



Sources: National Environmental Agencies, OECD, Eurostat, CyclOpe

E-waste (also referred to as WEEE-Waste Electrical & Electronic Equipment) is an emerging waste stream. Due to presence of heavy metals and toxic chemicals the E-waste is hazardous. Calculating the volume is difficult because of differences in definitions of E-waste and very complex disposal routes. Some estimate it to be in the range of 7-13 Kg/capita/year. It is estimated that there are over a billion personal computers in the world with an average life of just 2 years in developed countries. It is estimated that USA and Germany together generate more than 3 million tons of E-waste every year. In Europe E-waste is increasing by 3-5% per year – almost three times faster that the total waste flow. Globally E-waste is already estimated to be 5% of the total municipal waste. Large quantities of E-waste find their way to developing countries.

Construction and demolition is, weight-wise, another large waste stream in urban areas. In developed countries construction waste could be 10-15% of total waste. Spain produces 35 million tons/year of building and demolition waste.

Mining waste takes up a great deal of space, blights the landscape and often affects local habitats. By its very nature it can constitute a serious safety hazard. Countries that are members of European Environment Agency alone generate 400 million tons of mining waste every year accounting for 29% of total waste generated. Globally it is estimated that mining of iron, copper and gold alone requires removal of 33 billion tons of material every year.

The amount of waste being moved from one place to another is also increasing. As per reports to the Basel Convention it is estimated that between 1993 and 2001 the amount of waste crisscrossing the globe has increased from 2 million tons to more than 8.5 million tons. (Source: Vital Waste Graphics 2004). Quite a lot of it is hazardous waste, which is sometimes exported for recycling (e.g. waste lead acid batteries) and sometimes illegally for cheap disposal.

2.2. Recycling

Recycling and reuse of waste follows several routes. In developing countries, often materials are segregated from waste and recycled for secondary uses mostly through an informal route. This includes paper, bottles, textiles etc. Discarded products (especially WEEE) are refurbished and sold off as second hand products. Some wastes (such construction and demolition debris, organic waste converted into compost), with little or no processing, are reused for other purposes. Quite often waste is burnt/incinerated to meet the needs of heat energy – in developing countries a significant amount of cooking energy requirements in rural areas is met from waste agricultural biomass whereas in developed countries waste incineration with energy recovery is becoming popular.

The main materials that are recovered and treated to be reused are:

- Organic materials, wood
- Paper and cardboard
- Plastics
- Glass
- Ferrous and non-ferrous metals
- Textiles
- Batteries
- Waste electrical and electronic equipment
- Special substances such as waste solvents

The extent of recovery/recycling depends on several factors such as market for recycled materials, price of recycled material vis-à-vis virgin materials, local economic conditions etc. The estimated size of main world secondary material market is given below.

Table 3: Estimated size (for 2004) of main world secondary material

Material	Market Size million tons
Recovered fibers (paper)	170
Recovered ferrous metals (scrap metals)	405
Recovered non-ferrous metals	24
Recovered plastics	5
TOTAL	Approx 600

Source: Lacoste and Chalmin 2007

The estimated amount (2007) of materials collected from municipal waste in Europe and the US is given in table below.

Table 4

Recovery of materials from municipal waste in Europe and the United States
(in thousand metric tons)

	Germany	France	United Kingdom	Italy	Spain	Remaining EU15 (1) +NO+Switzerand Estimate	Total Europe	Etats Unis
Paper and cardboard (2)	8,500	5,200	3,700	2,000	3,500	9,800	32,700	40,000
Plastics	3,850	350	450	350	510	1,200	6,500	1,930
Glass	3,300	2,000	1,500	1,000	510	1,690	10,000	2,350
Non-ferrous metals	1,204	1750	75	278	131	797	3,975	1,750
Total	16,854	9,300	5,725	3,628	4,441	13,487	53,175	46,030
Batteries	11,5	9,6					28	
End of life vehicles Ferrous Metals							11,000	17,000

(1) Estimate: 30% of paper, 20% of plastics, 20% of glass and 20% of non-ferrous metals are recovered in the remainder of the EU15.
(2) Paper and cardboard are recovered from municipal and industrial waste

Sources: National Environmental Agencies

The percentage of recycled paper and glass in selected OECD countries is given in figure below.

Figure 5

The global market of recycled cellulose fiber is given in table below.

Table 5

World RCF market in 2004 (in thousand metric tons)

	Recovery of FCR	Use of FCR	Imports	Exports
Europe	51,970	49,074	11,359	14,465
North America	47,467	36,647	2,754	13,574
Asia	58,988	75,121	20,613	4,480
Latin America	7,850	9,837	2,081	94
Oceania	2,422	1,876	2	549
Africa	1,776	1,940	224	60
Total	17,0473	174,495		

Source: PPI

Recycling of scrap metal has perhaps been the most attractive recycling option. It is estimated that scrap metal reuse rate could be globally as high as 60-70%. The estimated reuse quantities of some metals are:

Steel – 405 million tons (40% of total steel production)
Aluminum – 7.6 million tons (20% of total aluminum production)
Copper – 2 millions tons (13% of total copper production)
Nickel – 0.46 million tons (40% of total nickel production)
Zinc – 2 million tons

Recycling in developing countries is mainly through unorganized sector; an informal network of rag-pickers (both from primary disposal points as well as intermediate/final disposal areas), door-to-door collectors, primary and secondary dealers and finally to recycling industries. There are no official estimates of the extent of such recycling. Recycling is mainly economics driven as it is a source of livelihood for many unemployed. It is estimated that the recycling for high value items e.g. metal, clean paper and plastic etc. is relatively high as compared to that of organic constituents (except for sporadic examples like that in Bangladesh). In rapidly industrializing countries like India and China public-private partnerships are now emerging to use municipal waste as a source of energy.

2.3. Disposal

There are only three things one can do with waste once it is generated; bury it, burn it or recycle. All these require a sound management system with supportive policy framework and adequate

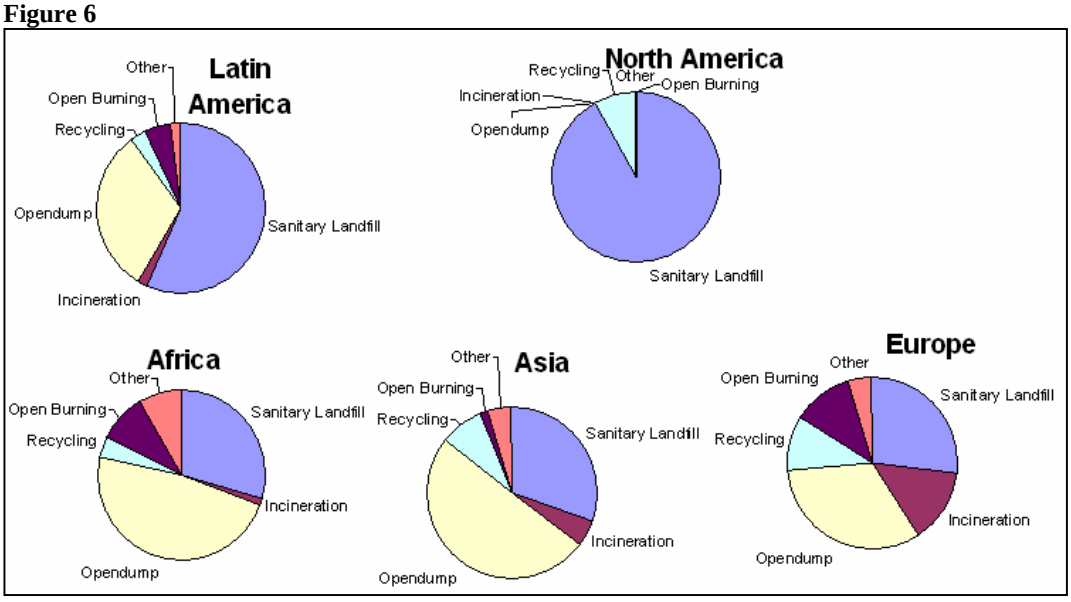
finances. At the first burying (better known as landfill) seems to be the simplest option. However, the potential hazardous consequences (auto combustion, seepage of highly toxic leachate etc.) demand that strict controls are exercised in terms of design and operation of landfills. Composting and/or bio-methanation are also emerging as widely favored technology to convert clean organic waste in manure/soil conditioner.

Generally, the most widely used technologies used for waste disposal are either landfills (including sanitary landfills, secured landfills for hazardous waste and open dumps) or incineration with or without energy recovery (including open burning). A properly designed and well managed landfill can be a hygienic and relatively inexpensive method of disposing of waste materials provided the geology is suitable and enough land space is available. However, poorly designed or poorly operated landfills can cause a number of problems. Local population is often hostile to landfills (NIMBY syndrome) because of the damage they can do. Organic matter in waste, as it rots produces methane which can catch fire or even cause explosions (fires in waste dumps are a common sight). This is also bad for global environment as methane has 21 times more global warming potential than carbon-di-oxide. The changing composition of waste also gives to other forms of pollution. The bacterial decomposition of waste releases acids which can leach heavy metals such as lead and cadmium into soil and ground/surface waters. The hazardous materials and wastes if not properly segregated such as solvents, motor oil, and mercury containing light bulbs could further aggravate the situation.

Incineration can be just as bad if not controlled properly. Untreated gaseous emissions contain nitrogen and sulfur oxides which cause acid rain, particulates cause respiratory problem. A particularly severe problem is release of dioxins and furans which are highly carcinogenic. Studies have shown that in many countries a major source of dioxin/furan emission is uncontrolled burning of waste. Some countries like Philippines have completely banned incineration. Well designed and well operated incineration system with proper controls is an expensive affair and is beyond the means of many local authorities.

The global distribution of deployment of various technologies grouped against three classes of economic development of countries is given in graph below.

Figure 6



Source: UNEP

North America and Europe still rely mostly on landfills as the primary disposal technology. However, incineration and recycling is becoming more common in Switzerland, Netherlands, Austria, Germany, Denmark etc. In other developed countries such as Japan, Singapore etc. more waste is recycled or incinerated.

In most developing countries waste dumps or open burning continue to be the principal method of waste disposal. Such dumps, apart from causing several accidents are continuous source of emission of harmful gases and highly toxic liquid leachate.

3. Economic, environmental, health and social impacts of current practices of waste management

In most situations, waste is still considered as a problem (having potential environmental, health and social ill-effects) which some how needs to be solved. There is a need for a paradigm shift in the thinking – to consider waste as lost resources and thus minimize its generation and recycling it as a source for materials and energy. Managing waste is a costly affair. It is estimated that OECD countries spend about US$ 120 billion a year disposing off their municipal waste alone and another US$ 150 billion on industrial waste. The World Bank estimates that in developing countries, it is common for municipalities to spend 20-50 % of their available recurring budget on solid waste management even if only 40-60 % of urban waste is collected and less than 50% of urban population is served. In low income countries, collection alone drains 80-90% of municipal solid waste management budget.

Waste can cause all sorts of problems. Unscrupulous dumping of waste can produce greenhouse gases. It is estimated that waste dumps contribute to as much as 4% of global GHG emissions. Changes in the water chemistry due to surface water contamination can affect all levels of eco-systems. The health of humans and animals which have to use such contaminated waters is adversely affected. It can also contaminate ground water and soil due to seepage of leachate. This in turn affects the entire food chain. Waste dumps are highly disaster prone. The accident at Payatas dumpsite in Philippines which resulted in death of 200 people and several hundreds were injured is well known. Fires and accidents in dumpsites is, in fact, a frequent phenomenon in many developing countries. The health and environmental impacts of waste dumps are amply demonstrated, for example, in the study carried out by UNEP at Dandora dumpsite in Nairobi, Kenya. (Reference: UNEP report – Environmental Pollution and Impacts on Public Health).

The social ramifications of improper waste management are very serious. The weaker section of societies has to bear the maximum brunt – exposure to unsanitary, unsafe and unhygienic conditions, infestation of vermins and vectors, contaminated soil and water, exposure to risks of emissions and odors, etc. Millions of people, often children, (World Bank estimates that in low income countries 2% of population) who earn their livelihood by scavenging useable/saleable materials from dumps are exposed to extremely hazardous and unsafe conditions.

4. Issues for waste management

4.1. General issues

The issues for solid waste management are multi fold.
In general, waste management is a global issue. It is as much relevant in developing countries as in developed countries. It is closely linked to our life styles and societal patterns. Rapid increase

in volume and types of solid waste and hazardous waste generation is becoming a burgeoning problem for national and local governments to ensure effective and sustainable management of waste.

Waste management has a strong bearing on quality of human life as well as that of flora and fauna. The adverse impacts of improper waste management are very serious and well known. Communities living near dumps suffer from littering, odor, insects and vectors. Scavengers are at even greater health risks. Substandard landfills and waste dumps emit methane, a major greenhouse gas of concern for climate change.

Waste management requires resources – both financial as well as sound technologies. The World Bank estimates that in developing countries, it is common for municipalities to spend 20 to 50 percent of their available recurrent budget on solid waste management. In low-income countries, collection alone drains up 80 to 90 percent of municipal solid waste management budget. Contrastingly, in high income countries, collection only accounts for less than 10 percent 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.

Finally, the perspective on waste management needs to be changed. It has to be viewed not merely as a problem but also as an opportunity -- waste represents lost resources and there is an opportunity of recovering and reusing these resources.

From the perspective of waste management chain some specific issues are listed below:

4.2. Issues for waste management (as per waste management chain)

a) Source Segregation, Collection

There is virtually no organized and scientifically planned source segregation in developing countries. Segregation, if at all, is driven by economic factors, except for industrial waste where due to organized nature of sector segregation is sometimes practiced and for healthcare waste due to regulatory requirements,. Sorting is mostly done by unorganized sector (scavengers and rag pickers) and rarely done by waste generators. Consequently, the efficiency of segregation is quite low as the unorganized sector tends to segregate only those waste materials which have relatively higher economic return in the recycling market. The unsafe and hazardous conditions under which the segregation and sorting takes places are well known.

The waste collection efficiency even in large cities is rather low. Often a substantial amount of waste is left to rot on the streets and/or is dumped into low lying areas, canals, rivers etc. Several factors are responsible for such low collection efficiency; lack of appropriate collection systems, lack of and/or inadequate collection facilities such as waste disposal bins, collection vehicles etc., lack of funds, lack of and enforcement of appropriate regulations etc.

b) Treatment & Disposal

In developing countries, generally no treatment is given to municipal solid waste (MSW) and it is usually disposed as it is. Most of MSW is still disposed off in dumps causing severe environmental and health risks. The progress in moving towards sanitary landfills and/or disposing through well designed and well operatored incinerators is rather slow.

c) Resource Generation

As is well known, a lot of materials can be recovered from waste for recycling which can then serve as an input for manufacturing. Of particular significance are cellulosic materials, plastic,

metals and glass. Despite the absence of organized segregation systems, quite substantial amounts of clean plastics, cellulosic material, metals and glass are already recycled in developing countries due to economic attractiveness. A large number of people ranging from rag pickers to primary dealers, secondary dealers and recycling industries earn their living out of waste recycling. In contrast, organic waste, which constitutes the largest proportion in the waste stream, is often disposed of rather than being segregated and converted into bio-gas, compost etc. Landfill gas is mostly unutilized. Only recently, some efforts have been started to recover energy from waste.

4.3. Issues for waste management (as per action category)

a) Policy Issues

In many developing, a robust policy framework to give a direction and thrust to environmentally sound waste management does not exist. If at all, the focus of policies is on collection and disposal. Policy measures to promote waste minimization, recycle and recovery are rather lean. Unlike in developed countries (e.g. Government of Japan has set the targets under its sound material recycling policy that by 2015 – Resource productivity will be enhanced from 26 to 42 million Yen/ton; cyclical rate will be increased from 10 to 15%; and final disposal will be reduced from 5.7 to 2.3 billion tons) no national targets have been set up to deal with overall issue of waste management in line with country's economic development programme. The environmental policies continue to be 'discharge end control' based instead of shifting to 'source end based' approach. The industrial policies continue to rely on manufacturing from virgin resources and a rational pricing mechanism and/or market based instruments to accelerate waste minimization and support greater use of recycled materials are not in place. There is a lack of IWM/3R orientation of waste management vis-a-vis urban environmental management policies. Most of the current policies are in support of end-of-pipe approach creating huge burden on municipal authorities. Specific policies to promote segregation and reuse at source and to promote conversion of waste into useful materials/energy are not there.

b) Technology Issues

There is an urgent need in developing countries to launch targeted efforts for development/acquisition of technologies for material and energy recovery from waste. To build confidence and test the application of such technologies in the context of developing countries pilot demonstration projects need to be established. This in turn will require extensive data collection on waste characterisation and quantification to facilitate assessment of recycling/recovery potential and design/development of technologies. Little or no effort seems to be taking place in this direction. Most of the work related to waste management continues to be focussing on augmenting waste collection and building disposal facilities.

c) Financing Issues

Availability of funds to support waste management continues to be the most pressing issues. The local authorities are mostly in a dire financial situation and are barely able to maintain the basic jobs of waste collection and somehow dispose it. Municipal level waste management continues to be heavily subsidised by governments. Financing mechanisms to promote use of Environmentally Sound Technologies, for technology development and demonstration are conspicuous by absence. As already mentioned, resource price rationalization to support market for recycled materials is yet to take place.

d) Trans-boundary movement and associated illegal trade in hazardous waste

Movement of waste, particularly hazardous waste, within a country and even between countries is another major issue. Movement of non-hazardous waste for the purpose of recycling is sometimes welcomed by recipient countries e.g. importing waste paper for recycling could be a cheaper way of making paper. However, sometimes hazardous waste is also moved (without meeting the requirements of Basel Convention) to take advantage of lower disposal costs in recipient countries irrespective of whether adequate waste processing infrastructure exists or not. Of late, E-waste has emerged as a major stream undergoing trans-boundary movement.

e) Other Issues

There are some other broader issues. In particular, one needs to address some location specific issues. The waste issues being faced by Small Island Developing States (SIDS) need to be highlighted. With small geographical areas, relatively smaller quantities of waste (which preclude economic viability of conventional recycling systems) and limited capacity, specific solutions need to be evolved for such areas. Enhanced efforts are required for awareness raising and capacity building. This is particularly important because the knowledge and information levels on modern systems and techniques of waste management (such as integrated solid waste management, converting waste into resources) are rather low. Waste management continues to be primarily in the domain of municipalities with little or no engagement of different stakeholders. There is a need to establish transparent monitoring mechanism and public reporting of results achieved.

5. Challenges in waste management

a) Increasing quantities and changing composition

Due to growth in population, changing lifestyles and consumption patterns, not only the quantity of waste generated is further increasing but quality and composition of waste is also changing – particularly more and more hazardous and toxic waste is being generated both because of industrialization as well as end-of-life products. A noticeable change in composition is observed that as the standards of living improve the proportion of paper and plastics increases – in many developing countries it has doubled in one decade.

b) Increasing severity of adverse impacts

The negative impacts of wastes on the local environment (air, water, land, human health etc.) are becoming more acute often resulting in public outcries and demands for action. The impacts of inadequate waste management are not just limited to local level but are now crossing boundaries and due cases like methane emission are even affecting global environment. More and more water bodies (both surface waters as well as ground waters) are getting contaminated. The land under and around waste dumps are heavily polluted and will require tremendous efforts and resources for rejuvenation.

c) Increasing cost of waste management

Cost of waste management is increasing on several accounts. Firstly, because of the sheer increase in quantity of waste being generated. Secondly, the changing composition of waste with increasing content of non-biodegradables and hazardous substances requires increasing complexity and sophistication in waste management techniques and technologies. Finally, with

increasing environmental and health awareness the demands on safe and environmentally sound waste management require more careful and extensive waste management. Already a significant budget of local authorities is being spent on waste management and the services are yet unsatisfactory. They are finding it extremely difficult to meet the demand for expanding/improving the waste management system which requires additional funds. Since municipalities continue to shoulder the major burden of waste management it is feared that unless new financing mechanisms are put into place, the waste management situation in many developing countries may further worsen.

d) Limited policy framework

As already mentioned, national and local policies on waste management are not yet comprehensive to cover all types of waste and all aspects of waste management particularly in developing countries. In developed countries policy framework to support resource recovery from waste is still inadequate.

e) Lack of political priority

Managing waste properly and resource recovery from waste is still low on the socio-political priorities even in developed countries. In developing countries, waste management loses out to other political priorities of health, education, infrastructure development, job creation, poverty eradication etc. The realization that waste management could be supportive of these issues is often not there.

While these challenges may appear difficult to overcome and may dampen the required initiatives, in today's context, waste management also offers some exciting opportunities.

6. Opportunities from waste management

a) Waste minimization or waste reduction at source is increasingly being realized as a component for enhancing competitiveness. Many industrial firms make a special effort to minimize generation of waste so as not only to reduce their waste treatment and disposal costs but also improve their resource efficiency. However, small and medium sized industry experience difficulties in systematically integrating waste minimization actions into their overall management practices – largely as consequence of their time, expertise and money constraints.

b) Waste is now being termed as a latent resource – and the landfills are being known as 'urban mines'. Thanks to increasing energy and material costs, recovery of materials and energy from waste is becoming more and more economically viable. A whole new range of industrial sector can be developed based on recycling waste materials. The Government of Gujarat in India is already contemplating an idea of establishing a 'Recycling industry park'. Apart from being free from the vagaries of price fluctuations and limitations in availability of virgin raw materials, recycling industries will also benefit from a cheap and perennial supply of input materials.

c) Scientifically designed waste management systems with focus on 3R can result in savings in current waste management costs. The volume of 'residual waste' after recovery / recycle of materials can be drastically reduced thus cutting down treatment and disposal costs. In studies conducted by UNEP it has been demonstrated that by adopting the Integrated Solid Waste Management approach the residual waste requiring disposal can be easily brought down to just 30-40%. In case the residual waste is sent to landfill, this would also mean that the life of existing

landfills will be appreciably increased. Earnings from recovered materials and resources can further ease the budget requirements for waste management.

d) Recovering energy from waste can become an excellent source of renewable energy. Conversion of organic waste into useful materials (e.g. compost) and/or energy can apart from affecting a significant reduction in waste quantity can provide cheap and renewable energy. Other waste components which are not easily amenable to recycling (such as dirty plastic and paper) can also be converted into fuel, of course with due care for combustion related emissions.

e) Waste management is not just a service to be provided by the government. The private sector is getting increasingly involved in waste management. In many cities the entire range of waste management services – collection, transportation, treatment and disposal are now provided by private sector. There is a huge potential for engaging private sector not only in recycling industry but also in establishing industry based on recycled material as input materials. This can have a snowballing effect in terms of directing private finances, job creation and industrial promotion. The beneficial environmental aspects in terms of reduced extraction of non-renewable resources are obvious.

f) Employment generation and empowerment of the poor is a major demand in developing countries. Waste management with focus on segregation and recycling can serve the twin objective of creating employment opportunities for the poor and thus enabling them to improve their life styles. It can be treated as a business opportunity with a good potential for job creation.

7. Conclusion

Keeping these challenges and opportunities in view as well as based on various UN initiatives, such as Local Agenda 21 and Millennium Development Goals several international initiatives have already been launched. In 2004 the Government of Japan launched the 3R Initiative at the G-8 Summit. This was followed by the endorsement of the Kobe 3R Action Plan in the G-8 Toyako Summit in 2008. In 2009 the Regional 3R Forum in Asia was established through the joint effort of the United Nations Centre for Regional Development (UNCRD) and the Japanese Ministry of the Environment with an objective to help mainstream 3R into national policies in Asia. The Tokyo 3R Statement, agreed on at the Inaugural Regional 3R Forum held in November 2009 in Tokyo, provides a comprehensive basis for the proliferation of 3R approach across Asia. In 2005, the European Commission proposed a new strategy on the prevention and recycling of waste. This long-term strategy aims to help Europe become a recycling society that seeks to avoid waste and uses waste as a resource. At the national level the Japanese policy on sound material recycling society has established time bound target to be achieved. China adopted a Circular Economy Promotion Law in 2008 and formed a Circular Economy initiative. Such initiatives have strategic importance not only at the national level but globally. UNEP, in partnership with international, national and local partners, under its thematic priority areas of (a) Resource Efficiency and (b) Harmful Substances and Hazardous Waste, has embarked upon intensifying and strengthening its activities in the field of waste management. In support of the Bali Strategic Plan for Capacity Building and Technology Support, UNEP's activities especially highlight capacity building and provide support for technology identification, assessment and implementation at national/local level. UNEP has launched the Global Platform on Waste Management for promoting international dialogue and cooperation in waste management.

Management of solid wastes and sewage are essential components of sustainable development, as mentioned in Agenda 21: "environmentally sound management of wastes is among the environmental issues of major concern in maintaining the quality of the Earth's environment and

especially in achieving environmentally sound and sustainable development in all countries". As indicated in Agenda 21, chapter 21 waste management is closely related to other programme areas of other chapters (fresh water, sustainable human settlement development, protection and promotion of human health conditions).

A paradigm shift in approach and thinking is required. As per Dr. Paul Connett of Zero Waste, the waste management challenge in 20th century was –

> "How do we get rid of our waste efficiently with minimum damage to public health and the environment?"

In the 21st century, this has to change to -

> "How do we handle our discarded resources in ways which do not deprive future generations of some, if not all, of their value?"

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