Solid Waste Management in the World's Cities

Pre-publication presentation

UN HABITAT
FOR A BETTER URBAN FUTURE

This is a pre-publication presentation of the forthcoming UN-HABITAT report:
"Solid Waste Management in the World's Cities"

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A Note for Decision-makers

A solid waste crisis can significantly undermine the credibility of a city government. Solid waste is embarrassing and difficult to discuss, so policy-making and political discussions have to deal with an array of taboos that trouble the process of arriving at a transparent political vision and concrete, achievable goals. And yet managing solid waste well and affordable is one of the key challenges of the 21st century, and one of the key responsibilities of a city government. It may not be the biggest vote-winner, but it has the capacity to become a full-scale crisis, and a definite vote-loser, if things go wrong.

A good solid waste system is like good health: if you are lucky to have it, you don't notice it, it is just how things are, and you take it for granted. On the other hand, if things go wrong, it is a big and urgent problem and everything else seems less important.

The urgency of the problem may tempt you to grab at whatever is offered that sounds like a solution, particularly if it appears to solve an urgent problem in a politically comfortable way. But if a solution seems 'too good to be true', probably it's not true. Unfortunately, many shadowy figures keep popping up with a promise that they offer the one 'right answer', the magic bullet to slay the 'garbage dragon'.

Instead, the reality is complex – but in its complexity lies also its strength and resilience. In low- and middle-income countries, there are usually a variety of formal and informal, public and private systems operating at one time, so the basis for a stable mixed system is present. What most low- and middle-income cities miss is organisation, specifically, a clear and functioning institutional framework, a sustainable financial system, and a clear process for pushing the modernisation agenda and improving the system's performance. As long as there is no overarching framework, the mixture remains a cluster of disjointed sub-systems that do not function well together – or at all.

This is a pre-publication short version of the book "Solid Waste Management in the World's Cities," which will be available in early 2010. The book aims to show, through a consistent and parallel analysis of some 20 reference cities on six continents, that cities everywhere are making progress, but also that there is plenty of room for improvement. The authors are interested in understanding and sharing insights on what works and what doesn't, under what circumstances, and why.

If you take just one message from this book, it should be that there are no perfect solutions, but also no absolute failures: the specific technical and economic approaches that work in Denmark or Canada may not work in your country. Seeking the perfect solution can delay improvements when they are desperately needed. Much like in most other human endeavours, also in waste management 'the best is the enemy of the good'.

There is only one sure winning strategy, and that is to understand and build upon the strengths of your own city – to identify, capitalise on, nurture, and improve the indigenous processes that are already working well. We hope that this book will inspire you to be both creative and critical: to design your own models, to pick and mix, adopt and adapt the elements and components and strategies that work in your particular circumstances. You

Man in front of his collected and selected carton in Serbia.
© WASTE

Different technologies for waste collection in one city.
© UN-HABITAT, Jeroen IJgosse

Some recent solid waste crises

- **2008: waste piled up in Naples streets for months, as the local disposal sites were all full. National government intervened.**
- **1993, 2000, 2005: major waste slides at dumpsites in Turkey, Philippines and Indonesia hit the world headlines, killing 39, over 200 and 147 persons respectively.**
- **1994: major outbreak of plague in Surat, India, blamed on uncollected solid waste blocking drains**

and your citizens and stakeholders deserve the best system for your circumstances, and nothing less. If this book can contribute to that, we will have done our work well.

Build on the human and other capacities present in your city, including small enterprises and the informal sector. Focus on understanding and strengthening what is already working well.

This book and these notes are built around the concept of integrated and sustainable (solid) waste management, known as ISWM.

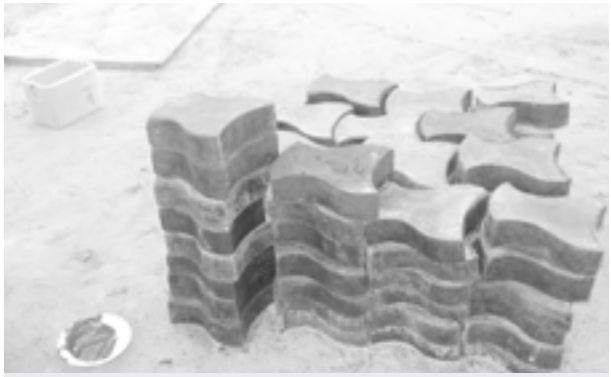
We look first at the three key elements which ALL need to be addressed for an ISWM system to work well and to work sustainably over the long term:

- *public health*: maintaining healthy conditions in cities, particularly through a good waste collection service;
- *environment*: protection of the environment throughout the waste chain, especially during treatment and disposal; and
- *resource management*: closing of nutrient and materials cycles, through high rates of reuse and recycling.

SOLID WASTE is a vital municipal responsibility. You need to address all three elements – collection, disposal AND materials recovery.

We then focus on how to deliver an ISWM strategy. Until the 1990s, the focus would likely have been primarily framed around technology, but there is consensus today on the need for a much broader approach. Three inter-related requirements for delivering ISWM are distinguished here, namely the need:

- to be *inclusive*, involving all the stakeholders;
- for the system to be *financially sustainable*, i.e. both cost-effective and affordable; and
- for *sound institutional arrangements* and *good governance*.



Tiles made from plastic waste, Benin.
© WASTE, Justine Anschütz

Three Key System Elements in ISWM

Public health (collection)

Safe management of human excreta (sanitation) and removal, treatment, and management of solid waste are two of the most vital urban environmental services. While other essential utilities and infrastructure like energy, transport and housing often get more attention (and much more budget); failing to manage the 'back end' of the materials cycle has direct impacts on health, length of life, and the human and natural environment.

The responsibility of municipalities to provide solid waste collection services dates back to the middle of the 19th century, when infectious diseases were linked for the first time to poor sanitation and uncollected solid waste. There are major cities in all continents that have had collection services in place for a century or more.

Cities spend a substantial proportion of their available recurrent budget on solid waste management, perhaps as much as 20-50% for some smaller cities. Yet UN-HABITAT data shows waste collection rates for cities in low- and middle-income countries generally in the range of 10-90%, which means that large portions of the population receive no services at all, and much waste ends up in the environment. The data also show that rates of diarrhoea and acute respiratory infections are significantly higher for children living in households where solid waste is dumped, or burned, in the yard, compared to households in the same cities, which receive a regular waste collection service.

Waste collection – removing waste from residential and commercial areas – is essential for protecting public health.

Uncollected solid waste clogs drains and causes flooding and subsequent spread of water-borne diseases. A major flood in Surat in India in 1994 caused an outbreak of a plague-like disease, and the official inquiry cited uncollected solid waste blocking drains. Annual floods in East and West African, and Indian cities are blamed, at least in part, on plastic bags blocking drains.

Perhaps surprisingly, even in Europe and North America uncollected waste can still hit the headlines, as in the recent example of Naples, Italy, where mountains of solid waste lined the streets for months, collectors stopped picking up the waste because all of the region's landfills were full, and residents went into fierce protests.

Environmental protection (waste treatment and disposal)

Until the environmental movement emerged in the 1960s, most unwanted materials were discharged to land, as open dumping, to air, as burning or evaporation of volatile compounds, or to water by discharging solids and liquids to surface or groundwaters or the ocean. There was little regard for the effects on drinking water resources and health of those living nearby, because disposal was based on the idea that wastes decomposed and returned to the environment without harming it.

Over the last 30-40 years, environmental control over has seen development of a series of steps, first phasing out uncontrolled disposal, then introducing, and gradually increasing, environmental standards, for example on water pollution and methane emissions from sanitary landfills and air pollution from incinerators.

Phasing out and upgrading open dumps and controlling the disposal of waste is a necessary first step towards a good waste management system.

Attention in high-income countries may now be moving on to other aspects, but many cities in low- and middle-income countries are still working on phasing out open dumps and establishing controlled disposal. This is a first step towards good waste management, and is designed to pave the way for a sanitary landfill, seen to be an essential part of any modern waste management system.

Whatever technologies and equipment are used, they should be adapted to the local conditions, for example with the skills and spare parts available locally for smooth operation and timely maintenance.

Resource management (valorisation of recyclables and organic materials)

Prior to the industrial revolution, most cities had few material resources, money was scarce, and households had more needs than they could meet. Wastage was minimised, products were repaired and reused, materials were recycled and organic matter was returned to the soil[1].

Extensive informal recycling systems flourished, but began to be displaced by emerging formal municipal waste collection systems in the 19th century. Recycling and materials recovery became large but almost invisible private industrial activities. During the past 10-20 years, high-income countries have been rediscovering the

The first global meeting for the informal sector has taken place in March 2008 in Colombia. © Sonia Diás

value of recycling as an integral part of their waste (and resource, management systems, and have invested heavily in both physical infrastructure and communication strategies to increase recycling rates.

Many developing and transitional country cities still have active informal sector recycling, reuse, and repair systems, which often achieve recycling rates comparable to those in the West, at no cost to the formal waste management sector. Not only does the informal recycling sector provide livelihoods to huge numbers of the urban poor, thus contributing to the Millennium Development Goals, but they also save the city 15-20% of its waste management budget, by reducing the amount of wastes that would otherwise have to be collected and disposed of by the City. In effect, the poor are subsidising the rest of the city.

Waste is a resource, and your SOLID WASTE system should be designed to maximise the benefits from the waste.

There is a major opportunity for the city to build on these existing recycling systems, to maximise the use of waste as a resource, to protect and develop people's liveli-

Selling of recyclables in Lagos, Nigeria.© Adebesi Araba

1. *Strasser 1999.*

hoods, and to reduce the costs to the city of managing the residual wastes. The formal and informal sectors need to work together, for the benefit of both.

Major priorities to improve environmental performance and conserve resources work to shift the focus of waste management. The goal of safe disposal shifts to an emphasis on valorisation, and commercialisation, of three sets of materials:

- products which can be re-used, repaired, refurbished, or re-manufactured to have longer useful lives;
- recyclable materials which can be extracted, recovered, and returned to industrial value chains, where they strengthen local, regional, and global production; and
- bio-solids consisting of plant and animal wastes from kitchen, garden, and agricultural production, together with safely managed and treated human excreta, which are sources of key nutrients for the agricultural value chain, and have a major role to play in food security and sustainable development.

Waste management and climate change

The importance of public health, environmental protection and resource management are reinforced by the imperative to reduce carbon emissions in a move to a sustainable, carbon neutral, society.

Municipal solid waste management and wastewater contribute about 3% to current global anthropogenic greenhouse gas emissions, about half of which is methane from anaerobic decomposition of organic waste in landfills and other waste disposal sites. One forecast suggests that, without mitigation, this could double by 2020 and quadruple by 2050. It is ironic that these alarming increases are largely due to improved disposal in low- and middle-income countries – open dumps decompose partly aerobically, and so generate less methane than – mostly anaerobic – sanitary landfills.

Effective mitigation consists of a mix of 'technical fixes', including landfill gas extraction and utilisation, and upstream instrumental and economic measures, particularly reduction, reuse, recycling, and recovery of organics. Prevention is especially beneficial, as it also reduces the amount of indirect carbon used to make the products that were being thrown away as waste.

Three ISWM Delivery Strategies

Inclusivity

The municipal government is responsible for solid waste management in a city, but cannot deliver on that responsibility by prescribing or undertaking measures in isolation, entirely on their own. The best-functioning solid waste systems involve *all* the stakeholders in planning, implementing, and monitoring the changes.

A solid waste system consists of three main groups of stakeholders: the providers, including the local authority, who actually offer the service; the users, who are the clients; and the external agents in the enabling environment, who organise the boundary conditions and make change possible.[2]

Users, or waste generators, are key stakeholders in waste management, as are the NGOs, women's' unions, and other organisations that represent them in the policy and governance processes. Service providers include the formal municipal waste organisation, in partnership with a variety of private, informal and/or community actors. In urban waste systems in most low- and middle-income countries, as well as in the US, Canada, Europe, and Japan, the informal recycling sector is particularly important, often providing a livelihood for up to 1% of the urban population and in effect subsidising the costs of the formal sector.

Ensure that you are inclusive in your plans, by working with others and engaging both the local community and private formal and informal service providers.

People bringing their own waste to the collection truck.
© UN-HABITAT, Jeroen IJgosse

2. *Spaargaren, G. and B.J.M van Vliet, 2000; Scheinberg 2009 (in press)*

Financial sustainability

Financial sustainability in solid waste management is a major issue for cities all over the world. In developing and transitional country cities, solid waste management represents a high proportion of the recurrent budget, as much as 20-50% according to the World Bank. Yet in spite of high costs, collection service coverage is low and disposal standards remain poor. Making service delivery more efficient should free up some resources, but many cities can expect to see costs rise substantially, as population and waste quantities increase, service coverage expands and open dumping is phased out.

Costs in high-income country cities are continuing to increase, as wastes are collected in several separate streams to facilitate recycling, wastes are diverted from landfill to higher cost facilities and the costs of environmental protection at treatment and disposal sites have increased.

For most cities in low- and middle-income countries, the coming years will see increased waste, more people, more vehicles, more labour needed for collection, more transfer stations, more types of collection, more administration, and more space taken up by landfills. As the city spreads, places for dumping will be scarcer, further from the city centre, and (much) more expensive. The costs will go up, as will the imperative to find regular sources of finance for them.

There is no such thing as a free lunch – beware the salesman whose technology will solve your problem at little or no cost.

Where international donors, or other investors, are involved in providing finance to cities for new waste management vehicles, equipment or infrastructure, one precondition is often that the city can demonstrate that they are able to pay for the recurrent costs. This usually involves discussion both on establishing the full current costs of providing the service, which is commonly underestimated by up to 50%; and on the introduction of user fees, which in turn raises the issues of equity, affordability and willingness to pay.

Poster encouraging the people to take a subscription to waste collection in Benin. © WASTE, Justine Anschütz

Experience has shown that users, even in slum areas, are prepared to pay for their waste to be removed, when they agree with the service levels, when the charging system is transparent, and when services are provided for locally acceptable prices. Moving from a position where solid waste management is paid for through general revenues, to one where it is paid for entirely from user charges, is likely to be a gradual transition, particularly if the overall costs are rising at the same time. So, at least in the medium term, a significant proportion of the total cost will still have to be paid for by the municipality or the national government from general revenues, as part of its public health and environmental protection responsibilities. Some of the resources will come from cross-subsidising, key activities with resources earned from 'high-end' services to wealthy payers, because they also benefit from a cleaner city, or suffer from waste-related pollution and negative health impacts.

Sound policies and institutions

A strong and transparent institutional framework is essential to good governance in solid waste. Without such a framework, the system will not work well over the long term. Conversely, it was suggested at the 2001 UN-HABITAT global conference that the cleanliness and effectiveness of a city's solid waste management system could be used as a useful proxy indicator of good governance.

If waste services are to be effective, a city must have the capacity and the organisational structure to manage finances and services in an efficient and transparent manner, streamline management responsibilities with communities, and listen to users. For waste management to work well, the city needs to address underlying issues relating to management structures, contracting procedures, labour practices, accounting, cost recovery and corruption. Clear budgets and lines of accountability are essential. The adequacy of services to lower-income communities also reflects on how successfully a city is addressing issues of urban poverty and equity.

Public-private partnerships (PPP) in service delivery are an option for improving both cost-effectiveness and service quality and coverage. However, PPP in waste management is not simple 'privatisation'. The municipal

authorities, as contracting body, need to have sufficient understanding and capacity to carry out their 'client' function. The necessary conditions, which must be met for successful PPP, include competition, transparency and accountability, which are all required to help ensure that the contracting process is free from corruption and citizens receive the services as contracted. The concept of Pro-Poor PPP (5-P) develops this more explicitly, by addressing the need to engage users, the rights of small and micro enterprises and the informal sector to hold on to their livelihoods, and the obligation to serve poor communities fairly and effectively.

Concluding remarks

There are no easy answers, as can be seen from the inter-relationships between the three elements of ISWM and the three delivery requirements. But a reliable approach is to be critical and creative; to start from the existing strengths and build upon them; to involve all the stakeholders' to design your own models; and to 'pick and mix', adopt and adapt the solutions that will work in your particular situation.

There is no one 'right answer' to solid waste management, rather a diversity of measures and approaches. You need to develop the solutions that will work in your city.

1 Setting the scene

1.1 Introducing this book

This is a pre-publication short version of the book *Solid Waste Management in the World's Cities*, which will be available in early 2010.

The book is designed to raise and address questions of policy, good and bad practice, management, communication and sustainable financing. The core of the book will be detailed profiles of urban solid waste and recycling systems in some 20 cities across six continents. The profiles will illustrate how solid waste works in practice in tropical and temperate zones, in small and large cities, in rich and poor countries, and at a variety of sizes and scales. Each of the cities will provide a parallel data set, allowing analysis, comparison, and cross-referencing.

We believe that the book will provide a fresh perspective and new data on solid waste management, which is an important challenge facing all the world's cities.

This book distinguishes itself in a number of ways:

First and foremost, it is based on the framework of Integrated Sustainable Waste Management (ISWM), especially the concepts of sustainability and inclusive good practice that have broadened and enriched the field.

It uncovers the rich diversity of waste management systems that are in place throughout the world. This book brings out common elements and develops a lens for "viewing" a solid waste management system, while at the same time encouraging every city to develop its own individual solution, appropriate both to its specific history, economy, demography and culture and to its human, environmental and financial resources.

It is not a 'how-to' book nor a 'lets fix it' book, but more of a 'how do they do it now and what do they want to fix' book.

This preview version of the book has been prepared primarily for the chief executives of cities, decision-makers in general, including political and social leaders, managers and opinion makers, who all take interest in the welfare of their cities. They can be at the top or ground level of the decision-making structure, from the greater municipality of a mega-city to a neighbourhood or village council. They can come from the public or private sector, from corporate entities or non-governmental or community based organisations (NGOs/CBOs). They share the commitment and the potential to contribute to change in their cities.

This pre-publication version seeks to set the scene on the solid waste management challenge facing cities worldwide; to examine three key *physical elements* of an ISWM system; to elaborate on the three ISWM *delivery strategies*; and to provide a flavour of the final book by interspersing a number of early city profiles through the text. The 'preview' is based on more than 300 person-years cumulative experience of solid waste management practitioners from 20 countries. It will be updated in the light of the final city profiles to become the decision maker's guide in the final book.

Keep our city clean poster in Colombo Sri Lanka.
© WASTE, Anne Scheinberg

Honourable Mayor, this book is for you!

The intention is to encourage you to think about your contribution to both reducing and managing solid waste in your city.

1.2 The scale of the solid waste problem

What is municipal solid waste?

Definitions of municipal solid waste (MSW) vary between countries, so it is important to establish at the outset just what is being discussed in this book. A working definition is 'wastes generated by households, and wastes *of a similar nature* generated by commercial and industrial premises, by institutions such as schools, hospitals, care homes and prisons, and from public spaces such as streets, markets, slaughter houses, public toilets, bus stops, parks, and gardens.

Some establishments are likely to produce both municipal and non-municipal wastes:

- Manufacturing industry: generates municipal solid waste from offices and canteens, and industrial wastes from manufacturing processes. Some industrial wastes are hazardous, thus requiring special management.
- Hospitals and other healthcare establishments/services: generate municipal solid waste such as food waste,

It is essential to collect hospital waste separately, Benin.
© WASTE

newspapers etc; and healthcare hazardous wastes contaminated with infected body fluids, various chemicals and sharp objects.

- Construction sites: generate some municipal solid waste from offices and canteens, and construction and demolition (C&D) waste from building works.

Other major non-municipal waste streams include agricultural wastes and mining and quarrying waste.

This working definition includes most commercial and business wastes as municipal solid waste, with the exception of industrial process wastes. Some countries include as municipal solid waste only that proportion of commercial waste collected by or on behalf of the municipality, rather than that collected by a private contractor hired direct by the waste generator.[3] Other sources suggest that all industrial and C&D wastes should be included in the definition of municipal solid waste.[4]

In practice, there are some 'grey areas' in the working definition. For example, industrial process wastes from small workshops in urban areas are likely to be collected with municipal solid waste. Similarly, construction and demolition wastes from household repairs and refurbishment, particularly 'do-it-yourself' wastes, are most likely to enter the municipal solid waste stream.

The working definition implies that parallel waste management systems will exist within an urban area, one for municipal solid waste run by or on behalf of the municipality, and others for industrial, C&D, healthcare and other hazardous wastes.

At an early stage of development, when the municipal disposal site is essentially 'open access', then it is likely that it will be used by all waste generators, and receive both hazardous industrial and healthcare wastes. In developing an ISWM system focusing on municipal solid waste, it is important that effective systems for other types of waste are also developed; cost-effectiveness will often suggest a degree of integration between the systems.

A working assumption in this book is that hazardous industrial and healthcare wastes are effectively segregated from municipal solid waste and managed separately. Substantial guidance on managing hazardous wastes is available, for example from the Basel Convention[5] and UNEP[6], and on managing healthcare hazardous wastes from WHO[7].

Municipal solid waste does include some so-called 'household hazardous wastes', which are segregated and managed separately in a few developed countries, and which will form part of the MSW collected elsewhere.

The composition of municipal solid waste varies widely, both within and between countries, and between different seasons of the year. Table 1.1 presents data on municipal solid waste composition for three of our profiled cities, representing high-, middle- and low-income cities.

Table 1.1 Municipal solid waste composition in high-, middle- and low-income cities.

Material	Quezon City	San Francisco	Nairobi
Organics	52.1%	30.9%	61.4%
Paper	17.1%	24.3%	11.8%
Plastic	21.4%	10.5%	20.6%
Glass	3.1%	3.3%	0.8%
Metal	3.2%	4.3%	0.6%
C&D	2.3%	12.2%	
Bulky waste		5.3%	
Textiles		3.9%	0.6%
Other	0.8%	5.3%	4.2%
Waste generated [kg/capita/day]	0.7	2.4	0.8

How much municipal solid waste?

Solid waste data are often largely unreliable and seldom capture informal activities or system losses. This situation is only now being addressed in developed countries – for example some countries generate regular and reliable statistics on municipal solid waste, but not on other waste streams. Even when waste data exist, they are difficult to compare even within a city, due to inconsistencies in data recording, collection methods and seasonal variations in the quantities of waste generated. Few developing and transitional countries have systems for weighing or measuring wastes disposed and wastes generated are usually estimated based on flimsy data.

3. *OECD Environmental Data Compendium 2006–2008 www.oecd.org/dataoecd/22/58/41878186.pdf*
4. *Daniel Hoornweg and Laura Thomas (1999)*
5. *Basel convention, www.basel.int*
6. *David C. Wilson, Fritz Balkau and Maggie Thurgood (2003)*
7. *Prüss et al (1999)*

Figure 1.1 shows data from a range of cities on the quantity of municipal solid waste generated per capita per year. This shows a wide range, from a low of around 100 kg/capita/year in Accra or Hanoi, to a high around 900 kg/capita per year in Guelph, Ontario, Canada and San Francisco, California, USA.

Estimating global waste generation figures is difficult, given the unreliability of the data, particularly for low- and middle-income countries. One estimate puts municipal solid waste generation worldwide in 2006 at 2 billion tonnes, with a 37% increase forecast by 2011[8]. The world population in 2006 was around 6.5 billion[9], giving an average per capita generation rate of just over 300kg/year. Table 1.2 shows corresponding estimates of what world municipal solid waste generation would have been in 2006, or could become by 2025, if everyone in the world generated waste at either the current average rate for the high-income OECD countries (580kg/year)[10] or at the current rate for San Francisco.

Table 1.2 Estimates of world MSW generation by OECD

World municipal solid waste	kg/capita/day	billion tonnes/yr	
		2006	2025
Current estimates	310	2.0	2.4
At average current rate for OECD	580	3.8	4.6
At current rate for San Francisco	880	5.7	7.0

The world currently generates an estimated 2 billion tonnes of municipal solid waste per year.

If in 2025 everyone in the world generated municipal solid waste at the current per capita rate in San Francisco that would become 7 billion tonnes.

8. *Key Note Publications Limited (2007)*
9. *US Census Bureau, Population Division, International Data Base. www.census.gov/ipc/www/idb/worldpop.php*
10. *OECD,Table 2A.. ibid*

Waste quantities have grown rapidly in high-income countries over the last few decades, often at a rate of 3% per year. Cities in low- and middle-income countries are experiencing even higher growth rates, due to a combination of increasing population, increasing collection rates and higher per capita generation due to rising living standards. Although there are some indications that growth may now be slowing down in some developed countries, in most of the world substantial growth rates are likely to continue for some time to come.

Data on waste volumes as well as quantities are important in planning waste collection. In a low GDP city, waste density can be as high as 400 kg/m^3, due to high fractions of wet organics. In some OECD cities, densities may be less than 100 kg/m^3, because the large volumes of packaging waste don't weigh much.[11]

If we all continue to move towards the current waste generation patterns of the wealthiest cities in high -income countries today, then by 2025, we could be generating as much as 70 billion/m^3 of MSW each year, enough to bury a large city of 1000 km^2 to a depth of 70 m.

Moreover, municipal solid waste is only a small proportion of total waste generation, so the total generation in much larger.

1.3 Historical perspectives

Development Drivers in Solid Waste[12]

Why has waste management developed? What have been the main driving forces for development? In parallel with industrialization and urbanization, there have been three specific drivers for the development and modernization of waste management: resource value of various waste materials, improvement of public health, and protection of the environment.

11. *Manus Coffey (2009)*
12. *David C. Wilson (2007)*

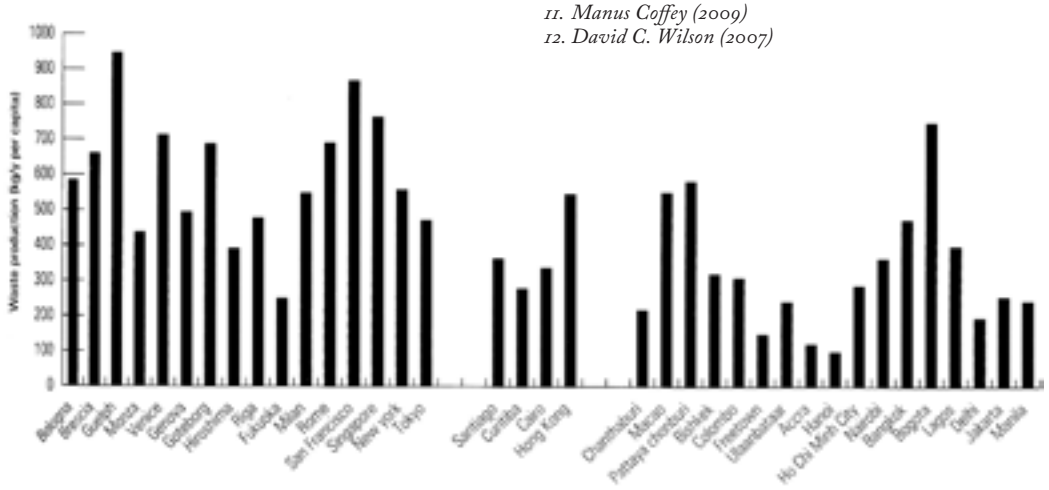


Figure 1.1 Waste generation (kg/year) per capita in selected cities. Source: UN-HABITAT (2009)

- **Driver 1: the resource value of the waste**. Beginning with urbanization in the 19th century. In pre-industrial times, resources were relatively scarce, so household goods were repaired and reused.[13] Food and garden waste entered the agricultural supply chain as animal feed or fertiliser. As cities grew with industrialisation, large numbers of people found an economic niche as 'street buyers' or 'rag-pickers', collecting and using or selling materials recovered from waste, often linked to itinerant selling and product distribution chains. This activity continues today – virtually unchanged – in many developing and transitional country cities, where informal sector activities in solid waste management and recycling secure the livelihood of millions of people.
- **Driver 2: public health**. Starting in the middle of the 19th century, as cholera and other infectious diseases reached the cities of Europe and North America, legislation was gradually introduced to address the problem of poor sanitation conditions. This legislation both established strong municipal authorities and changed them with progressively more responsibility for removing solid waste and keeping streets clean and litter free.
- **Driver 3: environment**. The focus of solid waste management remained on waste collection, getting waste 'out from under foot', for a century – right up to the emergence of the environmental movement in the 1960s. New laws were introduced first on water pollution, and from the 1970s on solid waste management, prompted by crises of contamination of water, air and land and their impacts on the health of those living close to abandoned hazardous waste dumps. The initial response focussed on phasing out uncontrolled disposal. Subsequent legislation gradually 'ramped up' environmental standards on, for example, emissions from sanitary landfills into groundwater and air pollution from waste incinerators.
- **Emerging Driver 4: climate change**. Since the early 1990s, climate change has directed attention in the West on the need to divert organic waste from landfill to reduce methane emissions associated with uncontrolled anaerobic decomposition. At least partly as a result, recycling and organic waste diversion rates, which declined to single figures as municipal authorities focused on waste collection, have now risen dramatically. Other policy measures have been introduced, including landfill bans for recyclable waste materials, extended producer responsibility and waste prevention. Waste management is beginning to evolve into a mixed system for sustainable resource management, so one could argue that history has come 'full circle'.

Waste management and climate change

Data show that municipal solid waste management and wastewater contribute about 3% to current global anthropogenic greenhouse gas emissions, about half of which is methane from landfills. One forecast suggests that, without mitigation, this could double by 2020 and quadruple by 2050. It is ironic that these increases are largely due to improved disposal in low- and middle-income countries – open dumps decompose partly aerobically, and so generate less methane than an anaerobic sanitary landfill.

Mitigation needs to be a mix of the 'technical fix' approach, such as landfill gas collection and utilisation, and upstream measures, particularly reduction, reuse, recycling, and composting. Reduction is especially beneficial, as it also reduces the amount of indirect carbon used to make the products that are being thrown away as waste.

Modernisation of Solid Waste in OECD Countries

For most OECD countries, modernisation began when there was a crisis of contamination from waste, either in the city, at the disposal site, or in ground or surface waters. More important than the crisis itself, the political discussion around it is usually the immediate stimulus for change.

Modernisation usually begins with climbing on the disposal-upgrading ladder, that is, with the phasing out of open dumps. Driver 2 usually results in the closing of town dumps, and a plan, often not realised for many years, to develop and operate a "state of the art" regional landfill. The relatively high costs for installing and operating environmental controls tend to push the economy of scale upwards: regional landfills are bigger than town landfills, serve many cities and towns, and are usually not very close to the main population centres. In this they match the economy of scale and degree of institutionalisation of the agencies that control them – that is, the scale of the facilities mirrors the scale of the ministries and inspectorates.

Regionalisation sets in motion a series of rapid changes, including an upward spiral in costs, based on introducing landfill gate fees and increasing the average distance a vehicle has to carry waste to get to the disposal site. In OECD countries, the result was a kind of 'sticker shock' at the increasing price of solid waste management, and a search for less expensive ways to be modern and environmentally responsible. This in turn led to an increasing interest in transfer stations, as a form of improved efficiency of transport, and a strong commitment to recycling and composting, as less expensive forms and environmentally preferable options for materials management. During

13. Strasser, S. Waste and Want (1999)

the period of active modernisation in the US, for example, recycling goals in many states increased from 15% of total waste to more than 50% in a relatively short period of time at the end of the 1980s.

This required active engagement with households, to persuade them to change their habitual behaviour and to separate their waste into several streams. Collecting several source separated waste streams without greatly increasing collection costs was a challenge, and has led in some instances to a reduction in collection frequency for the residual waste for disposal. Waste quantities have generally continued to grow, and only recently have begun to level off in some countries[14].

1.4 The solid waste challenge in developing and transitional country cities

Why is solid waste a priority?

Solid waste management is a challenge, but it can easily become a crisis if it is ignored. The plague epidemic in Surat is one example. Another comes from Europe: mountains of solid waste lined the streets in the Campagna (Naples) region of Italy for months at the beginning of 2008, when collectors stopped picking up the waste because all of the region's landfills were full. There were at-times violent protests, both by residents forced to live beside stinking heaps of waste in the street, and by neighbours protesting at attempts by the authorities to forcibly reopen the 'full' landfills.[15]

There have also been cases of disasters at dumpsites in low- and middle-income countries which have received international coverage. For example a landslide at the Payatas dumpsite in Quezon City, Philippines in July 2000 killed 200 persons, while that at Bandung in Indonesia in February 2005 killed at least 40.

Solid waste management is a major challenge for many cities in developing and transitional countries. The urban areas of Asia were estimated to spend about $25 billion on solid waste management each year in 1998.[16] Solid waste management may represent 20-50% of a city's budget, with 80-90% of that spent on waste collection.[17] Collection rates in urban areas vary widely, often in the range 10-70%, in cities where the norm for waste disposal is still open dumping.

Experience in the West is that modernisation in the waste management sector has increased costs dramatically, challenging a mayor or city management give priority to improving solid waste management when there is so much competition for municipal resources. Why should the authorities choose to invest in a waste system?

A basic answer is public health. UN-HABITAT data shows significant increases in the incidence of sickness among children living in households where garbage is dumped or burned in the yard. Typical examples include twice as high diarrhoea rates and six times higher prevalence of acute respiratory infections, compared to areas in the same cities where waste is collected regularly.[18]

Uncollected solid waste clogs drains and causes flooding and subsequent spread of water-borne diseases. In Surat in India, solid waste blocking drains and causing flooding in 1994 was identified as a main cause of a major outbreak of plague. Uncontrolled disposal also affects those living nearby: in one small city in Egypt, 89% of villagers living downwind of the burning dumpsite were suffering from respiratory disease.[19] Contaminated liquids, or leachate, leaking from dumpsites may also pollute a city's drinking water supplies.

The modernisation challenge facing a low- and middle-income country city generally has an additional dimension

14. *For example, average MSW growth rates in England averaged -0.4% per annum for the 5 years to March 2008 (Defra, 2008).*
15. *Charles Hawley and Josh Ward, Naples Trash Trauma, 03/07/2008. Spiegel online www.spiegel.de/international/europe/0,1518,563704,00.html*
16. *Hoornweg and Thomas (1999). ibid*
17. *World Bank website (undated). Urban solid waste management homepage.*
18. *UN-HABITAT, State of the World's Cities 2008/09, page 129.*
19. *SWM case study for Sohag City, as part of the DFID funded SEAM (Support for Environmental Assessment and Management) project in Egypt, 1999.*

Plague outbreak, Surat, India[1]

A major flood in Surat, India, in 1994 caused an outbreak of a plague-like disease, and the official inquiry cited uncollected solid waste blocking drains. The disease caused panic countrywide and while the citizens blamed the municipality, the public authorities in turn blamed the citizens for their lack of civic sense.

Over 1000 plague suspected patients were reported, with the final death toll of 56 people. The city incurred a daily loss of 516.2 million Indian rupees during the plague period and total loss amounting to 12 billion. This was a high price to pay for negligence in the area of solid waste management.

Alarmed at the situation, the Surat Municipal Corporation undertook a stringent programme of cleaning the city.

Within a year after the plague, the level of (daily) solid waste collection increased from 30% to 93%, and 95% of streets are cleaned daily. Market areas, major roads and litter prone spots are cleaned twice a day. Surat is now identified as one of the cleanest cities in the region.

1. *Gupta, Sanjay own experience*

to that faced in the West in the 1970s: how to extend collection coverage to unserved parts of the city where there is less infrastructure and the ability to pay is lower.

Solid waste and the MDGs

The Millennium Development Goals (MDGs) were ratified by 189 heads of state at the UN Millennium Summit in September 2000, with the overall objective of halving world poverty by 2015. Improving solid waste management systems will contribute to achieving many of them, as summarised in Table 1.3.

This conclusion based on the MDGs is reinforced by recent work, which shows that the informal sector is saving many cities perhaps 15-20% of their municipal budget, through reducing the amount of wastes that the formal sector would otherwise have to handle.[20]

Much of the table focuses on recycling. Modernisation of solid waste management in the West started when recycling rates had declined to a very low level, and has included a drive to rebuild recycling through the formal waste system. Most developing and transitional country cities still retain their informal recycling systems, which provide a source of livelihood to vast numbers of the urban poor. So building on this existing system makes good sense.

20. GTZ and CWG (2007) – see also Section 3.1 below

Table 1.3 Relevance of improved solid waste management to the Millennium Development Goals

Millennium development goals (MDGs)	Achieving MDGs through Improved Solid Waste Management
1. Eradicate extreme poverty and hunger	Informal sector self-employment in waste collection and recycling currently provides sustainable livelihoods to millions of people who would otherwise have no stable source of income and would be most susceptible to extreme poverty and hunger. City authorities can both promote recycling and create more opportunities for the informal sector to provide waste collection services in unserved areas and thereby help eradicate extreme poverty and hunger.
2. Achieve universal primary education	Waste management activities contribute indirectly to education, through income generated by the parents. Many waste pickers earn sufficient income to send their children to school and do so with pride. The poorest waste pickers do engage their children for picking and sorting waste, but in instances where NGOs are involved, classes are organised for these children, after their working hours, and parents are informed about the need and the benefits of primary education.
3. Promote gender equality and empower women	A substantial percentage of informal sector waste collectors and waste pickers are women. Efforts to improve solid waste management services and enhanced recycling can include improvement and equal working conditions for men and women, by creating financial and other arrangements that build capacity and empower women.
4. Reduce child mortality	Effective solid waste collection and environmentally sound disposal practices are basic public health protection strategies. Children living in households without an effective waste collection service suffer significantly higher rates of for example diarrhoea and acute respiratory infections, which are among the main causes of childhood deaths. Co-operation with informal sector waste collectors and recyclers will improve their livelihoods, reduce child labour and hence direct contact of children with the wastes.
5. Improve maternal health	Almost all women waste pickers have no maternal healthcare available to them. Enhanced recycling may directly/indirectly improve maternal health through achieving improved living standards among households engaged in the sector.
6. Combat HIV/AIDS, malaria and other diseases	Originally, waste management activities started due to public health concerns. The reasons are almost self-evident: uncollected waste clogs drains, causes flooding and provides breeding and feeding grounds for mosquitoes, flies and rodents, which cause diarrhoea, malaria, and various infectious and parasitic diseases. Mixing healthcare wastes with municipal solid waste and its uncontrolled collection and disposal can result in various infections, including hepatitis and HIV. Reliable and regular waste collection will reduce access of animals to waste and potential for clogging of drains. Proper waste management measures can practically eliminate risks associated with healthcare waste.
7. Ensure environmental sustainability	Few activities confront people with their attitudes and practices regarding sustainability as waste management does. Reduce-reuse-recycle is yet to realise its full potential as a guiding principle for environmental sustainability through conservation of natural resources and energy savings, as well as through reduction of GHG and other emissions.
8. Develop a global partnership for development	Through co-operation and exchange, developed and developing countries can develop and implement strategies for municipal services and job creation where unemployed youth will find decent and productive work and lead a dignified and good life.

References: Barbara Gonzenbach et al (2007); Adrian Coad (2006); Doug Hickman et al (2009)

1.5 Sustainability in solid waste management is possible

The ISWM framework

When the modernisation process started in developed countries in the 1970s, solid waste management was seen largely as a technical problem with engineering solutions. That changed in the 1980s and 1990s, as it became clear that municipalities could not successfully collect and remove waste without active co-operation from the service users. Cities also learned that technologies depend on institutional, governance, and policy frameworks, which are both highly varied and complex, and directly related to local conditions.

There is now broad international consensus for what has come to be known as ISWM, i.e. integrated and sustainable waste management. As shown in the box below and Figure 1.2, this identifies three important dimensions which **all** need to be addressed when developing or changing a solid waste management system, namely the stakeholders, the elements and the sustainability aspects.

ISWM is designed to improve outcomes and solid waste system performance, by balancing short-term crisis management and long-term vision.

The severity of the solid waste management problem may lead a city mayor to grab at whatever is offered that sounds like a solution, particularly if it appears to solve an urgent problem in a politically comfortable way. But if a solution seems "too good to be true," probably it's not true. Unfortunately, many shadowy figures keep popping up with a promise that they offer the one 'right answer', the magic bullet to slay the garbage dragon.

This applies both to waste collection and disposal. Technologies need to be both appropriate and financially sustainable under local conditions. For example, large waste compaction collection vehicles designed to collect low density, high volume wastes on broad suburban streets in Europe or North America, are unlikely to be suitable for use in a low-income city, for collecting much denser wastes from narrow streets and transporting it over roads built to a lower technical specification and on which the legal payloads are therefore less.

Integrated Sustainable Waste Management (ISWM)

Integrated Sustainable Waste Management (ISWM), as shown in Figure 1.3 is a framework that was first developed in the mid-1980s by WASTE, a Dutch NGO, and WASTE's South partner organisations, and further developed by the CWG in the mid 1990s, since when it has become the 'norm'.

ISWM is a systems approach which recognises three important dimensions, which all need to be addressed when developing or changing a solid waste management system. The dimensions, shown in Figure 1.3, correspond to three key questions:

1. **The stakeholders – the people or organisations with a 'stake' or interest in solid waste management – who needs to be involved?**
2. **The elements – the technical components of a waste management system – what needs to be done?**
3. **The aspects which need to be considered as part of a sustainable solution – how to achieve the desired results?**

Stakeholders: The main 'recognised' stakeholders include the local authority (mayor, city council, solid waste department), the national environment and local government ministries, and one or two private companies working under contract to the municipality. Often unrecognised stakeholders include (female) street sweepers, (male) workers on collection trucks, dumpsite 'waste pickers', some of whom may actually live on or at the edge of the dumpsite, and family-based businesses that live from recycling. Other key stakeholders include the waste generators, the uses of the waste management service provided by the city, including households, offices and businesses, hotels and restaurants, institutions such as hospitals and schools, and government facilities such as airports or the post office.

Elements: These are the technical components of a waste management system. Part of the purpose of using the ISWM framework is to show that these technical components are part of the overall picture, not all of it. In Figure 1.3, the boxes in the top row all relate to removal and safe disposal, and the bottom row of boxes relate to 'valorisation' of commodities. Solid waste management consists of a variety of activities, including reduction, reuse, recycling and composting, operated by a variety of stakeholders at various scales.

Aspects: For a waste management system to be sustainable, it needs to consider all of the operational, financial, social, institutional, political, legal and environmental aspects. These form the third dimension in Figure 1.3, in the lower box. The aspects provide a series of analytical 'lenses', which can be used for example for assessing the situation, determining feasibility, identifying priorities, or setting adequacy criteria.

'Integrated' in ISWM refers to the linkages and interdependency between the various activities (elements), stakeholders and 'points of view' (sustainability aspects). Moreover, it suggests that technical, but also legal, institutional and economic linkages are necessary to enable the overall system to function.

Figure 1.2 The Integrated Sustainable Waste Management (ISWM) Framework

A landfill site that meets the latest EU standards is unlikely to be either appropriate or financially affordable in, for instance, a smaller city in Africa. A modern waste-to-energy incinerator designed for high-heating value Japanese or European waste is likely to require supplementary fuel to burn a typical waste in a transitional country. And a novel waste treatment technology, which has not yet found a buyer in a European market crying out for alternatives to politically unpopular incineration, is not likely to be a good choice for the low- and middle-income country mayor who needs a guarantee that his wastes will be collected reliably, 365 days a year.

One important message of this book is that there is no 'magic bullet', and chasing the illusion of a single perfect technology is a waste of time, resources, and political credibility.

The examples from countries like Denmark or Japan – which some would regard as world icons of good waste management practice – suggest that a sustainable, affordable waste management system consists of a stable mixture of technologies and institutions, which function flexibly under a clear policy umbrella. Such systems mimic an eco-system, which is robust and resilient when there is a mix of unique niches and competition for resources. If one species falls out, others move in to take its place. Similarly, a mixed solid waste system gives opportunities to many stakeholders to earn livelihoods, conserve resources, and keep the city clean and healthy. Internal diversity promotes sustainability.

In low- and middle-income countries, there are often a variety of formal and informal, public and private systems already operating, so the basis for a stable mixed system is already in place. What most low- and middle-income cities miss is organisation, specifically, a clear and functioning institutional framework, a sustainable financial system, and a clear process for pushing the modernisation agenda and improving the system's performance. As long as there is no umbrella framework, the mixture remains a cluster of separate parts that do not function well together – or at all.

Think outside the box

Most books on solid waste view developing and transitional country solid waste systems as imperfect or incomplete copies of an 'ideal' system that operates in developed countries like Canada or Sweden. Many, if not most, waste interventions seek to perfect or improve the

copying process and spread the ideal. Or, at most, low- and middle-income countries have, up until now, sought to adapt the models from developed countries to their local circumstances.

This book takes a different view, responding to a growing global consensus that cities in low-income, middle-income and transitional countries need to take charge of the modernisation process and develop their own models for modern waste management that are more and other than simply 'imperfect copies' - models with focus and approaches that fit their own local conditions.

Low- and middle-income countries deserve better than an imperfect copy

But the real hard work of figuring out what is right for their particular climates, economies, and citizens is largely yet to be done. We hope that, by identifying good and innovative practices from cities at all stages of developing their waste management systems, this book will contribute to helping countries find innovative and different solutions that are appropriate to their own particular circumstances.

It is also part of our ambition to encourage decision makers to think 'outside the box', and to think beyond the short term. An effective collection system serving the whole city, and a safe and environmentally sound disposal site, are essential components of an ISWM system. But so also are effective systems to address the *3Rs* (Reduce, Reuse, Recycle), i.e. to reduce the quantities of waste generated, and to build on the existing, largely informal sector, systems for reuse and recycling.

1.6 Structure of this book

The remainder of this pre-publication version of the book is organised around two of the dimensions of ISWM.

Section 2 discusses the three key drivers in waste management (section 1.3), linking each to key physical elements in an ISWM system, i.e.:

- public health – waste collection;
- environment – waste disposal; and
- resource management.

Section 3 turns from what needs to be done, to how to deliver an ISWM system. Three inter-related requirements are distinguished, namely the need for:

- inclusivity (involving all the stakeholders);
- financial sustainability; and
- sound institutional arrangements and good governance.

To provide a flavour of the final book, Two profiles are included in Annex 3.

2 Three Key System Elements in ISWM

2.1 Public Health (Waste collection)

Issues

Together with safe management of human excreta (sanitation), effective removal and treatment of solid waste is one of the most vital urban environmental services, and needs to be seen as both an essential utility, alongside electricity, gas and clean water, and as a necessary part of urban infrastructure and services, alongside housing and transport, education and healthcare.

Poor solid waste management has a direct impact on health, length of life and the urban environment. Table 2.1 provides data from Habitat's Global Urban Observatory, based on Demographic and Health Surveys in 12 selected countries, on waste collection rates in urban areas. Collection coverage, percent of households receiving services from both formal and informal, public and private providers, varies widely, from less than 10% to more than 90% in African cities, and from less than 50% to 100% in Latin American cities.

Table 2.1 Waste collection rates in urban areas (%) in selected African and Latin American countries[21]

Region/ Country	Year	Average	Minimum	Maximum
Africa				
Benin	2001	27.3	12.4	47.4
Egypt	2005	86.6	40.8	96.4
Ethiopia	2005	39.0	19.6	69.6
Ghana	2003	39.6	30.1	64.4
Kenya	2003	28.5	5.6	57.7
Senegal	1997	62.6	34.3	85.9
Latin America				
Bolivia	2004	79.9	67.9	84.8
Colombia	2005	97.2	89.0	100.0
Dominica	2002	83.6	78.2	85.8
Guatemala	1998	56.2	42.9	89.5
Nicaragua	2001	64.7	56.1	80.8
Peru	1991	70.8	59.1	85.6

Figure 2.1 compares data for non-slum and slum households, demonstrating that access to waste collection is an equity issue.

If solid waste is not collected, it ends up in any convenient place that can be found. The largely organic waste is dumped in backyards, public spaces, alongside roads or pathways and in watercourses, or is burned. This matters: the DHS data shows significant increases in the incidence of sickness among children living in households where garbage is dumped, or burned, in the yard. Typical examples include twice as high diarrhoea rates and six times higher prevalence of acute respiratory infections, compared to the areas where waste is collected regularly.[22]

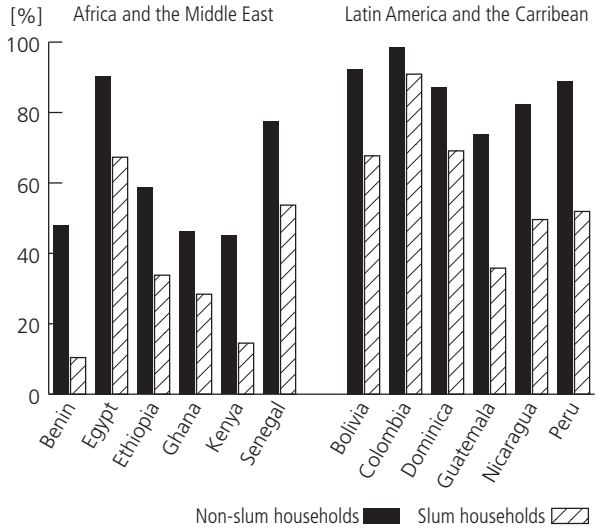


Figure 2.1 Collection coverage in percent for non-slum and slum households. Source: UN-HABITAT Global Urban Observatory 2009. Data compiled from national Demographic and Health Surveys.

Uncollected solid waste clogs drains and causes flooding and subsequent spread of water-borne diseases. Blocked storm drains and pools of stagnant water provide breeding and feeding grounds for mosquitoes, flies and rodents. Collectively, these can cause diarrhoea, malaria, parasitic infections and injuries.

The annual floods in Kampala and other East African cities are blamed, at least in part, on plastic bags, known as 'buveera' in Uganda, blocking the drains. In response to annual flooding in Mumbai, the State of Maharashtra in India banned the manufacture, sale and use of plastic bags, in 2005. Poor enforcement means that the ban has so far been ineffective. In West Africa, the floods are blamed on the small plastic pouches for drinking water.

Uncollected waste has economic costs for a city. A dirty and unhealthy city will make it difficult to attract businesses. In Tangier, Morocco, pollution of beaches by solid wastes was cited in the late 1990s as the leading cause of tourism decline that cost hotels in the area $23million/year in lost revenues.[23]

21. UN-HABITAT, Global Urban Observatory 2009. Data compiled from national Demographic and Health Surveys.

22. UN-HABITAT (2009). Page 129.

23. METAP Solid Waste Management Centre website – Highlights – Decision Makers' Support Document. www.metap-solidwaste.org/index.php?id=12

The economic cost of poor waste management

According to the Chairman of Nigeria's House of Representative's Committee on Environment: "Unhealthy and poor environment costs the federal government of Nigeria a whopping N10billion (Naira) annually. A World Bank report puts the environment cost to the country of water contamination from improper waste disposal at N10billion each year and the lives of about 40 million Nigerians being at risk." He added that "municipal waste [remains] the most visible and grave environmental problem especially in urban areas".[1] (N10 billion = USD86 million, 29 July 2008).

1. *Nigeria: Country Loses N10 Billion Annually to Unhealthy Environment – Rep. Nasidi Adamu Yahaya, 29 July 2008 http://allafrica.com/stories/200807290311.html*

Street sweeping in Latin America. © Jeroen IJgosse

Even in Europe uncollected waste can still hit the headlines, as in the recent example of Naples, where the collection service broke down due a failure of governance and disagreements on siting of a new waste disposal facility and financing of the system between elected officials, private companies, and citizens.[24]

Approaches and good practice solutions

Ever since the middle of the 19th century, when infectious diseases were linked for the first time to poor sanitation and uncollected solid waste, municipalities have been charged with providing solid waste collection services to their citizens. There are major cities in all continents, which have had formal collection services in place for a century or more. The World Bank reports that it is common for developing and transitional country cities to spend 20-50% of their available recurrent budget on solid waste management[25]; yet it is also common that half the urban solid waste remains uncollected and half the city population unserved.

So how can city authorities resolve this dilemma of high costs for poor service? We explore this in four headings:

- A 'good' collection service in your city?
- Improving cost-effectiveness and service coverage;
- Keeping the streets clean and the drains clear;
- Engaging the users of the system and creating effective channels of communication between users and providers.

A 'good' collection service?

If people are to trust a waste management system, it needs to be regular, reliable, user-friendly, and affordable. It also needs to match expectations and develop with them over time.

Frequency of collection is often seen as a measure of good practice, but frequency actually tends to drop during the modernisation process. Most developed country cities collect waste once per week or even less, while low- and middle-income countries – particularly in the tropics – are convinced that once per day is necessary. Daily collection may be necessary and justified in your local circumstances, but the question should be asked whether this is really the case.

So what constitutes a good collection service? The answer is different in different places, but results talk.

Collecting air in Byala, Bulgaria[1]

In 2002, Byala Bulgaria was a sleepy Black Sea fishing town with a few modest summer resorts and small hotels. Together with five extremely rural villages, it had a winter population of less than 2,500. The economic transition was accelerating, and fuel prices were rising rapidly. The cleansing department was using up its yearly fuel budget in the first 4 months of the year.

In the process of updating its solid waste plan, Byala invited an international consultant to help with cost reduction. During a visit in the off-season month of November, the consultant and staff did a field audit of the relationship between waste generated and frequency of collection. It turned out that 90% of the 40-litre containers were less than 20% full at the time that they were collected three times a week.

Based on a simple calculation, the cleansing company was able to reduce off-season collection from three times per week to once per month for 9 months of the year. This allowed the department to cover its fuel needs with the existing budget during the entire year, including tourist season. The consultant is still welcomed in Byala as "that girl who came from abroad to ask us why we were collecting empty containers."

1. *Scheinberg and Mol, in press*

24. *Hawley and Ward (2008)*
25. *World Bank website (undated).*

Customer satisfaction with a collection service

Recent market research in the UK[1] has identified 5 main factors, which drive customer satisfaction with waste and recycling collections systems:

- **Frequency, reliability, regularity and consistency of collections**
- **A commitment to recycling**
- **Clean streets**
- **Sensitivity to circumstance**
- **Customer service**

The results are being used to develop a set of principles for a good collection service, which all local authorities will be invited to commit to.

1. *Survey undertaken by Brook Lyndhurst for Wrap, 2008.*

The collection service that serves all areas of the city on a regular basis, keeps streets clean and drains clear, hires collectors in a safe working environment for a living wage, and meets the needs of the users, comes pretty close to the ideal.

Improving cost-effectiveness and service coverage

Providing a good collection service to the poor as well as the rich is more than just an equity issue – infectious diseases will affect the whole city. But if a city is struggling to find the money to pay for its existing collection service, how can it hope to extend the service to unserved communities?

Part of the answer is to improve the cost-effectiveness of present services, so as to free up resources to expand the service. Habitat has recently updated its seminal publication on waste collection in developing countries[26], the key message of which is to design your system to be sustainable under local conditions. Many cities rely on foreign donors for collection vehicles: this will only work if those vehicles are appropriate to the local waste, which tends to be wetter and denser in low-income countries than in the North, and the local roads, which often have lower legal weights for trucks, as they are built to a lower specification. It requires that spare parts, specialized equipment and skilled labour are locally available for maintenance.

26. *Manus Coffey (2009)*

Ensure that donated vehicles can be maintained locally[1]

More waste management systems in low-income cities have failed due to the use of imported vehicles and equipment, without an adequate local spare parts and service back-up, than from any other cause. As a consequence, municipal workshops are filled with broken down vehicles awaiting spare parts while the collection system falters. A key to reliable and sustainable waste collection must be to encourage the local manufacture of vehicles and vehicle bodies on locally available truck chassis, thus ensuring the availability of the spare parts and service and interesting a local manufacturer in providing an on-going service. In that way, the current "crisis management" repair of vehicles after they have broken down can give way to a preventive maintenance that is feasible under local conditions.

1. *Manus Coffey (2009)*

Expanding service coverage outside the city centre is a challenge. Where neighbourhoods cannot be served by large vehicles, a common approach is to provide primary collection using hand-carts, tricycles, animal carts or small vehicles, which bring the waste to secondary collection points or small transfer stations for transfer to bigger vehicles. In many cities, primary collection is organised by community groups micro enterprises or the informal sector, while secondary collection is organised by or on behalf of the municipality. There are at least three key principles of success, one technical and two organisational:

- Use collection vehicles and transfer systems appropriate to the local waste characteristics, street and traffic conditions and distances between collection and disposal points.
- Keep costs down by avoiding multiple manual handling of the waste. The ideal is for waste to be collected from household containers into a cart, from which it is tipped directly into a larger transfer container (or tipping vehicle), for direct transport to disposal onto a special tipping floor or sorting table and loading by hand. Tipping may be a good option when nothing else is available.
- Ensure co-ordination of the primary and secondary collection services, that the overall system works effectively and reduces the risk of illegal disposal by the primary collectors. Separate systems for different materials facilitate high-value recycling and reduce contamination.

Keeping the streets clean and drains clear

Municipal cleansing services are intimately linked to waste collection. As Habitat's DHS data shows, much waste that is not collected is dumped in the street, in public spaces and in watercourses. Many cities keep streets clean in the central business district but leave other areas unattended. This is unsightly and off-putting to visitors to the city, and discourages investments. It has even been suggested that the visual cleanliness of the *whole* city can be used as a surrogate performance measure for city governance.

In the Philippines and Indonesia, cities organize annually a street cleaning competition among their communities to encourage active participation of their local residents, while national environmental agencies grant awards to outstanding 'clean and green' cities. In Japan, street cleaning is a regular activity that city authorities invite their residents to participate in at least once a month.

Beijing Spring Festival[1]

In Beijing, a week before the Spring Festival in February 2007, in preparation for the 29th Olympic Games in 2008, about 100,000 residents took their brooms outdoors on a Saturday for a "Clean City" drive to mark traditional Chinese "Little New Year".

1. *www.chinadaily.net/olympics/2007-02/11/content_6005068.htm*

Engaging the users and creating effective channels of communication

This is arguably the most important factor for effective waste collection: a city government cannot manage solid waste management in isolation. It is responsible for ensuring that a service is provided, but needs also to ensure that it is a service that their 'customers', that is, households, businesses, institutions, will use. Any change in the type of service will probably require that the users change an established behaviour, such as learning to place their waste in a container rather than throwing it in the street, or to separate materials for recycling. So user engagement, participation and good communications are essential for the system to work.

Providers and users are in a dynamic relationship with solid waste practices at the centre. A well-functioning system relies on their working together, and this requires permanent and multi-directional communication channels. Some cities think of communication as a kind of advertising campaign that tells the users how to behave. This helps, but it places the users in a position of passive receiver. Active feedback systems and institutions that engage users have been proven to work better over the long term.

Users cooperate better if they understand why solid waste services are set up in a particular way, and they are in a good position to monitor effectiveness and serve as a source of information as to how the system is actually working. Feedback systems can include telephone lines for complaints, continuous or community monitoring of satisfaction and payment rates, and creating collaborative relationships between inspectors and the community.

Compliance and payment behaviour are also forms of communication. People communicate their satisfaction or discontent by obeying or violating the rules for disposal or recycling. They also show approval by paying on time, and signal dissatisfaction with the system or the providers by withholding payment or paying too little, too late.

Creating trust and willingness to pay in Nairobi[1]

When the Japanese development agency JICA prepared a solid waste plan for Nairobi in 1995, they found that no one was willing to pay for solid waste services, because no one believed that improvements in their horribly dirty city were possible. JICA, together with the city council and some private companies, set up an experiment to pilot-test whether it was possible to change opinions. They organised waste collection in several low-, medium-, and high-income communities, 'free' for the first three months. After three months of experiencing what it was like to live in an area that was clean and free of waste, the residents of all of the 'pilot' communities indicated that they were willing to pay quite a lot, in order to have the service continue.

1. *WASTE feasibility study for a PPP in Nairobi, 1999*

The community has been involved to plan for solid waste collection in their neighbourhood. © Jeroen IJgosse

The providers of the service are what make the system work, and communication is also important for them. The people in provider organisations tend to be overworked and underpaid, and they suffer from a low status of their work: there is a tendency to assume that anyone who does 'dirty work' is somehow a 'dirty person'.[27] Under such circumstances contact with users may seem unwelcome, or a luxury. In the midst of this stress, providers and their staff may forget why they are working and for whom.

27. *In many countries, waste work in both the formal and informal sectors is often reserved for members of disadvantaged classes and religious or ethnic minorities. For example: in Egypt, Coptic Christians; in India, people from lower social strata; in the Balkans and Central Europe, Roma people; in USA, the dominant group of new immigrants.*

A working collection system thus, depends on a high degree of co-operation and trust between users and providers, so any attempt to improve and modernise solid waste services require that both users and providers change habitual attitudes and learn new behaviours. In order for this process of innovation and mutual adaptation to work smoothly and effectively, there is a need for clear and continued communication, and the information channels need to be maintained.

Public engagement for enhanced recycling in UK

Situated on England's south coast, Rother is a typically British municipality. In 2007, they launched a kerbside recycling service to around 35,000 homes, rolling out across the entire district over one month.
A local recycling brand was developed and supported by a campaign, carefully choreographed to deliver the right information, in the right way at the right time.
The result was a rapid jump in recycling from 16% to 38% within 4 months of introducing the new service, exceeding their 2010 target of 32% recycling almost immediately. By the early summer of 2009, that had increased to nearly 50%.

2.2 Environmental Protection (waste treatment & disposal)

Issues

Removal of waste from houses and city streets was the main priority of cities' waste management systems for nearly a century, with little or no attention to what was then done with it. The edge of town was usually far enough away, and better still if there was a swamp to be filled. Dumping waste into rivers or sea was an acceptable strategy, where available. In many cities with high-rise apartment houses, waste was burned in simple incinerators and filled the urban air with ashes, odours, particles and pollutants. It was not until the emergence of the environmental movement in the 1960s that attention began to focus on the threat to water resources and air quality, and on the significant health risks to those living near such uncontrolled disposal facilities.

A crisis stimulates change

In most high-income countries, a crisis, and the political debate it stimulated, were responsible for starting the modernization process.
In 1971, drums of cyanide waste were dumped at an abandoned brick kiln near Nuneaton, UK, leading to a huge public outcry. The ensuing upheaval, along with press coverage of waste disposal drivers taking bribes to dump hazardous waste illegally, and a report by the Royal Commission on toxic wastes, provided a catalyst for the first ever legislation to control hazardous waste. The consequent Deposit of Poisonous Waste Act 1972 was drafted in only 10 days and passed through Parliament within a month.[1]

1. *www.wasteonline.org.uk/resources/InformationSheets/HistoryofWaste.htm*

Dumping of waste next to the river, Nigeria.
© Kaine Chinwah, Imperial College

In countries where there is a low level of control, and a lack of infrastructure, hazardous wastes from hospitals and industry often become mixed with the municipal or household wastes. This dramatically increases the health and environmental impacts from uncontrolled disposal; uncontrolled hazardous waste dumpsites were indeed a key driver behind 1970s waste legislation in developed countries.

The environmental impacts of uncontrolled dumping are most acutely felt at the local level. Dumpsites are usually located in or adjacent to poorer communities, where the land costs are lower, and it is politically and socially easier to locate and continue to use these facilities.

In terms of health impacts, the informal and formal sector workers on waste disposal sites are on the front line – they are exposed to dangerous substances and face significant health risks. Waste disposal sites can attract dogs and rats, and sometimes also cows and goats and pigs, and these can be a mechanism for spreading disease.

Nowadays, environmental policy is generally founded on the principles of the 'waste management hierarchy'. The hierarchy is represented in many different ways; however the general principle is to move waste management 'up the hierarchy', towards reduction, reuse and recycling (the '3Rs') nearer the 'top', diverting waste away from disposal, which is situated at the 'bottom'. The version of the hierarchy in Figure 2.2 emphasises that a necessary first step is to get on the hierarchy in the first place, by phasing out uncontrolled disposal.

This first step was only taken in the 1970s or 1980s in many developed countries. Official statistics for

Figure 2.2 Waste Hierarchy. Source: David C Wilson, Andrew Whiteman and Angela Tormin (2001)

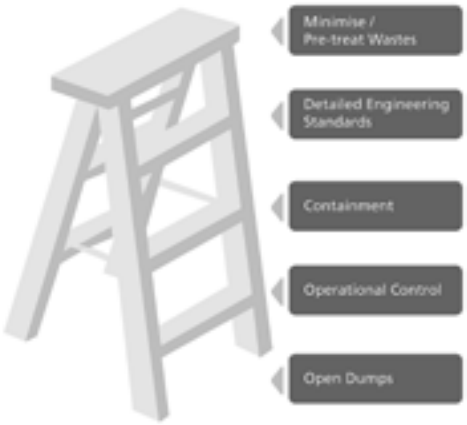


Figure 2.3 Stepwise progression in developed countries from 1970-2010. Source: David C. Wilson (1993)

1990 showed that 6 of the then 12 member states of the European Union were still using uncontrolled landfills, with 3 countries disposing of more than half their municipal solid waste by this route.[28]

Progress in controlling waste disposal in developed countries can be represented as a series of steps, shown in the 'stepladder'. (Figure 2.3).

- Step 1 focused on operational control of the site, by organising the receiving function, dividing the site into cells, compacting and covering the waste, and restricting access, so there is a fence and a gate.
- Step 2 focused more on containment, restricting the migration of contaminating substances from the landfill site via leachate or landfill gas. Control features such as bottom liners, drains for surface run-off, leachate collection pipes in drainage layers, and some form of gas vents became common practice.
- Step 3 established detailed engineering standards and gradually increased their stringency, including hydraulic permeability and chemical resistance requirements for liners; drainage and filter functions of leachate collection and removal systems; gas extraction and utilisation measures; and others.
- Step 4 is now moving beyond the landfill itself, diverting wastes up the hierarchy and restricting the range of wastes that can be legally landfilled.

A large proportion of the costs of developing waste treatment and disposal infrastructure in the OECD world is now spent on various engineered controls for environmental pollution prevention. This is reflected in high investment and operating costs. Operating costs for landfills range between €10 and €50 per tonne. Incineration of municipal non-hazardous waste costs between €80 and €200/tonne, partially due to very high investment costs, in the order of 100 million Euro, for modern incinerators that meet strict EU emission standards.

All this poses a challenge for cities in low and middle-income countries, already struggling to replace their open dump with a more sophisticated waste disposal facility. It may appear impossible and even hopeless, particularly if 'western' legislation has been copied, requiring the same advanced technology features as those applied in for example Germany or Switzerland. An additional problem is that European donors generally require all new facilities they support to immediately meet current EU emission standards, which took 40 years to evolve. Expecting poor countries to switch immediately can act as a barrier to working on the improvement at all. When the investment, operating and maintenance costs of new facilities are prohibitively high, this tends to result in continuing the status quo of open dumping, even after 40 years of focus on environmental protection.

Approaches and good practice solutions

Even though attention in the West may now be moving on moving waste management 'up the hierarchy' by restricting landfilling of untreated municipal solid waste, many developing and transitional country cities are still at the stage of phasing out open dumps, or establishing a controlled landfill, which remains a necessary part of an ISWM solution. Some of the approaches and solutions being adopted in such cities are discussed here:

- Phasing out or upgrading open dumps
- Adapting technologies to local conditions
- Reducing GHG emissions.

Phasing out or upgrading open dumps

As noted above, the costs of latest engineered controls for waste landfills may be prohibitive in a low or medium-

28. ERL (1992). Quantification, characteristics and disposal methods of municipal waste in the EU – technical and economic aspects. Report for the European Commission.

The Matuail Landfill, Dhaka Bangladesh

Half of the residents of the mega-city Dhaka, a population of 7 million people, are served by the Matuail landfill site. Dhaka City Corporation took a decision to upgrade the standard of disposal at this site utilising finances from the Japanese debt-cancellation fund.

Over a period of 2 years Matuail was transformed from an open dump subjected to closure during flooding, to a controlled landfill, with perimeter drainage, site roads, leachate management, landfill gas venting, site control offices and electronic weighbridge.

Site staff, cleaners with low qualification, were trained in landfill management, and assumed the daily tasks for site operation.

The Matuail landfill is now a shining example of a controlled landfill in South Asia; incredibly, all of the upgrading work was done whilst receiving 1,500 tonnes per day of waste input to the site.

income country, and may discourage decision-makers in taking the necessary steps to phase out open dumps.

Fortunately, instead of doing nothing or attempting the leap from the bottom to near the top of the stepladder (using the analogy from Figure 2.3), there is extensive experience that intermediate steps can bring about substantial improvements. The intermediary steps include either upgrading the operations at existing sites or developing new sites that are appropriate and affordable under local conditions. These steps can mitigate current and future environmental risks, while providing an opportunity to gain valuable operational experience and develop expertise.[29] [30]

As South Africa occupies a middle ground between developing and developed countries, its solid waste practices require specific solutions at the interface of the transition. South African solid waste practitioners have produced an internationally accepted approach of progressive rehabilitation to upgrade and phase out dumpsites.[31] The mains steps are as follows:

- With the assistance of the facility manager, selected for the rehabilitation process, initiate stakeholder meetings to involve both the public and the waste pickers in the proposed dumpsite rehabilitation. This participation process must be ongoing throughout the rehabilitation process.
- Establish control over vehicle access to the dumpsite, i.e. only via one gate.
- Identify a single working face in an area of the dumpsite, which is not burning, and establish a trafficable road leading to it. Keep hazardous waste separated from other waste.
- Control waste placement, i.e. allocate and control where loads are tipped. Spread the waste in layers of a maximum 1 m, and compact as best possible with the machine available. Stop end tipping, i.e. the pushing of waste over an extended slope, where the waste is not compacted and can burn.
- Extinguish fires in other parts of the dumpsite by exposing smouldering areas and smothering them with soil (no water).
- Develop a draining system, which prevents run-off water from adjacent areas entering the waste body.
- Create an operating plan that is as simple as possible, which progressively levels areas of the landfill and always uses only one single working face and some degree of compaction.
- Cover deposited waste as best possible with incoming soil, rubble or quenched ash. Establish vegetation on the covered waste if possible.

Most important in upgrading of open dumps[1]

Most important is to negotiate with the waste pickers throughout the process. They will be most affected by the proposed rehabilitation and are able to cause major problems on a site if they feel that their livelihood is threatened. Consequently, they must be made part of the solution. This is achieved by:

- **Recognising the fact that they are on site and are to stay;**
- **Formalising the right for the regular or career waste pickers to operate on the site in a controlled manner;**
- **Developing a mutually acceptable working relationship, facilitated through negotiation between the landfill manager and the recognised leader of the waste picker community.**

1. Rushbrook and Pugh, 1998.

This last point is reinforced by the example the Jam Chakro landfill in Karachi, which was built with donor funds in 1996. The site never really operated as a sanitary landfill and reverted to become an open dump, primarily due to failure to consult and take account of informal waste pickers.[32]

Moving from open dumping to controlled disposal has many advantages for other parts of an ISWM system:

It allows the segregation of hazardous and non-hazardous waste, through gate controls and through direction of any difficult wastes admitted to a remote part of the site. This may cost nothing in financial terms but may be the single most important measure to reduce pollution potential of the disposal site and improve occupational safety of workers and waste pickers at the site.

29. Rushbrook and Pugh, 1998.
30. Ali et al, 1999
31. Ball and Bredenhann, 1998
32. J. R. Rouse, 2006

Landfill in Catia la Mar, Brazil. © Jeroen IJgosse

Investing small amounts of money in a reasonable road to the site will save a lot in terms of collection and transfer vehicle maintenance and prolong their useful life.

Diverting waste from disposal through materials recycling and valorisation of organic waste, as discussed further in Section 3.3, will prolong the useful life of the disposal site as well as that of collection vehicles that haul the waste to disposal.

Adapting technologies to local conditions

Technologies developed in the OECD countries are designed for their own local circumstances where labour costs and technical capacities are high, waste is rich in packaging, and collection systems are based on compaction. They are 'high-tech', and work in the context of high investment costs, skilled maintenance and expensive imported spare parts to keep them operational, and to comply with the necessary environmental standards. This is true for state-of-the-art compaction collection vehicles and sanitary landfills; it tends to be even more true for, waste-to-energy incinerators and the many new technologies on the market.

Simply importing European, American, or Japanese technologies to a low- or middle-income country, without considering how they will work under local conditions, can be a recipe for disaster. Waste composition varies widely around the world: waste in cities in low- and middle-income countries generally have a much higher organic and moisture content than Western European or North American wastes. Put simply, wet waste is difficult to burn, so the developing world is littered by donor-funded Western incinerators that have never worked, or require supplementary fuel, because they are designed for waste streams with more plastic and less moisture.

It works better the other way around, when the characteristics of the waste stream and a good understanding of local conditions form the basis for choosing management strategies or technologies. The high moisture and organic content that make waste in middle-income countries difficult to burn make it an ideal material for composting, anaerobic digestion, animal feed, or direct land application. Specifics are important: in Africa where houses or household compounds often have dirt floors, street sweepings add so many inert materials that composting may be less advantageous than direct land application.

Failed treatment facilities in India[1]

In 1984, the Municipal Corporation of Delhi built an incinerator, to process 300 tonnes per day of solid waste and produce 3 MW of power, with technical assistance from Denmark (cost ~US$ 3.5 million). The plant was designed for segregated waste as input, which was not practiced by the households or promoted by the municipality. The plant had to be closed down within a week of its opening as the waste had a very low heating value and a high percentage of inert materials.

In 2003, Lucknow Municipal Corporation, built a 5 MW waste to energy project based on biomethanation, also called anaerobic digestion, to process 500-600 tonnes of municipal waste per day in 2003 at a cost of US$ 18 million. Private companies from Austria and Singapore provided the technical inputs and Indian firms the human resource for execution, on a build own and operate (BOO) basis. The plant was not able to operate even for a single day to its full capacity due to the high level of inert materials in the waste and was closed down. The plant is still non-operational due to the inability of the plant to receive segregated organic waste.

The operational difficulties and the failures were mainly due to the difference between the design assumptions, based on European waste and management practices, and the actual field scenario.

Both are landmarks to the failure of imported technologies in waste to energy for India.

1. *Kurian Joseph (2007)*

Unloading waste at Sisdol Landfill. © Bhushan Tuladhar

One way to approach this challenge is through understanding the functions of the technology currently applied in developed countries, instead of copying their technical specifications. This is particularly relevant for landfills. Part of landfill technology is intended to reduce emissions to groundwater via leachate. But if a site is available with 20 metres of naturally consolidated clay, it is actually better than any engineered liner, in terms of environmental protection.

The relatively new tool of Environmental Technology Assessment (EnTA) developed by UNEP provides a valuable framework for assessing technology impacts not only on the physical environment, but also on the local social and economic circumstances.[33]

33. Hay and Noonan, 2002.

Beware the 'magic solution' salesman

The Western market for novel waste treatment technologies is proving to be limited, and salesmen, both legitimate and unscrupulous, often target developing and transitional country cities desperate to find an easy answer to a difficult problem. A key message of this book, however, is that there is no 'magic bullet'. The checklist below provides some questions to ask such salesmen and yourself, to help you evaluate if their technology really is appropriate for your city:

1. **Is this technology suitable for your waste? (For example is the heating value of your waste high enough to burn without support fuel?)**
2. **Is the technology being proposed proven elsewhere? If yes, what documentation is there to prove this? (Do you wish to be a 'guinea pig' for a new technology?)**
3. **Would the contract proposed require you to meet a specified minimum tonnage of waste? Is this realistic in your current situation? Would it discourage the city's recycling efforts in the future?**
4. **Does the technology meet international emission standards? (This is essential for waste to energy facilities, to ensure that air emissions, including carcinogens such as dioxins, do not pose a risk to your citizens.)**
5. **Are the costs both realistic and affordable? Are local markets available for the heat or other products from the facility? If yes, how do you know? If not, are there plans to develop the markets? Who will finance market development?**
6. **Can the plant be run and maintained locally, using local labour and local spare parts?**
7. **Has a suitable site been identified? Which criteria have been used to assess suitability? Will the developer pay for full and independent environmental and social impact assessments to international standards?**
8. **Does your country have the institutional capacity to permit and regulate facility operations?**
9. **Have you sought independent advice, perhaps at your local university, before signing any contract?**

Reducing GHG emissions

The importance of environmental control over waste disposal, and also of resource management through the 3Rs (section 2.3), is reinforced by the current imperative to reduce carbon emissions in order to address climate change.

Methane emissions from anaerobic decomposition of organic waste in landfills are an important contributor to global greenhouse gas (GHG) emissions. Methane is more than 20 times more powerful a greenhouse gas than CO_2.

The IPCC estimate that around 3 % of total global anthropogenic GHG emissions are from post-consumer municipal solid waste and wastewater, of which around half are methane emissions from landfills.[34] Global landfill methane emissions in 2005 were estimated around 700 Mt CO_2-eq. These figures are expected to grow rapidly as anaerobic sanitary landfills replace many of the at least partly aerobic open dumps in developing countries. One projection shows emissions rising to 1000 Mt CO_2-eq in 2010, 1500 Mt CO_2-eq in 2020 and 2900 Mt CO_2-eq in 2050.[35] This emphasises the importance of mitigating methane emissions from landfills, through gas collection and either flaring or utilisation.

Methane is removed from the atmosphere more quickly than CO_2, so its contribution to global warming over its first 5 years in the atmosphere is estimated at nearly 100 times that of CO_2. This has led some commentators to argue that it makes sense to focus short-term mitigation measures on major methane more than CO_2 sources.[36] This increases the importance of landfill beyond its relatively modest % contribution to global emissions.

Capturing a proportion of landfill gas emissions and either simply burning the methane or using it as a fuel is the end-of-pipe approach to mitigation. The EU Landfill Directive has taken a more proactive approach, combining engineering standards for gas collection and utilisation with targets for member states to divert wastes from landfill. Extensive studies have been done on the relative benefits in GHG terms of the various alternatives to landfill: this has led most developed countries to prioritise recycling of paper, plastics, metals and glass and composting of organic wastes, with the use of various alternatives to landfill for the residual fraction that cannot economically be recycled. Opinions vary as to what is the optimum level of recycling as opposed to energy recovery in high-income countries: the answer is likely to vary widely, with

34. Bogner et al, 2007.
35. Monni et al, 2006.
36. Kirk Smith. Methane first, OK? New Scientist, 27 June 2009, 24–25.

local conditions. However, for developing countries it is clear that recycling and composting will reduce the quantities of waste that would otherwise have to be landfilled, thus reducing costs to the city and benefiting the environment through reducing GHG emissions.

The IPCC estimate of a 3% contribution to global GHG emissions looks just at the direct consequences of disposing of the waste at the end of its life. This consists of carbon impacts of disposal and incineration of waste with carbon content. Many components of urban waste have high 'embedded carbon' content, which determines the amount of indirect GHG emissions attached to their production and distribution, so that there are potentially larger carbon savings to be made by waste avoidance, reuse and recycling, all of which displace products made from virgin materials, and so avoid the carbon emissions involved in their raw material extraction, manufacture and distribution.

2.3 Resource Management (valorisation of recyclables and organic materials)

Issues

The separation of recycling from public cleansing

Up until the industrial revolution in Europe and North America in the 18th and early 19th centuries, most people knew how to produce goods for their own basic needs for food, shelter, and clothing. They also understood how to return broken or worn off products and materials into original use or other useful applications. Repair and reuse of household goods was a way of life.[37]

37. Strasser, Susan (year 1999)

Sorted waste offered for sale in the Philippines. © SWAPP

With industrialisation, the making of things became more centralised and more distant, and so waste materials – some of them still a valuable input into the next production process – accumulated in the city. Due to public health considerations, municipal solid waste management, then known as 'public cleansing', was established to get waste out of the city. In parallel, industrial recycling value chains developed to capture secondary materials for recycling, primarily from industry and businesses but also from households. Thus industrial recycling evolved in parallel to but separated from the evolution of solid waste management as municipal cleansing.

It was only as part of the modernisation process, after the birth of the environmental movement in Europe and North America in the 1960s, that formal municipal waste collection authorities got interested in recycling, composting and valorisation activities, driven mainly by the need to divert waste from disposal and thereby relieve the pressure on scarce disposal capacities. As a result, the past 40 years have seen gradual re-integration of resource management into solid waste management in industrialised countries.

Global markets for recycled materials

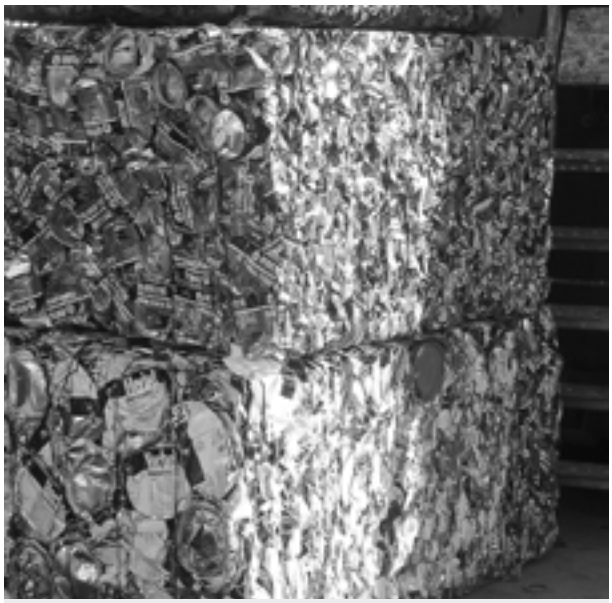
Secondary materials are big business. The total world market for scrap metal is over 400 million tonnes, while that for recycled fibre, consisting primarily of waste paper and cardboard is around 175 million tonnes[38]. In both of these cases, consumption is split roughly 50:50 between developed and developing countries, with a strong net export of secondary fibre to Asia.

Recycling in low- and middle-income countries

Industrialisation has changed residence patterns, concentrating masses of people – and their waste – in urban and peri-urban areas. So thousands of people in rapidly industrialising cities like Delhi, Managua or Shanghai, use that waste as the basis for livelihoods – just as they did in Paris or San Francisco, when these cities were industrialising in the 19th and early 20th century. These informal sector recyclers extract waste, valorise it, and live from trading it into the industrial or agricultural value chain.

At present, cities in low- and middle-income countries have a large and very active informal recycling sector. Millions of individual entrepreneurs picking waste in cities as varied as Nairobi and Bangalore, São Paulo and Manila, are responsible for high recycling rates even before city authorities modernise their waste systems.

38. Figures for 2003 and 2004 respectively. Lacoste and Chalmin (2006).



Tin cans compressed ready for selling to metal recycler, the Netherlands. © WASTE, Justine Anschütz

When low- and middle-income countries make efforts to industrialise and modernise their waste systems, they tend to ignore the economic and environmental benefits of informal recycling, not least because of the image of poor people who look dirty and backwards, use hand or animal-powered vehicles, and as such don't fit the image of a modernised city!

Instead, some city authorities prefer to create new recycling systems designed to copy those in Copenhagen or Toronto. They move to prohibit or criminalize traditional recycling practices, cutting off livelihoods from literally millions of people, who work as individual entrepreneurs, or in micro and small private recycling enterprises.

But this is not only a social issue; it is very much an economic one. Even though many city authorities do not recognise the informal recycling sector as an integral part of the city's waste management system, recent work has shown that informal recyclers are often saving the city millions of dollars, and are in effect subsidizing the costs of formal waste management.

'Modern' recycling collection in high-income countries often costs more than the intrinsic value of the materials. When the cost for collection, processing and marketing exceeds the market value, the difference is paid by city's waste budget, because it is less than the cost for collection, transfer, and disposal in the state-of-the-art landfill. Even though the net costs of recycling may be less than that of disposal, the idea that recycling produces net revenues is an illusion. Well designed, highly optimised formal recycling systems may create savings, but most formal recycling systems in low- and middle-income countries are neither well-designed nor fully optimised.

The converse is true of informal systems. The informal sector are the recycling experts; they developed their expertise without any form of protection, financial guarantees or incentives, other than the highly variable global free market prices for the commodities they are selling. Rather than ignoring this expertise, it would make more sense for the city to invest some money in facilitating the informal sector to work more efficiently and under better health and social conditions – this investment would be much less than the cost of collecting and managing the increased waste quantities if the informal sector were driven away.

Approaches and good practice solutions

Integrated waste management, which seeks to complete the cycle of returning waste materials to the production process, now includes not only collection and disposal of mixed waste, but also a number of specific approaches to resource management. The 3Rs – Reduce, Reuse, Recycle – has become a familiar 'brand' around the world. As reuse is one of the measures to reduce waste, these will be discussed together. A final section focuses on a particular aspect of recycling, the valorisation of organic wastes.

Since in the early 1990s, there has been an increase in the attention paid to the fate and rights of the millions of waste pickers and small recyclers. Data and information from a number of 'integration' projects suggest that there are significant win-win approaches to inclusive modernisation, which maintains an economic and operational space for the informal sector.[39]

Reduce and Reuse

"A clever person solves a problem. A wise person avoids it."[40] This quote, attributed to Albert Einstein, is certainly valid in addressing the issue of solid waste. If waste is growing at 3-5% a year (often tracking GDP), and rural-urban migration increases a city's population at a similar rate, then the city's waste generation will double around every 10 years. In other words, by the time the siting and licensing procedures for a new landfill are completed, funds found and construction done – the amount of waste generated in the city will have doubled! This clearly calls for some prevention measures, in addition to investment in technical fixes. Generating lesser amounts of waste will decrease the pressure on both municipal waste collection services and disposal space. Waste prevention practices, also known as source reduction, typically also save money

39. Scheinberg, A. Paper presented at CWG workshop in Cluj Romania (2008)
40. http://nickelkid.net/quotes/einstein.html

for the waste generator, whether they are households, businesses or industry.

Even though few would oppose the logic – or even wisdom – of these statements, waste prevention is just beginning to get off the ground as public policy. After 40 years of modernisation of solid waste management, European countries are only just arriving at the point where waste prevention, as the highest step in the waste management hierarchy, receives broad political and regulatory attention. The latest EU Directive on Waste requires member states to establish national waste prevention programmes by December 2013.[41]

On the other hand, both government agencies and non-governmental organisations and individuals have been proposing an array of voluntary measures to various waste generators – households, offices, hotels, manufacturing industries – to adopt more sustainable practices of 3Rs[42] [43] 60 (or the wider concept of sustainable consumption and production – SCP)[44]. In developing countries, 3R centres have been established around universities and NGOs.[45] *Precycling* is a general term used for a range of purchasing, waste prevention, and reuse strategies, coined by Maureen O'Hara, a public educator working for the city of San Francisco in the 1980s.

But, even though many agree that waste reduction is essential for sustainability, there is still a major gap in terms of practical experience as to how to go about achieving it.

The situation for reuse may be better than for other aspects of waste prevention. Most low- and middle-income cities have a thriving reuse sector, built around small businesses who repair household items, and who will buy 'end-of-life' items and repair or remanufacture these, inspect them and resell on the local market. This sector is now being rediscovered, strengthened, and recognised as an important step of the waste hierarchy and as part of an ISWM system.[46] Flanders is an example of a region, which has invested public money heavily to re-establish the reuse sector, working with community enterprises to set up a network of reuse centres and shops. California is also extremely pro-active.[47]

The message for low- and middle-income country cities is clear. The reuse sector needs to be recognised as a valuable contributor to sustainable waste and resources management, and may need your support, both to survive and indeed to develop and grow. It makes an important contribution to reducing the waste quantities that your service providers need to collect and manage, so saves the city money. If locally appropriate ideas are applied to use this window of opportunity, it may prove to be a valuable addition to your sustainability efforts. If you do nothing, then experience in the West suggests that the sector will gradually decline, driven out by rising rents or other reasons, and the city will have to deal with more waste as a result.

Office waste, either in governmental institutions or commercial companies, is similar in cities like London or Delhi or Shanghai. Office waste has prevention and reuse potential that has not yet received due attention. Opting for reusable products, such as rechargeable batteries and printer cartridges instead of once-thru versions, would contribute to a sustainable resource management, reduce hazardous waste, and save costs at the same time.

Recycle

Sustainability requires closing the loop of material use, which starts by extraction from natural resources such as ores and forests, to processing, to manufacture of various products to distribution and consumption. Not only does recycling make sense from environmental sustainability point of view – it also makes sense economically. A study at Yale University found that most of the metals that are currently targeted for recycling have concentrations that are more enriched than minimum profitable ore grades.[48]

Formal and informal recyclers around the world know this already – valorisation of waste materials through recycling has been practiced since the industrial revolution.

Many low- and middle-income country cities aspire to modern waste management systems, which are all characterized by high recycling rates based on source separation. In low- and middle-income countries, most collection for recycling is undertaken by the informal sector and is funded entirely from selling the recovered materials into the recycling value chain. The informal sector collect recyclable materials and feed them, often through middlemen, into a formal private sector network of main dealers, recycling industries and perhaps exporters. Evidence shows that recycling rates already achieved by the informal sector can be quite high, often in the range from 20-50%[49] that matches the recycling targets from developed countries!

41. Directive (2008). Article 29.
42. USEPA (undated). The Consumer's Handbook for Reducing Solid Waste
43. WRAP (2009). Waste Prevention Toolkit.
44. www.scp-centre.org
45. 3R Knowledge Hub (undated). www.3rkh.net
46. Arold and Koring (2008)
47. ibid; further information on waste management in Flanders at www.ovam.be/jahia/Jahia/pid/1010?lang=en
48. Johnson et al (2007)
49. GTZ and CWG, 2007; David C Wilson et al, 2009

Itinerant waste buyers (IWBs) have a particular role as they collect clean, source-separated materials directly from households and businesses. In low- and middle-income countries separate collection, itinerant waste buying and door-to-door collection is usually a person-to-person transaction in which the generator gives or sells the materials to a collector (who then either accepts them as a donation or pays for them). In developed countries separate collection is part of a municipal or private waste collection service where different bins or containers distinguish the materials to be recovered from the mixed or rest-waste fraction destined for disposal.

The involvement of waste generators in set-out is of paramount importance. Set-out is the activity by which households or businesses prepare and present their waste materials to a collection service provider (private or public, formal or informal). There are better opportunities for valorisation and the market value of the materials is higher, when materials are source separated or collected in a single stream recycling.

If waste is not segregated at its source, then recyclable materials are extracted during the process of waste collection, when truck crews skim recyclables off and sell them, or at the disposal site, where waste pickers collect glass, metals or cardboard. The quality of materials from such 'mixed waste' recycling will generally be lower than that from source separated materials, which affects the price and can affect the marketability of the product.

Purchase of products made entirely or partly out of recycled materials is the final loop in recycling chain. Technical performance, appearance, consistency with specifications, transport logistics, institutional relations, price, and buyer perceptions determine the market success of recycled products. Many high-income countries are adopting public procurement policies, which give preference to materials with a high recycled content, to try to increase 'market-pull', and stimulate demand and stabilize prices.

Processing

Processing refers to the steps or types of operations in the recycling chain that prepare the collected materials for sale:

1. **Sorting: removal of contaminants, and/or separating for example different types of plastic, by hand or by machine, resulting in sub-fractions that are purer and more uniform than the original streams, and therefore, achieve higher prices;**
2. **Densification: increasing the density of the materials so they can be transported more efficiently. The two main options are baling for paper, cardboard, textiles, steel and aluminium cans and plastic film and containers – which produces bales or materials that can be stacked, and shearing or milling and screening, which cuts or breaks the materials into small fractions, and is used for glass, plastics, organic wastes, wood, and some types of construction and demolition materials;**
3. **Aggregation: an often misunderstood step, aggregation refers to the accumulation of sufficient quantities of materials to command a good price, or even to influence the behaviour of industrial buyers;**
4. **Packing for transport: for size-reduced materials, it means putting them in 1 cubic metre polyethylene 'big bags' or cardboard 'gaylords' other bulk shipping container, stacking bales, and loading into a truck or shipping container.**
5. **Marketing: the transaction where the materials are valorised, that is, their economic value is fixed and they are sold to industry.**

Green public procurement in the Netherlands

The Central government of the Netherlands has an ambition to incorporate sustainability criteria in 100% of their public procurement actions in 2010. For municipalities this goal is set for 2015. The Sustainable Procurement Programme encourages governments at all levels to consider environmental and social aspects at purchasing products and services.[1]

1. www.senternovem.nl/duurzaaminkopen/

Organic waste valorisation

Pre-industrial societies re-used any edible leftover food as animal feed, and other organic wastes, including the organic fraction of municipal solid waste, agricultural wastes and human excreta, were generally returned the soil. This organic resource loop is still important today, as witnessed by Habitat's bio-solids atlas.[50]

The organic fraction may be as much as 50% and 70% by weight of municipal waste in low- and middle-income countries. Therefore, exploring possibilities to engage citizens and service providers in valorisation of organic waste through composting would alone significantly improve the situation and alleviate the problems with municipal solid waste. Composting of organic waste, either at household level or on a more aggregated scale, divert significant quantities from being disposed and producing methane.[51] A good example is Bangladesh.

Recycling or composting only makes sense if there is a market for the product. Whereas markets for recyclable materials exist in most countries in the recycling value chain, this is only partially true for organic wastes. Food waste may still have a market value as animal feed, and farmers used to accept or even pay for organic wastes as a source of nutrients. This was the general disposal route in

50. Le Blanc et al (2006).
51. Rothenberger et al (2006)

Women receive information on household composting in Siddhipur. © Bhushan Tuladhar

China before chemical fertilisers took over, and is still the case in parts of West Africa.

Organic waste in these circumstances may have a market value, but products made from it, such as compost, usually do not. For this reason, it is not reliable to assume that there is a "market" for compost. Instead, a market for compost needs to be developed, by building urban-rural linkages and by educating potential users and buyers of compost about its properties, nutrient value, and similarity or differences in relation to the fertilisers and mulches, which are better known. This process takes several years, and compost operations are generally not able to cover their own costs until compost itself becomes a commodity with a market price.

High-income countries have done much work on product specifications, to give the buyer confidence in the quality of the compost product. An important consideration in this has been presence of trace contaminants, particularly heavy metals, in the compost. This problem can be avoided by composting a source-separated organic fraction, so that the possibility of cross-contamination by other waste components is avoided.

3 Three ISWM delivery strategies

How do you deliver an ISWM system, for whom is it, and who is responsible for creating it? Until the 1990s, the answer would likely have been primarily framed around technology. Since then an extensive global community of practice has come to recognise the need for a much broader approach, which is referred to as integrated and sustainable waste management (ISWM).

Three inter-related requirements for delivering ISWM are highlighted here, (1) the need to be inclusive, involving all the stakeholders; (2) the need for the system to be both cost-effective and affordable in order to be sustainable; and (3) the requirement for sound institutional arrangements and good governance.

As with the three elements introduced above, a successful ISWM system needs to address all three of these principles.

3.1 Inclusivity

Issues

The *municipal government is* responsible for solid waste management in a city, but they cannot deliver on that responsibility by prescribing or undertaking measures in isolation, entirely on their own. Experience shows that *all* the stakeholders need to be involved and 'on board' (Figure 3.1).

National government sets the policy, financial and administrative framework within which the city needs to work. Many different ministries and departments may be involved, as may regional government, neighbouring jurisdictions, transnational institutions, and the private sector.

The main *service users* are households and commercial and institutional waste generators.

Non-governmental organisations (*NGOs*) and community-based organisations (*CBOs*) are important as representing wider sections of the community. Trade and professional associations and chambers of commerce have a similar representational function for businesses and institutions, as do labour unions and syndicates for workers.

Both the *informal* and *formal private sector* actors are, or may wish to become, service providers in waste collection and recycling. They are often recycling a significant proportion of the city's waste. The private sector also includes commodity traders and their industrial customers for recycled materials; together with manufacturers, retailers and others who supply products that end up in the municipal waste stream.

Formerly informal collectors in Cañete, Peru. © IPES

Some types of stakeholders are not that obvious, nor do they think of themselves as involved in waste, These unrecognised stakeholders are nonetheless important; they include professional associations, churches and other houses of religion; sport and social clubs; schools, universities, other educational and research institutions and consultancies; and the many sub-groups of waste generators and service users, including market stall-holders; kiosks; hotels; restaurants; sport clubs; hospitals; hydroelectric companies; transport operators; schools and kindergartens.

Figure 3.1 Stakeholders in solid waste management

Waste management is a public service, but it differs from most other public utility functions in one important respect. The closest public service in terms of its regularity and complexity is perhaps the postal service. In a sense, waste management could be viewed as a kind of 'postal system in reverse' – indeed some researchers have classified waste management as 'reverse logistics'.

However, the postal service runs quite well in most countries of the world, whereas the waste management system does not. Why is this?

Simply put, we value our post. We make sure we put the right number of stamps on our letters or packages, and we ensure that they are placed in the letterbox or deposited at the post office. And because we value the cargo, we have no problem paying for this service.

This is the crucial difference between waste management and other utilities and public services. Most people don't care where their waste goes, as long as it is not next to their house. They may be willing to pay for removal of their waste. And when they are not willing to pay, the cost of an individual opting out of a waste management service is much less 'personal' than for any other utility: others suffer from the impacts. It is much easier and much more harmful to burn or to dump your own waste than it is to generate your own electricity, or indeed to deliver your own letter to your family in a distant village.

It is for this reason that involving the service users is critical to the success of any waste management system. A good service is one that people will use and be willing to pay for, something which is more likely if they have been involved in its design. Moreover, providing a good collection service to slum areas as well as middle class districts is more than just an equity issue – infectious diseases will affect the whole city.

Changing the waste collection service implies changing people's habitual behaviours. In a city in a low- and middle-income country seeking to expand service coverage, this may mean persuading people to put their waste in a household or communal container rather than dumping it in the street. During later stages of modernization this shifts to persuading people to separate their wastes into several streams for recycling. Attention is now moving towards how to promote waste prevention.

Equity of service means that all users – or said another way, all waste generators – need to be able to have their waste removed regularly and reliably and disposed of safely. However, when the focus shifts from pure removal, with waste being dumped without much if any control, to environmentally appropriate disposal, the game changes. Even if everyone agrees that new sites are needed, very few people want a new landfill site next to their home if their only experience of waste disposal is of a stinking, burning open dump – the NIMBY syndrome for 'not in my back yard'. And few generators are willing to pay the costs of safe disposal.

A resident handing over waste to collector
© Sanjay Gupta

But providing a regular collection service depends on there being a place to put the collected waste. Two stories illustrate what can go wrong.

The waste management service in Naples broke down in early 2008, with wastes piling up in the streets because all the region's landfills were full and the collectors had nowhere to take the waste. According to one press report: *"Naples has been choked by waste over and over in recent decades, partly due to mismanagement, corruption and mafia involvement in trash pick-up, but also because of Neapolitans' refusal to sort their trash"*.[52] Other contributing factors included authorities arguing with each other and not involving local citizens and other key stakeholders in the decision-making process.

Another well-known case was the New York garbage barge. In the 1980s, a barge carrying municipal and hazardous waste left the New York Metropolitan area to a regional landfill where it was supposed to discharge the waste. The destination facility refused to take it, and the barge went from place to place along the East coast of the US. Finally after a 'cruise' of about 6 months, it returned to its point of origin. It became an icon of the failure of waste management in the USA at that time.

Equity is critical for another frequently overlooked stakeholder group in most developing and transitional country cities, the informal and poor providers of services and traders of recyclables. The informal sector often collects and recycles a significant proportion of a city's waste, at no direct cost to the city. Yet rather than working with the informal sector to increase the amount they recycle, and thus reducing further the quantities that the city handles directly and saving even more money, the traditional attitude of city authorities has been negative.

Co-operation with waste pickers is made more difficult because waste picking has a universally low social status. Somehow the 'dirtiness' of the work results in society tending to despise waste pickers. It is also that the work attracts marginalised groups, whose access to the formal labour market is restricted due to various factors of ethnic

52. Hawley and Ward (2008)

or social exclusion. These groups include internal or international migrants, rural to urban migrants, specific ethnic or social groups, so-called low castes and the non-pensioned elderly. It is easy for city authorities to blame waste pickers for the waste problem, instead of seeing how they are making it more manageable.

Such blame sometimes even extends to persecution and criminalising informal activities, condoning police harassment of the 'garbage thieves,' awarding exclusive access to recyclables to a formal private company or declaring a municipal monopoly on recycling, or physically preventing access to waste.

Approaches and good practice solutions

Stakeholder involvement in waste management, and in the making of difficult decisions, is the only way to avoid 'Naples' in your city, or 'the garbage barge in your harbour'. The process is challenging and takes time, and the goals are complex. It requires courage for politicians to trust that their citizens will engage in the process of arriving at the right decision, but it works. And if the users and the citizens are not involved, experience shows that it can go badly wrong.

This section begins by looking at two successful approaches to stakeholder involvement, through a platform for dialogue on solid waste issues, and by using a participatory approach to strategic planning. Approaches to siting new waste management facilities are then explored. The section concludes by focusing on the informal sector recyclers and service providers.

The solid waste 'platform'

A successful ISWM system needs mechanisms for two-way communication between all the stakeholders, and in particular the municipal authorities, the service users, both formal and informal sector service providers, and the wider community.

Waste picker at work along the street in a city in Latin America. © ACEPESA

A platform for dialogue on solid waste issues is one example of how to increase ownership and to anchor institutional memory in ISWM. A platform is often created in solid waste management at the beginning of the modernisation process, under the general rubric of 'stakeholder mobilisation'. It is commonly initiated or convened by an NGO, and brings together a diverse group of individuals, businesses, organisations, municipal and government officials and institutions. The involvement of the city authorities or their officials is critical – they need to be seen to be engaging with other stakeholder groups.

A platform maintains open channels of communication between actors who are normally isolated from, or actively antagonistic to, each other. What makes a platform more than just a series of meetings is its continuity over time, the fact that it does not depend on the results of elections, and the fact that it provides a safe social space for discussing differences, resolving conflicts and arriving at a common way of looking at the situation. A key feature of platforms is that they have permeable boundaries, 'members' are self-selecting and represent themselves as much as their organisations, and the local authorities neither own them nor control their activities. This last feature in particular makes platforms an important host organisation for long-term processes and a repository of institutional memory. Unlike elected government, platforms survive elections and make a bridge to new administrations.

The Swabhimana Platform in Bangalore is a classic solid waste platform in the broadest sense of the word, and its characteristics serve as a general description of what a platform is and does.

Another example comes from Bamako in Mali.

The Swabhimana platform[1]

Key to waste planning in Bangalore

- **Provides representatives for planning or evaluation teams or meetings;**
- **Sponsors, promotes, organises and attends events, ranging from promotional days to study tours to training events to working meetings;**
- **Organises themselves into working groups for specific purposes;**
- **Mobilises technical expertise to complement or balance the expertise offered by the formal authorities;**
- **Shares information among the members and also with other platforms;**
- **Prepares or commissions key knowledge products, such as handbooks and brochures.**

1. *UWEP plus (2004).*

COGEVAD, a stakeholder platform[1]

COGEVAD, the Committee for the management and recycling of waste, in Commune VI (one of six cities in the Bamako district of Mali), was another platform in the UWEP programme. COGEVAD and the corresponding platform in Commune IV, COPIDUC, were the focus of the UWEP programme's exit strategy from Bamako. Each platform became the formal owner of the physical, social and information infrastructure in its city, and the institutional home for further developments in waste management.

1. *UWEP plus (2004).*

Participatory planning

Policy makers and practitioners around the world know how difficult it is to develop the ISWM sector. An inclusive planning process has proven to be a key to success.

The most comprehensive guidance for inclusive strategic waste management planning was published by the World Bank in 2001[53], and has since been applied in many locations. The guide was one of the outputs from an inter-donor and expert Collaborative Working Group[54] and received contributions from many international organisations and practitioners working on the issue around the world.

The guide is based on a step-wise planning process, shown in Figure 3.2, where stakeholder working groups are trusted to research options and propose specific aspects of the planned new system. It emphasises the need for 'facilitators' to manage complex process of discussion and debate between stakeholders.

The outputs from the process are a 'strategy' and 'action plan', with the strategy focusing on those issues which stakeholders can agree on, and the action plan dealing with the often more contentious measures required to implement the strategy, such as specific technologies and sites for waste infrastructure.

Further testing of the strategic planning guide was funded by DFID (UK), and resulted in a series of practical 'Waste Keysheets'[55] to assist in stakeholder consensus building, and with implementing the initial steps in the planning process. Training materials were prepared as part of a later World Bank – METAP project[56].

53. *Wilson D.C., Whiteman A. and Tormin A. (2001)*
54. *CWG – the Collaborative Working Group on Solid Waste Management in Low- and Middle-income Countries. www.cwgnet.net*
55. *IJgosse et al (2004). www.wastekeysheets.net*
56. *METAP (undated). Includes seven training modules on strategic planning – click on policy and planning – training. Available in English and Arabic.*

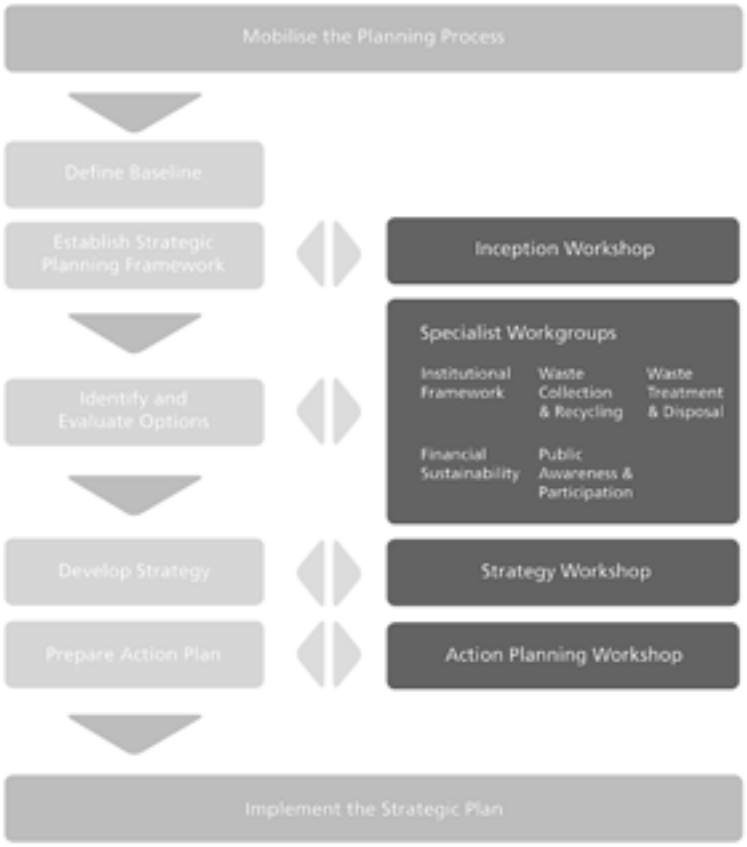


Figure 3.2 Steps of the World Bank's Strategic Planning Guide

Participatory urban waste planning in Vietnam

In 1998 participatory planning in the urban waste management sector was tried out for the first time in Ha Long and Camp Pha, a beautiful UNESCO World Heritage location in the north east of Vietnam.

All of the major stakeholders involved in and influencing urban waste management were invited to join the process in a structured series of workshops, to prepare a Provincial Waste Management Strategy. There were no pre-arranged results, and the final form of the plan depended purely on the results of the process.

The initiative was a great success and resulted in the creation of a fresh approach to waste management planning. The World Bank Strategic Planning Guide methodology was born.

Siting facilities

Modernisation of waste management includes developing environmentally sound facilities. A key part of an ISWM solution, at least in the medium term, will be a sanitary landfill, or at least a controlled disposal facility. Upgrading an existing disposal site may be an appropriate first step, but at some point, most cities will have to take the decision as to where to site a new landfill. Economies of scale are likely to favour a regional facility, so issues of inter-municipal cooperation and equity between communities become important.

The traditional 'top-down' approach to siting has been for the city to hire consultants to find the 'best' site. People living near to candidate sites organise themselves into protest groups, and 'battle lines' are drawn. Once that happens, effective communication is hindered and rhetoric escalates. Even if the consultants are genuinely independent, and carry out state-of-the-art environmental and social impact assessments, the results may still be perceived as biased and politically motivated.

It is for such reasons that this book advocates the need for an inclusive approach, involving all stakeholders from the beginning. Establishing a platform, and/or developing the strategic plan in a participatory manner, provides a solid foundation. With a clear and transparent approach, and the political commitment to open up the decision-making process, leave the final results open, and give the decisions back to the people, it is possible to move from argument to implementation.

No one wants to live next to a waste management facility, but someone has to. Tompkins County in New York State provides an interesting case study of a successful, participative, siting process.

Siting the new Tompkins County landfill

The rural county of Tompkins, NY, population ~ 100,000, had a full landfill in the mid 1980s. Like most other US counties, they accepted the challenge of regionalisation and hired technical consultants to identify geologically appropriate sites for the landfill.

When they had the short-list, the county decided to depart from the normal ways of doing business: They held community meetings in each community, and asked one simple question: "Suppose your community turns out to really be the best, and the most environmentally sound, location our new regional landfill. What would your community need in order to make it acceptable that the landfill comes here?"

Several communities reacted positively to being involved in this way. The one that was eventually selected as technically the best asked for a new school and recreation centre; for house prices in the community to be benchmarked at current values, and the County to guarantee to buy any house within a certain radius of the landfill for that (inflation-corrected) benchmark price, for an agreed-upon period of years during construction and after opening; and for the municipality to receive a "host community fee" for each ton of waste disposed over the life of the landfill.

The total cost of all of these measures to the County was a fraction of what was usually spent at the time on legal fees in settling siting issues; and the host community was content.

*The key was that the local authority **asked** stakeholders for their opinions, **listened** to their answers, and **respected** their position.*

The informal sector as key stakeholders

For there to be a service, there have to be service providers. Waste collection providers can be public or private, informal or formal, large or small, local or international. They can use their own muscles for energy, or animal traction, or small, medium, or large vehicles of all types.

But not all economic activities in waste are services. In many cities, at least as many – if not considerably more – people earn their livelihoods in recovery, valorisation, and recycling as are employed in the public services of waste collection and street sweeping. In fact, many formal employees of the waste system supplement their income or personal possessions by separating materials for repair, reuse, recycling, and feeding animals.

Anecdotal and historical evidence suggests that resource value was the earliest driver for waste management, predating both public health and environmental concerns. Informal sector recyclers, including both itinerant waste-buyers, who collect source separated materials door-to-door, and 'waste pickers' who separate saleable materials from mixed waste, still play an important, if generally unrecognised, role in solid waste management systems in most developing and transitional country cities. They

represent the foundation of most recycling activity and the bottom layer of the so-called secondary materials pyramid.

Quantifying the contribution of the informal sector to waste management has been difficult[57] – few developing and transitional country cities have good statistics on the formal sector, and there is even less about the informal sector – which by definition tends not to keep written records. A recent GTZ project has changed that, providing for the first time authoritative data on both waste and money flows in the waste management – combined formal and informal – systems in six cities.

The research results are in some ways shocking. By recycling significant percentages of the cities' waste, the informal sector is saving the city perhaps 15-20% of its municipal budget, through reducing the amount of wastes that the formal sector would otherwise have to handle. In effect, this is a 'reverse subsidy', with some of the poorest sections of the community subsidising the middle and upper classes.

Given this very substantial subsidy to its budget for waste management, city authorities should be actively engaging with the informal recycling sector, to see how best they can work together to increase the quantities of waste recycled and thus reduce further the burden on, and the costs to, the city of handling the residual wastes. Investing some city resources in facilitating the work of the informal sector, to maintain and extend their services, or to make their work more sustainable by improving their living and working conditions, makes sound financial sense.

57. David C Wilson et al (2009)

'Economic Aspects of the Informal Sector in Solid Waste' 2007[1]

In 2006, the German Technical Co-operation (GTZ) financed a study entitled "Economic aspects of the global informal sector in solid waste," co-financed by the CWG. Six cities formed the focus of the study on relationships between formal and informal solid waste activities. The cities, Cairo, Egypt; Cluj-Napoca, Romania; Lima, Peru; Lusaka, Zambia; Pune, India; and Quezon City (part of Metro Manila), the Philippines, represented five continents and ranged in size from 380.000 to 17 million people. In only these six cities:

1. **More than 75,000 individuals and their families are responsible for recycling about 3 million tons per year.**
2. **The inputs from the informal private recycling sector to the recycling supply chain, and therefore to the economies in the six cities, have a value of more than US$120 million per year.**
3. **In Lusaka, more than 30% of the city's waste collection service is provided by unregistered, informal collection service providers.**

1. GTZ/CWG (2007)

Such positive engagement is beginning to happen, particularly in Brazil. Cities in all kinds of countries may learn from their positive experiences.

Framing social dialogue & social inclusion in Brazil

In Brazil, there are many initiatives throughout the country, at national, state- and city-levels that attempts to implement a participatory and inclusive approach to solid waste management.[1]

This has been framed under different institutional arrangements with varying degrees of formalization. At national level, an Inter-ministerial Committee for Social Inclusion of Waste Pickers also involving the waste pickers´ national movement, MNCR, was created in 2003 with the task of devising and coordinating policies for integration of informal recyclers.

There are also many provincial states and municipalities throughout the country with Waste and Citizenship Forums – a multi-stakeholder channel whose focus is to eradicate open dumps, child labour, and integrate waste pickers.

In some cities inclusivity issues in solid waste are debated at environmental committees. This whole process has led to a great degree of integration of waste pickers in solid waste management in the country furthering the association of waste with citizenship.

1. Sonia M. Dias (2006) and (2000)

A recent court case in Colombia has ruled in favour of waste pickers who were being denied access, and may represent a landmark ruling worldwide.

Legal Backing for Waste Pickers in Cali, Colombia

In a recent case, CiViSOL, a foundation that works to amend the cultural and legal norms of state and society, intervened before the Constitutional Court of Colombia on behalf of the waste pickers of the Navarro Dump of Cali.

In April 2009, the Constitutional Court of Colombia ruled in favour of the waste pickers guaranteeing their customary rights to access, sort and recycle waste and their legitimacy to compete in the waste recycling business.

The Court recognised the importance of waste pickers, granted them full protection, and recognised their environmental contribution.[1]

1. www.civisol.org

Efforts of local and international NGOs to help the pickers often focus on the unhygienic work conditions, while ILO is working to eradicate child labour in scavenging.[58] Other initiatives aim to 'clean up the streets and get rid of waste pickers,' or to 'save people from this

58. ILO/IPEC (2004); Rosario (2004)

Waste pickers near truck at landfill in Latin America.
© Jeroen IJgosse

horrendous and undignified work'. Yet the millions of informal service providers and recyclers in Asia, Africa, the Americas, or Eastern Europe are professionals in a legitimate, if not legalised, economic activity.

The informal sector are recycling experts, they do it effectively and efficiently. The new-found realisation that they make such a significant economic contribution to reducing the burden of waste management of city authorities, will hopefully secure their rightful place as key stakeholders in strategies for sustainable modernisation.

A lively global discussion and associated advocacy in Brazil, India, and other middle-income countries, is gradually leading to a shift in power relations between the informal recyclers and service providers on the one hand and formal institutions of government, industry, the financial sector, the broader society, and the recycling supply chain on the other. The Philippines has recently published a national framework plan for the informal sector in solid waste management.[59] Experts, advocates, and waste pickers themselves are talking in global meetings like the First World Conference of Waste Pickers in Bogotá, Colombia, in March 2008[60], and the Collaborative Working Group (CWG) workshop "Waste Management in the Real World" in Cluj-Napoca, Romania, one month earlier.

The activity, research, and global discussions have produced a compelling body of evidence that the models for sustainable, affordable waste management and recycling outside of the developed world work best when they are built around the integration of waste pickers and other informal recyclers and service providers into modernising ISWM systems. When this happens, the resulting systems are robust, socially responsible, and economically productive. When it fails to happen, recycling systems in low- and middle-income countries function poorly, create stakeholder resistance, and are often both poorly designed and seriously over-capitalised, in short, good examples of poor global practice.

59. Solid Waste Management Association of the Philippines, (2009)
60. WIEGO (2008). Waste Pickers Without Frontiers, First International Conference of Waste Pickers, Bogotá, Colombia.

3.2 Financial Sustainability

Issues

Financial sustainability of solid waste management services is a major issue for cities all over the world. In cities in low- and middle-income countries, solid waste represents a high proportion of the recurrent budget, approximately 20-50% according to the World Bank[61]. Yet collection service coverage remains low and disposal standards are generally poor. Making service delivery more efficient frees up some resources, but many cities can expect to see costs rise substantially, as population and waste quantities increase, service coverage expands, and open dumping is phased out.

Solid waste costs in Western and OECD country cities are continuing to increase, as environmental regulations become stricter, wastes are diverted from landfill to higher cost incineration facilities or to landfills at a greater distance, and the costs of environmental protection at treatment and disposal sites have increased.

The principles of financial sustainability for a municipality in solid waste management are essentially the same as for any business or household trying to function within a limited budget: know your costs, know your revenues and live within your means.

By knowing your financial costs, you can control your own solid waste improvements, both financially and technically. Financial management systems in many cities are often inadequate:

1. Accounting systems through which service costs are recorded may be poor or ill-suited to the practical circumstances of waste service.
2. Recurrent costs may be regarded simply as the regular cash expenditures needed to operate and maintain the services, with no routine provision for financing vehicle or equipment replacement.
3. No attempt may be made to aggregate the costs incurred by all of the various city departments or agencies involved – in one way or another – in waste management.
4. Activity-based costing – allocating costs to specific activities in order to optimise the system – may be prohibited by the country's accounting standards and practices.

61. World Bank website (undated). Urban Solid Waste management homepage

5. The amount of waste is structurally over-estimated in cities where there is no weigh-bridge at the disposal facility, so estimates are made based on truck design capacity. This means that the cost per ton will be higher than projected when there turns out to be less waste over which to spread fixed costs.

The costs of providing municipal waste management services are thus commonly under-estimated by a large margin. As a result, cities frequently struggle to secure the financial resources necessary to sustain, never mind to improve, service coverage and quality.

Knowing your revenues and how far they could potentially be increased is also critical. Cities fund their solid waste services from a range of sources:

1. Indirectly, through a direct grant from national or regional government.
2. Indirectly, through their general local fund raising, which may be through local taxes of some kind, commonly on property.
3. Through a specific solid waste management levy, which may be collected separately or via electricity or water bills.
4. Directly, through a charge, tariff or fee, levied by the service provider. This may be a flat rate, or be related to the quantity of total or non-recyclable waste collected.

In practice, the situation is complex, and many cities use a combination of sources, financing capital expenditures with donor or national ministry funds, for example, and operating costs from a user fee. In Europe such user fees for households are still a relatively new phenomenon. Volume based fees, or 'pay-as-you-throw', are relatively unknown in Europe, and are still prohibited by law in England, even though they have expanded rapidly in North America since the mid- 1980s, and is familiar in the former Soviet Union and many post-socialist economies in the Balkans.

A woman standing next to her crop fertilised with here own home made compost in a master composting project in Sri Lanka. © WASTE Anne Scheinberg

Where international donors, or other investors finance new waste management equipment or infrastructure in cities, such financing may demand a fiscal reform and insist that the city can demonstrate that they are able to pay for the operational costs. This frequently leads to a political discussion about direct user fees, which in turn raises the issues of equity, affordability and willingness to pay.

In general, a well-designed and transparently functioning tariff or fee system can recover some of the costs of operating the service, but at least in the short term, much of the full cost will continue to be paid for by the local, regional, or national authorities from general revenues, as part of the government's public health and environmental protection responsibilities.

In these circumstances, any new source for funding solid waste management services is very welcome. Carbon financing is one new source of financing which is potentially available to offset the cost of new projects in non-OECD countries, when the projects are specifically designed to reduce emissions of methane, CO_2,, or other greenhouse gases.

Another relatively new mechanism to support solid waste costs is extended producer responsibility (EPR). EPR systems are gaining popularity in high- and middle-income countries as a means of transferring to producers, some part of the environmental cost of end-of-life management of their products.

Approaches and good practice solutions

Living within your means. In practice, municipalities cannot easily increase their general revenues, and solid waste is just one of many competing demands on limited resources. Direct charging of users is probably inevitable, but is not without its problems. So, it is vital for city administrations to plan carefully, and to match their ambitions in improving services to their ability to pay.

Alternative solutions are discussed here under the same three headings as for the issues; the section concludes with a discussion of innovative sources of funds: carbon financing and EPR.

Analysing costs

Determining the real costs of existing waste and recycling operations can be difficult in all countries, and a real challenge in low- and middle-income countries where traditional accounting systems prevail.

Reliable cost information is the basis for affordable and efficient services. It sets the foundation for providers to be able to recover costs from users, which in turn is necessary

if there will be private sector participation or access to bank financing. A first step in cost analysis is to establish the 'end-to-end' operational costs, taking into account ALL components and matching these with the flow of materials through the system. An intermediate step might be to distinguish between capital purchases associated with facilities and equipment, and day-to-day operating costs. This basic division allows a city to allocate *the full costs incurred over a period of time,* for example, a week or a year, to the services provided over that period. In the longer term aim should be to establish full-cost accounting (FCA) for the whole system, and activity-based costing for each operation or sub-system.

Sound internal financial management environment is necessary for the financial viability and long-term sustainability of solid waste services.

A good internal management system can help you to:

1. **Establish the full costs of the solid waste service and its individual parts.**
2. **Allocate funds to the various parts of the service based on demonstrated needs.**
3. **Measure the performance of parts of the service, including private sector contractors, and compare these with established norms & benchmarks.**
4. **Establish fair and sustainable contracts for private sector contractors.**
5. **Plan service developments and the replacement of plant and equipment.**
6. **Hold managers accountable for service outputs, relating to costs, revenues, quality, performance and efficiency.**
7. **Formulate and implement viable cost-recovery schemes.**

Extensive guidance on setting up such systems, and on other aspects of finance and cost recovery for solid waste management, is available.[62]

Knowing your costs is necessary even when the city delegates both service delivery and collecting user fees to the private sector. In such situations, the city council often sets the fees based on what they think is politically acceptable to their constituents. As illustrated by the example from Mali, it is important to know actual costs of delivering the service and use this as the basis for establishing fees and tariffs.

Raising revenues

At some point in the planning process for modernising and improving waste management in a city, increasing costs for regional state-of-the-art disposal will almost require some new sources of revenue, leading to a discussion of user charges. At that point it is key to consider equity issues among the different users, in relation to their needs, preferences, and ability and willingness to pay.

The general options for cost recovery include:

- differentiating fees by categories of household and business users, so that those who are able to pay more cross-subsidize those who can pay only a little; and
- setting a fee per 'connection' based on average socio-economic characteristics in the different wards in the city, with the possibility of granting exceptions to the general rule based on specific characteristics.
- differentiating fees for types of services based on their environmental footprint, so that disposing of hazardous waste 'costs' more than delivering tree branches to a wood recycler.

When a city is dirty, then people are unlikely to be willing to pay for waste management services – both because they don't see what they would be paying for, or because they believe that they are already paying through their general municipal 'tax'. Experience has shown that people are pre-

Why the donkeys of Bamako, Mali, were dying in 1999[1]

In Bamako, Mali, the donkeys and the owners of the GIEs (Groupes d'Interet Économiques, or MSE collection enterprises) were, until recently, the casualties of a poorly functioning cost recovery system. The city council set the tariffs per household for waste removal, based on what they thought was politically acceptable, without considering the real service costs to the GIEs.

A law prohibiting the donkey carts from using paved roads made the situation worse: the collectors began to overload the carts and under-feed the donkeys in order to make ends meet.

The result was that the donkeys did not take in enough calories to replace the energy they used for pulling the carts, and usually died within a year. This is a good example of poor financial practice: where operations costs are not covered, the system will not be sustainable.

1. *M. M. Keita (2003)*

Donkey cart in Ouagadougou, Burkina Faso. © WASTE

62. *METAP (undated). Includes regional guidelines on Finance and Cost Recovery, available in English, French and Arabic.*

Gender and willingness to pay in Choluteca, Honduras[1]

In 1997, only 22% of households with access to waste collection in Choluteca, Honduras, paid their waste bills. Most people coming to the public works office to pay were women.

One woman head of household in a peri-urban colonia explained as follows: "We are poor people. We don't make so much waste. Officially we have waste collection three times per week, but that's a fiction, in practice they only come here irregularly. That part is OK, actually once per month is enough for a poor community like ours if they put a container.

What is not OK is that they are charging us as if we were receiving the service three times per week, which we aren't. Our husbands go to the meetings and agree to whatever they say. It's OK for them, they are not the ones who pay; they tell us to take it out of the household money. If the mayor's people would just ask us women what kind of service we need and how much we can pay for it, and listen, and make it officially once per month, then we would pay."

1. *Notes from USAID WorldWID gender fellowship in Honduras, 1997*

pared to pay, particularly for local, primary collection, and street cleaning, when they can see the benefits, have input into the choices, and are in a position to mobilise the funds, as illustrated by the example from Honduras.

Moving from a position where solid waste management is paid for through general revenues, to one where it is paid for entirely for user charges may not be possible in the short- or medium-term in low- and middle-income countries. Where it is desirable or proved to be feasible, a gradual transition is sensible particularly if the real system costs are rising at the same time. As with other aspects of the waste service, dialogue with all the stakeholders, including the users, community organisations and service providers, is critical.

Getting people to pay for primary collection, where they can see the benefit of keeping their neighbourhood clean may be a realistic first step. Expecting them to be equally willing to pay for (secondary collection and environmentally sound disposal is optimistic, because they don't immediately experience the impacts of problems of the status quo. (The proposal of David Morris of the Institute for Local Self-Reliance in the 1980s was to require that all waste be disposed of within 35 km of where it is generated, to make it clearer to more citizens what the problem actually is.

Another challenge to be expected is structural non-payment of fees. Charging for utilities and other services is standard practice, and if the customer does not pay, the service is withdrawn.

Yet experience has shown that the mail alternative, direct user charges, unrelated to property values or utility use, and collected separately, has generally been poor, with very low payment rates. A lack of electricity or water is a life- and death situation, but too much waste is a nuisance only, and a solvable one at that. Thus people may choose to make private legal and illegal arrangements to get rid of their waste, and this then has public health consequences for the city as a whole.

For the local authority, an attractive alternative is to collect the waste fees with other utility charges, but this may not be possible when sanitation or water have been privatised. In Russian cities, for example, and prior to 1989 in Bulgaria as well, housing management companies collect one fee, which covers water supply, heat, sewage, waste, gas, TV antenna, etc. Collection with electricity charges has also been used in Jordan and Egypt.[63]

In some of the newly independent states of the former Soviet Union, the municipal waste collection company contracts directly with the management company for each housing block. Most sign up and pay, but some don't, preferring instead to make their own arrangements, such as burning, dumping, using street bins or neighbour's bins, or taking the waste to work. So the definition of the term 'collection coverage' changes – the service may be available to 100% of the city, but perhaps only 80% actually sign up to and use the service.

In most of these examples, charges are levied at a 'flat rate', depending on the size or value of the property, rather than directly on the quantity of waste generated. True 'pay-as-you-throw' systems are relatively uncommon: more are being introduced in high-income countries, at least partly to provide an incentive to householders to segregate their wastes for separate collection and recycling, for which a charge is not made. Nairobi is an exception. There private waste collectors sell their own garbage bags for a fee, which includes the cost of collecting and disposing the amount of waste that fits in the bag. In many low- and middle-income cities, itinerant waste buyers are already collecting source-separated materials door-to-door, often making a small payment based on weight. So an 'incentive system' to encourage separate collection already exists there, and could be built upon.

Living within your means

Low- and middle-income countries and their city authorities frequently are in the position to receive capital financing from multi-national development institutions

63. *METAP, ibid*

or bilateral donors. External financing is most likely to be offered for landfills, waste treatment and disposal facilities, or investments in the private sector. External financing for equipment is more likely to come in the form of donations of vehicles, ICT equipment, or machines from twinning relationships.

External financing goes wrong when the receiving authority doesn't need what is offered, can't get spare parts, or simply cannot afford to operate it within the local economic circumstances, for example, because fuel use is high or maintenance requires special skills, or even because of a mismatch between imperial and metric measuring systems. So donations and donor purchases have to be domesticated, otherwise it might be better to decline them. In short, it is essential that the city be able to maintain and operate the vehicles, equipment and infrastructure they have received.

A similar point relates to the type and specification of the technology supplied. Two situations can arise, typified by US and European Union donor styles. EU donors generally require all facilities they fund to meet the latest EU standards; US donors often require that all equipment procured with their funds be spent on US-made products. In both cases the city needs to be absolutely sure that they a) need and want what is being offered; b) can and will use it for the purpose it is designed, or some other similar purpose; c) can find and afford fuel and spare parts; d) can in general afford associated operations, maintenance and any additional costs; and e) are clear which budget and source of funds will produce the means to do these things. Otherwise the new state-of-the-art landfill, incinerator, bio-gas facility, vehicle or bulldozer may turn out to be an expensive 'white elephant', which the city cannot afford to operate.

A third situation is that international equipment suppliers, often with funds from their home country economic ministries, offer subsidised equipment and make over-optimistic revenue projections, for example high energy revenues, low operational costs, great market prices for recyclables, or dream-like technical promises. An extreme example is the incinerator that was marketed to a Nairobi private waste collector by a Swedish company in the 1990s, with the 'guarantee' that it would burn garbage and turn it into hundreds of litres of clean drinking water.[64] More plausible claims of energy from waste or oil from tires merit close examination, because there are frequent hidden costs for supplementary fuel, maintenance, or parts. Looking back to the Bamako example, one can say that if your city or your private operator can't manage to feed the donkeys, you won't be able to afford fuel for a tractor either. A donation of physical infrastructure does not change the financial and institutional conditions of your city, only focused modernisation efforts, capacity strengthening, and political commitment can do that.

There are examples in several continents of donor funded incinerators that have never operated, but have sat for years as a kind of dinosaur in the landscape.[65] Or consider the sanitary landfill built to meet EU environmental standards, which it quickly reverts to being operated as an open dump because energy costs of the leachate collection system are too high, or even because the city can't afford to pay a weighmaster and buy rolls of paper for weight slips. The trucks roll by the entrance and dump into the river. Another example is the fleet of donor-provided collection vehicles, fitted with tyres of an uncommon size, which were not available locally, so that when the tyres needed replacing, the vehicles could no longer be used.[66] Inappropriate donations and investments are not only a waste, they can actually break a solid waste organisation by loading it up with debt, undermining its credibility, or appearing as corruption or conflict of interest. Appropriate, needed donor financing or donations can rescue a city solid waste department, but inappropriate financial support can equally well be the 'trojan horse' that causes a functioning but modest solid waste system to collapse.

To avoid classic failures, and to live within their means, cities need to think critically and make their own choices, even daring to refuse donations when they don't fit the needs or match the plans. The donors will not be there to pay the fuel bills, order the tyres, or answer to the citizens at the next election, so it should not be the donors who decide what equipment is needed to keep the city clean. Cities – especially those in low- and middle-income countries – need to dare to refuse unwanted technology, and if they accept, to do so only when their own experts are convinced that what is offered meets their plans and needs, that operating it is sensible and affordable, and that parts and expertise are available locally.[67]

Carbon Financing

'Carbon credits' through the so-called Clean Development Mechanism (CDM) and Joint Implementation (JI) projects of the Kyoto Protocol have the potential to sup-

64. WASTE, project for UNEP IETC for private waste collection company in Nairobi, 1999.

65. WASTE, project for UNEP IETC for private waste collection company in Nairobi, 1999.

66. This specific example is from Zambia, provided by Manus Coffey, personal communication

67. See also discussion in sections 2.1 (collection vehicles) and 2.2 (waste treatment and disposal)

port new solid waste, composting, and recycling initiatives in the medium term. Carbon financing can provide the financial cushion that allows a composting facility or landfill gas recovery project to operate sustainably, and to improve the local and global environment. In carbon financing, CERs, or carbon emission reduction units, are issued to projects which make a difference in the amount of greenhouse gases (GHGs) emitted. Carbon credits may reassure or attract private or public investment, and because they are paid out only after the fact, they do contribute to guaranteeing that such facilities will indeed be operated as they were designed.

The most common type of carbon financed project in the waste management sector is landfill gas extraction, combined with either flaring or electricity generation. Landfill gas projects qualify because they prevent release of methane, and methane is a major contributor to global warming, a dangerous greenhouse gas, and therefore a priority target for short-term mitigation efforts.[68] Composting also reduces formation of methane, and the Dhaka composting project is the first of many composting projects in the CDM pipeline. Recent work on methodologies has also expanded potential for carbon financing to project-based approaches, which allow multiple small projects to be bundled together in a single application for carbon financing.[69]

Carbon financing projects may become feasible for cities of a minimum of 150,000 inhabitants for projects with environmentally sound landfilling or landfill closure, composting, or reduction of anaerobic decomposition or certain kinds of water pollution. The financial structure of these projects is relatively simple: when the project succeeds in reducing emissions, it can claim credits for the difference between actual performance and the status quo without the project. This difference is called, in carbon jargon, 'additionality.'

Approved CDM methodologies[70] are available for various projects utilising the heating value of waste, such as controlled combustion, gasification, or mechanical/ thermal treatment. There are also methodologies available for processing of the organic fraction of municipal waste, such as aerobic composting with soil application and controlled anaerobic digestion with biogas utilisation and composting of digestate. New methodologies are being proposed all the time. Small projects have a slightly easier procedure than large ones.

68. See also Section 2.2, Reducing GHG emissions.
69. WASTE, carbon finance research report done for the ISSUE 2 programme in 2008-2009 by Evgenia Tasheva.
70. http://cdm.unfccc.int/methodologies/index.html

Composting in Cañete, Peru

Carbon financing is not a panacea, since the administrative mechanism for CDM projects is quite bureaucratic. Interested cities need to build their professional capacity, and to take professional advice, if they are to take full advantage of the opportunities and avoid the pitfalls. An application for registration as a carbon credit project costs between US$15,000 and $40,000, although in some cases these costs will be paid by potential buyers, such as United Nations or World Bank carbon funds, the European Emissions Trading System, or certain European public utilities who have high emissions that their governments require them to offset by investing elsewhere. The informal carbon market is also growing rapidly, allowing companies and individuals to fly, drive, or manufacture

Carbon Financing in Action: *Worldwide Recycling and the Dhaka Market Composting Initiative*[1]

World Wide Recycling, a Dutch private company together with Waste Concern, an NGO in Bangladesh developed a CDM project for a private composting plant in Bangladesh. Dhaka's muncipal waste is 80% organic, and suitable for aerobic composting. In addition to avoiding the formation and emission of methane, the project will produce quality compost for sale to the Bangladeshi agricultural supply chain. The first successful CDM composting project developers, the Dutch-Bangladeshi proposer consortium was one of a handful of project developers to develop and propose a methodology for 'Avoided emissions from organic waste through alternative waste treatment processes'. This methodology was approved in 2005 as a large scale UNFCCC methodology, and subsequently modified to allows bundling of small projects. The project diverts 700 tonnes per day of organic waste from disposal to aerobic composting, reducing emissions of about 90,000 tonnes of CO2 per year, for which carbon credits, have been awarded. Without the revenues from the carbon credits, the investment would have a negative internal rate of return (IRR), but with the carbon credits, IRR is estimated at 17.8%.

1. Waste Concern, Bangladesh and World Wide Recycling, the Netherlands (2007)

"carbon-neutrally". Rotterdam is one of the first cities in the world to commit to carbon-neutral city operations.

One advantage of this carbon financing is that it is results-based. Annual revenues, which can be as much as $2 million per year for a large landfill gas project, are only paid out upon proof of actual carbon reductions, thus providing a strong incentive to maintain operating standards at the landfill.

At the time of writing, most experience with CDM and JI projects in waste management is with landfill gas extraction and utilisation, with a wave of composting projects in the pipeline. Methodologies are being developed for programmatic, demand based projects for small scale composting and the search for a methodology to earn credits from recycling is a top priority.

Extended producer responsibility

As recycling has become an established component of ISWM, attention has shifted from marketing recyclables after they are collected to making producers responsible for the life cycles of the materials in their products. Extended Producer Responsibility (EPR) is the main policy instrument for this, and it is designed to stimulate a shift from end-of-pipe 'waste management' to more integrated 'resource management'. The basic concept is to shift the financial, logistical, and physical responsibility for safe end of life management or valorisation from the local authority that collects municipal wastes to the manufacturer, importer, retailer and/or distributor of the product. The European Union has led the way – EU applications of EPR have focused on fluorescent lights, waste automotive oil and accumulators, end of life vehicles (ELVs), packaging, electrical and electronic equipment (WEEE), construction and demolition waste, batteries, and many other kinds of products.

EPR is a national policy instrument, and is only available to cities within the framework of national legislation; there is considerable variation between national systems even within the EU. Many waste professionals in developing countries advocate the introduction of EPR in their countries; however, care is needed to ensure that the additional finance available from the producers, of packaging in particular, is targeted at existing recyclers, including the informal sector, to help them improve both the efficiency and the sustainability of their operations, rather than becoming yet another threat to their survival. One of the very few examples of a national system outside of the developed countries, in Tunisia, provides a good example of what can be done.

Packaging producer responsibility in Tunisia

Tunisia has developed several producer responsibility schemes for the collection, treatment and recovery of certain categories of waste, including plastic packaging, WEEE, batteries, lubricating oil, oil filters and tyres.

Eco-Lef was set up in April 2001 as a producer responsibility system for plastics packaging. It works with micro enterprises to achieve recycling. There are 313 collection points across the country, enabling the collection of 15,800 tonnes of plastic packaging waste in 2008. Depending on the type of polymer, 70 to 90% of collected plastic waste is captured by the system.

Eco-Lef has made it possible for 11,000 persons within over 1,900 micro-enterprises to gain employment in plastics waste collection for recycling.[1]

1. GTZ/GOPA (July 2009)

3.3 Sound institutions & governance

Issues

Waste management is one of the most visible of urban services. These services are a major employer and consume a large proportion of the operational revenue of a city or municipality. As such, an effective and sustainable waste management service goes hand-in-hand with good local governance and sound municipal management.

ISWM tests the full range of governance skills: priority setting, strategic planning, consultation, decision making, law making, delegation, contracting, human resources management, financial management, enforcement and conflict resolution.

If waste services are to be effective, a city must have the capacity to streamline management responsibilities, manage finances and services in an effective and transparent manner, and work effectively with communities.

Where waste management is working well, it is likely that the city has also addressed and opened up underlying organisational arrangements, management structures, contracting procedures, labour practices, accounting, cost recovery, transparent budgeting, and corruption.

The adequacy of services to lower-income communities also reflects how committed the city administration is to addressing urban poverty and equity, suggesting that the solid waste sector can be a useful proxy indicator of good governance.[71] For better or worse people often judge whether or not a mayor is doing a good job by the cleanliness of the streets and the quality of the waste management service, even though the actual realities of garbage governance may be more complex, requiring inputs from a range of departments and professionals.

71. Andrew Whiteman, Peter Smith and David C. Wilson (2001)

Approaches and good practice solutions

Institutional and governance aspects are discussed under the following headings:

- National policy framework
- Institutions and management
- Inter-municipal co-operation
- Public-Private Partnerships and 5-Ps
- Professional competence and networking

National Policy Framework

The relationship between the city authorities and the enabling policy environment have a strong influence on ISWM. The larger political context is shaped by environmental ministries, inspectorates and agencies; by national and international health, economic, and finance institutions; by rule of law; by commitments to stakeholder participation; and by national and global rules about the private sector and financial institutions. A clear and transparent policy framework is critical for ISWM, and guides the city authorities in the processes related to planning an implementation.

Modernising and optimising the relationship between the city authorities and national ministries is one of the main institutional issues in ISWM. For example, are the city authorities allowed to retain the revenues collected from local taxes, or to levy direct charges for services? Do city authorities have the right to adjust their internal management structures and personnel? What are the rights and responsibilities of the city when it comes to contracting out of services?

The answers to these questions may have more influence on the cleanliness of the city than the type of trucks or the location of the landfill, but they usually get far less attention.

Institutions and management

Municipal solid waste management in many cities is institutionally fragmented lacks administrative coherence. For example, a small cleansing department at city hall, may depend on labourers and supervisors managed on a decentralized basis in all the individual districts. Vehicles and drivers for both the waste and highway departments may work for a central transport department, rather than for their operational divisions. Salaries for these labourers and drivers may be paid by the personnel organisation or finance ministry, meaning that there are three, four, or even more, separate departments involved in day to day operations. Fragmentation makes it difficult to assign responsibility or accountability, but consolidation is difficult because of established bureaucratic claims and traditional organisational structures. A broadly supported, highly popular project to introduce an EPR-based national management system for e-waste (WEEE) in Costa Rica was delayed for *two years* because it was unclear whether the established health ministry or the new environmental ministry had jurisdiction to sign the enabling legislation.

Modernising waste systems and improving performance is easier to implement and monitor when all or most waste-related functions come together under a single node in the organogram, making it possible for accountable, transparent management, budgeting, and operations. Where this is not possible, relations between different departments and their specific roles and responsibilities need to be spelled out and endorsed by all parties.

Key responsibilities include the following:

- *Service provider:* has the responsibility for ensuring the provision of an adequate level of service that protects public health and the environment, at an affordable cost, to all of the population.
- *Comptroller or fiscal manager:* is responsible for financial management, but not for setting policy. Typical responsibilities include collecting, receiving, or raising funds, managing the process of allocating them to operations; budgeting; disbursement; and accounting.
- *Operator or operators:* has/have the obligation to implement physical systems and deliver actual services for street sweeping, waste collection, transport, transfer, treatment and disposal. or some combination of the above. Sometimes recycling and organic waste management are included in operations, sometimes they are considered to be separate.
- *Regulatory body or inspectorate*: is charged with monitoring and inspecting operations, applying and enforcing environmental legislation, regulation and standards, issuing site licenses, or permits, to treatment and disposal facilities and inspecting/monitoring their operations to enforce the license conditions, and by policing illegal dumping elsewhere.
- *Adjudicator or process manager:* is an independent authority for adjudicating conflicts, managing environmental impact assessment and strategic environmental impact assessment (SEIA) processes; ensuring that laws and rules about inclusivity and participation are observed; and handling complaints.

Prior to modernisation these functions tend to reside within a single municipal organisation, where they can easily lead to internal conflicts of interest. Good practice guidelines suggest that a clear division of responsibilities results in better outcomes, and that some of them should

be shifted out of waste management to other municipal organisations, even if this contradicts the principle of coherent institutional structure. For example, when a municipality decides to stop operating its collection system and contract it out to private operators, it may close its operational division, but the functions of service provider, comptroller, regulator and adjudicator still remain. This is because public cleanliness and public health are a 'public goods', and the local authority holds the responsibility for ensuring that there is an ISWM system which delivers them.

Inter-municipal Cooperation

Waste collection is usually best provided at the lowest appropriate level of municipal administration, but waste treatment and disposal may need to be organised on a unified basis across the metropolitan area as a whole. Inter-municipal cooperation is thus essential.

There is a growing trend for landfills and other waste management facilities to be regionally shared, accepting waste from multiple municipalities, the city and surrounding towns.[72]

Developing the accompanying regional cooperation and fair cost-sharing arrangements represents an ongoing challenge to city authorities.

Quiriri, Brazil[1]

In the South of Brazil inter-municipal cooperation between 4 municipalities led to the formation, in 1997, of a consortium called 'Quiriri' benefiting 125,000 inhabitants and involves shared final disposal, and institutional infrastructure for regional planning, revenue generation, budgeting, and various other aspects of solid waste management.

As a result, open dumps are being upgraded, hospital wastes are being properly treated and disposed of on an inter-municipal basis, separate waste collection has been implemented in most cities, and citizens are engaging themselves in planning and monitoring.

1. *P. Jacobi (2006).*

PPPs and 5-Ps: Public Private Partnerships and Pro-poor PPPs

Public-private partnerships in service delivery are an option for improving both cost-effectiveness and service quality and coverage.

The principle is that a formal or informal private company, motivated to produce income and support its owner and workers, has more incentive and flexibility to deliver services efficiently and cost-effectively, but needs the counterweight of a public authority to protect the public good of a clean, waste-free city. Municipal authorities, as providers, can contract out their operational responsibilities while retaining the other functions. In ISWM, sound contracting practice begins with setting operational goals, defining performance standards and specifications, and producing a document that communicates these to private, semi-private, NGO, CBO or other economic actors who would like to participate as service providers. A competitive tendering procedure is a usual, but not the only, mode for engaging private actors in operations, but all instruments have to ensure agreed-upon performance levels, enforce contract conditions and introduce sanctions for non-performance. On-time payment is another provider function, and even when the arrangement calls for the contractor to collect user fees directly from the users, the provider function has to keep the system operating. As providers, municipal authorities need to ensure that the operators provide the service, and that it meets the required standards of reliability, efficiency, customer relations and environmental protection as specified in the contract.

Successful PPP in waste management is much more than simple 'privatisation'.

Three standard conditions of competition, transparency and accountability[73] are associated with successful PPPs. A less-frequently mentioned but essential fourth condition is the presence of external controls and horizontal power relations that safeguard a balanced partnership. For PPPs in waste management to be successful, all of the four key conditions must be met.

The challenge is to find the balance between efficiency, effectiveness, and fairness – the three ISWM principles. A recent publication provides many useful examples, both good and bad, to help you to avoid the problems and build on the successes presented.[74]

ILO Micro-Franchising in Africa

The city of Dar es Salaam, Tanzania, organises waste collection via more than 55 micro, small, and community-based enterprises that tender for micro-zones, some with less than 500 households. The ILO, which pioneered this model there in the late 1990s, has been working with cities all over East Africa to replicate it.[1]

1. *Alodia Ishengoma and K. Toole (2003)*

72. See discussion in Sections 1.3 and 2.2

73. Cointreau- Levine, Sandra and Coad, Adrian (2001)
74. Adrian. Coad (2005)

In many parts of Africa, where local governments often do not have the capacity to organise waste management services themselves, a great many waste-related services are provided through some form of private-to-private financial relationship which is mediated by the local authorities. Municipalities award zones, or give micro-zone monopolies, to firms, MSEs, CBOs, or even to informal family enterprises, to collect waste, sweep streets, clean out drains and gutters, maintain parks and beaches, install office paper systems, and the like. In the so-called 'ILO-Dar es Salaam' model, each micro-contractor collects fees direct from the users, itself a difficult and expensive task, within guidelines set by the municipality. Both collection zones and provider-operators are classified as large, medium, or small. This model, increasingly referred to as Pro-Poor PPP (5Ps),[75] is receiving increasing global attention as one viable, proven variant of public-private partnerships (PPPs), which has the goal of helping small enterprises to provide services to unserved, poor communities.[76]

Safi Youth Group in Mombasa

In June 1999 a group of 22 unemployed school leavers in Mombasa, Kenya, decided to organise themselves and offer a waste collection service in their neighbourhood Mikindani that at the time was not receiving waste collection services from the municipal waste department.

The group did some very basic market research by simply knocking on families' doors and offering their services, and leaving leaflets. Out of 200 doors where they spread the leaflets, around 60 families accepted their offer. They started collecting household waste twice a week and charging a fee of Kenya shillings 200 per month.

The residents were so satisfied with the services that within three years the collection service area had expanded to over 1000 households. As of mid-2009, the Safi Youth Group is serving more than 2000 households and four companies in the area. They have expanded their services to include separate collection of PET bottles as well as street compound cleaning, car washing, and carpet and sofa cleaning.[1] School-leaver MSEs of this type are receiving increasing recognition as the dominant model for micro-privatisation in francophone West Africa, where the MSEs are called GIEs.

1. Case study provided by Alodia Ishengoma (ILO)

The four conditions go a long way to ensuring that the contracting process is transparent and free from corruption; the latter has regrettably been associated with waste management services in a number of places.[77]

Fair contracting and transparent legal and commercial arrangements are at the core of every functioning PPP, whether the private partner is a powerful multi-national corporation, or a local MSE or informal sector co-operative operating in a situation of economic weakness.

Professional competence and international networking

Municipal waste management organisations need to have the skills and resources to enable them to function properly. This requires sustained commitment to capacity building and institutional strengthening,[78] because ISWM systems are run by people, and the quality of service is determined by the professional capacity of those making the policy, plans, contracts and operational decisions.

Clearly, ISWM is not just an engineering discipline. The field of work attracts people from a range of disciplines and with a range of competencies. Solid waste planning and operations departments are populated by natural scientists, economists, planners, environmental activists, business managers, farmers, sociologists, lawyers, medical doctors, statisticians, IT specialists and political scientists. As a field of specialisation, ISWM offers a wide range of intellectual and practical challenges. Everybody knows something about waste but nobody knows everything!

Capacity development programs are a popular focus for international development assistance, and solid waste and recycling have had a certain amount of direct attention in recent years. Waste and recycling trainings are offered by UNDP PPP-SD (public-private partnerships for sustainable development), by the Cities and Climate Change Initiative (formerly the Sustainable Cities Programme of UN-HABITAT), ICLEI (the International Council for Local Environmental Initiatives), by the World Bank Institute, by many bilateral donors, and many others. The International Finance Corporation has been developing specific business trainings for the recycling supply chain in the Western Balkans and central Asia. Specific ISWM training materials are available from the organisations involved in producing this book. Many universities are now offering specific courses in waste management. In some countries, there is a legal requirement for certifi-

75. UNDP-PPPUE, (2003)
76. CWG (2003)
77. Corruption is seldom talked about. An interesting exception was an interview given by the recently appointed head of Rostekhnadzor (the Russian federal environment inspectorate), Mr Nikolay Kutjin, with the Komsomolskaya Pravda newspaper on 20 July 2009. He stated that the bribes taken by his staff could well reach 3 billion USD per annum. www.mnr.gov.ru/
78. METAP (undated). Provides guidelines, tools and training materials, covering a wide range of aspects of an ISWM system

cation and accreditation of the competence of operating personnel at all levels of delivering waste management services.[79] Such initiatives work to underpin the development of the sector through training, skills transfer, and strengthening of professional competence and critical thinking.

Networking, conferences, and informal peer exchanges are also critical to strengthening the human resources in the solid waste and recycling sector, especially as processes of modernisation and globalisation increase the benefit of exchange between and among cities of all kinds and sizes, and other stakeholders.

Many cities have benefitted from establishing and maintaining networks or platforms at the regional, national and/or international level. There are networks, such as UCLG, United Cities and Local Governments (until 2008, the International Union of Local Authorities, IULA), City Net Asia and others, of which many cities may already be members, which are excellent platforms for exchanges and sources of new information, insights, and inspiration on waste management. Some networks are specific to solid waste management, such as the Association of Cities and Regions for Recycling and Sustainable Resource Management (ACR+)[80] in Europe, the National Recycling Coalition in the US, ReCaribe in the Caribbean, and 3Rs Knowledge Hub in Asia.[81] One global platform, the Collaborative Working Group on Solid Waste Management in Low- and Middle-income Countries (the CWG), deserves mention for its bi-annual workshops and capacity materials that support of global networking related to facilitating co-operation between cities and their informal recyclers, informal service providers, and micro and small enterprises in waste and recycling. The growing interdependence of cities in solid waste management is beneficial at the country level and at the regional and international levels.

Networking is also a form of capacity building. Good practices and lessons learned have more impact and memory recall when shared directly between one Mayor and another through networking.

79. See for example the UK Waste Management Industry Training & Advisory Board (WAMITAB): www.wamitab.org.uk/

80. www.acrplus.org/index.asp?page=280

81. www.3rkh.net (cited in Section 2.3)

4 Conclusions

Solid waste management is an important and difficult challenge facing the world's cities today. It can become a public health or environmental 'crisis' if it is neglected. Good solutions and strategies are available, but they will not be the same for all cities. There are no easy blueprints, and within each city, competent local authorities have to do their own homework if they want a clean city with a strong ISWM system.

If you take just one message from this book, it should be that there are no perfect solutions, but also no absolute failures. The specific technical and economic approaches that work in Denmark or Canada may not work in your country. Searching for the perfect solution can delay improvements when they are desperately needed. Much like in most other human endeavours, also in waste management 'the best is the enemy of the good.' Similarly, unsuccessful experiences reveal a potential and point a direction for improvement.

As a city official, we invite you to really understand your city waste issues, to identify and name problems, and to take the next critical steps – together with a range of stakeholders – to find solutions that are appropriate to your specific local situation, to move from where you are to where you want to be.

If you are at a relatively early stage of the 'journey' of modernising your solid waste management system, then it is important to identify simple, appropriate and affordable solutions that can be implemented progressively, giving your constituents the best system they can afford.

Early steps are likely to include extending collection to the whole city and phasing out open dumps.

But that is not enough: an ISWM approach is likely to come at the problem from three directions at the same time:

- from the 'bottom', to get onto the hierarchy in the first place by phasing out open dumps;
- from the 'middle' ensuring that wastes are increasingly diverted from disposal to recycling and composting; and
- from the 'top', to address prevent waste, to reduce disposal at source, to bring waste growth under control, so that you can progress, rather than 'running as hard as you can to stand still'.

Recycling and reuse are an integral part of a modern, integrated and sustainable waste – or rather waste and resources – management system. Recent work has shown just how much of a contribution the existing informal sector makes to recycling and waste management in developing and transitional country cities, saving perhaps 15-20% of what would otherwise be spent by the city, as well as providing livelihoods for thousands of families. So our key messages include: build on what you already have, work with the informal sector, and work with both the informal sector and the domestic and commercial system users to encourage and expand segregation at source and separate collection of waste materials for recovery purposes.

There is only one sure winning strategy, and that is to understand and build upon the strengths of your own city – to identify, capitalise on, nurture, and improve the indigenous processes that are already working well. We hope that this book will inspire you to be both creative and critical: to design your own models, to pick and mix, adopt and adapt the elements and components and strategies that work in your particular circumstances.

You and your citizens and stakeholders deserve the best system for your circumstances, and nothing less. If this book can contribute to that, we will have done our work well.

Informal metal waste collector. © UN-HABITAT, ACEPESA

Annex 1
Glossary of terms

There are many different terms in use for different parts of the solid waste and recycling systems. The terms in this glossary are the ones that the project team has agreed to use. Many of the working definitions are those of the project team – where they are taken form elsewhere, an explicit reference is given at the end of the table. Wherever possible the definitions are drawn from standard English-language use in the UK and in the US.

Term; *Other Terms or Abbreviations Used; Working Definition*

Annex 1 countries; *Industrialised nations, OECD countries*; These are the industrialised countries that have carbon reduction targets to reach under the Kyoto Protocol

Avoided cost of disposal; *Diversion credit*; The amount that would have been paid per kilo for disposing of materials in a controlled or sanitary landfill and paying the official tipping fee

Beneficiation; *Processing, pre-processing*; Preparation of recovered materials for transport, marketing and recycling

Biogas; *Methane, wood gas*; Typically refers to a gas produced by the biological breakdown of organic matter in the absence of oxygen. Biogas originates from biogenic material and is a type of biofuel

Biosolid; *Human excreta, waste water treatment facility solids, animal wastes, agricultural wastes*; Plant and animal wastes that have value as a soil amendment with fertilizer value that can be used as an input into agriculture, horticulture and silvaculture [1]

Broker; *Stockist, dealer*; A trader in one or more types or grades of recyclables who trades without ever being the physical owner of the materials, usually having no storage place

Capital cost; *Investment cost, capital, purchase cost*; The amount it costs to purchase new equipment, facilities, space, buildings, etc

Capture rate; *Separation rate*; A percent relationship between the amount of recoverable materials that are directed to processes of recycling or composting and the total amount collected

Certified Emission Reduction (CER); ; Climate credits (or carbon credits) issued by the Clean Development Mechanism (CDM) Executive Board for emission reductions achieved by CDM projects and verified by a third party (DOE) under the rules of the Kyoto Protocol

CBO; *Community-based organisation, grassroots organisation*; A private group organised to provide a recycling, composting, community clean-up, environmental management, or solid waste function or service in a community, often fully or partially staffed by volunteers

Clean Development Mechanism (CDM); *Kyoto project financing*; An international institutional mechanism that allows industrialized countries that have targets under the Kyoto Protocol to invest in emission reductions in non-Kyoto countries and count those reductions towards their own legal commitments. A CDM project is issued with Certified Emission Reductions, which may then be traded

Commingled materials; *Mixed, multi-material, co-collected material, combined streams, single-stream collection*; Specific mixing of recoverable materials for purposes of efficient collection. The combination is designed for post-collection separating or sorting. Commingled materials do not include mixed waste

Commercial waste; *Business waste, shop waste, small quantity generator waste*; Waste that comes from shops, services, and other generators that are neither residential nor industrial. Sometimes includes institutional or public sector waste

Communal container; *Container, skip, dumpster, box*; A vessel to contain waste, usually larger than 1 m^3 and used for more than one household

Community; *Barrio, barangay, district*; A physical or social subdivision of or within a city, it may be as small as a group of neighbours or as large as a formal sub-municipal division which may or may not have its own governance functions

Composition; *Characterisation, Physical composition*; Quantitative description of the materials that are found withn a particular waste stream, in the form of in a list of materials and their absolute quantities per day or per year, or as percent of total materials

Composting; *Treatment, organic waste management*; The decomposition of materials from living organisms under controlled conditions and in the presence of oxygen

Construction & demolition waste; *Debris, C&D, Rubble, contractor waste*; Waste from the process of construction, demolition, or repair of houses, commercial buildings, roads, bridges, etc. Generally divided into commercial construction waste from construction companies, and do-it-yourself (DIY) waste from homeowners making their own repairs

Controlled waste disposal site; *Controlled dumpsite, upgraded dumpsite*; An engineered method of disposing of solid wastes on land, in which, at a minimum, there is perimeter fencing, gate control, and the waste is covered every day. Some form of reporting is usual, often in the form of a weighbridge (scalehouse), and some form of tipping fee is usually charged. A controlled waste disposal site differs from a sanitary landfill in that is not sealed from below and does not have leachate collection system.

Co-operative; *Co-op, buyers association, sellers association, MSE, CBO*; An enterprise organised as a co-operative with multiple owners who participate in the activities. In some Latin American countries, co-operatives have a special tax status and so are a favoured form for establishing a business [2]

Coverage; *percent service availability*; The percent of the total (household and commercial) waste generating points that have regular waste collection or removal

Depot; *Deposit, drop-off, community collection point, community container*; A place where individuals can bring their own waste or recyclables, varying from a single container, to a recycling centre, a reverse vending machine, or a special site or facility designed to receive waste materials, kitchen, food and yard waste, demolition debris, and/or separated recyclables directly from the generator.

Dumpsite; *Dump, open dump, uncontrolled waste disposal site*; A designated or undesignated site where any kinds of wastes are deposited on land, or burned, or buried, without supervision ad without precautions regarding human health or environment

Disposal-illegal; *Dumping, wild dumping, littering*; Disposal of waste at a site different from one officially designated by the municipal authorities, especially where it is specifically prohibited. May also refer to disposal at the wrong time or in the wrong quantities, even if all other aspects are correct

Disposal-legal; ; Disposal of waste at a site designated by the municipal authorities

Dump picker; *Scavenger, waste picker*; Woman, man, child or family who extracts recyclable materials from disposal sites [3]

Effectiveness; *reach, performance*; The extent to which the solid waste or recycling system meets its goals and does what it claims to do, the cleanliness of the city

Efficiency; *Collection efficiency*; One or more measures of the performance of the collection system, usually expressed as households/vehicle/day or tonnes/litre of fuel used or distance travelled/litre of fuel

Emission Reduction Unit (ERU); Climate credits (or carbon credits) issued by the countries participating in Joint Implementation projects, or the Joint Implementation Supervisory Committee, emission reductions achieved by JI projects and verified by a third party (Accredited Independent Entity AIE) under the rules of the Kyoto Protocol

Ferrous metals; *Iron, steel, magnetic metals*; Metals which contain iron and which react to a magnet and are subject to rusting [4]

Formal sector; *Official, government, municipal*; Encompasses all activities whose income is reported to the government and that are included within a country's gross national product, such activities are normally taxed and follow requisite rules and regulations in regards to monitoring and reporting [5]

Formal waste sector; *Solid waste system, solid waste authorities, government, materials recovery facility*; Solid waste management activities planned, sponsored, financed, carried out or , regulated and/or recognised by the formal local authorities or their agents, usually through contracts, licenses or concessions

Full cost accounting (FCA); *Total cost analysis, true cost accounting*; Is a systematic approach for identifying, summing, and reporting the actual costs of solid waste management. It takes into account past and future outlays, overhead (oversight and support services) costs, and operating costs. FCA attempts to quantify environmental and social external costs [1]

Generator; *Waste producer, household, business, user*; The source of the waste, that is, the first point it is discarded as a useful object and is redefined by its owner as waste

Hazardous wastes; *Toxic wastes*; Is a material that poses substantial or potential threats to public health or the environment and generally exhibits one or more of these characteristics [6]:

- Ignitable (i.e., flammable)
- Oxidant
- Corrosive
- Radioactive
- Explosive
- Toxic
- Carcinogenic
- Disease vector

High -income Countries; *OECD countries, developed countries, the North*; Countries with a Gross National Income per capita of $11,905 or higher,[7] or which are located in Europe, North America, Oceania,

Household container; *Set-out container, garbage can, waste can, waste bin, dustbin, bin*; The vessel used by a house-

hold or commercial generator to store and set out the waste materials, commonly made of metal, plastic, rubber, wood, or a basket

Household waste; *Municipal solid waste, domestic waste, msw, non-dangerous waste*; Discarded materials from households which are generated in the normal process of living and dying

Incineration; *Burning, combustion*; Controlled process by which solid, liquid or gaseous combustible wastes are burned and changed into gases [4]

Informal sector; *Waste pickers, rag pickers, scavengers, junkshops, street vendors, bicycle taxis, etc*; Individuals or businesses whose economic activities are not accounted in a country's gross national product (GNP), such activities are not taxed, exchange of goods or services is on a cash basis, and the activities are not monitored by the government and often the activities operate in violation of or in competition with formal authorities [8,5]

Informal waste sector; *Waste pickers, scavengers, junkshops*; Individuals or enterprises who are involved in waste activities but are not sponsored, financed, recognised or allowed by the formal solid waste authorities, or who operate in violation of or in competition with formal authorities

Integrated Sustainable Waste Management (ISWM); *ISWM is a systems approach to waste management which recognizes three important dimensions of waste management: stakeholders, waste system elements and aspects* [9]

Itinerant waste buyer, itinerant waste collector; *IWB, IWC, house-to-house collector*; Woman, man, child, family or enterprise that purchases or barters source separated waste materials from households, shops or institutions, usually focusing on one specific material or type of materials [3]. In the case of an IWC, there is no payment for the goods.

Joint Implementation; *Kyoto project financing,* ; The CDM allows industrialized countries that have targets under the Kyoto Protocol to make emission reductions Annex 1 Kyoto countries and count those reductions towards their own legal commitments. A JI project is issued with Emission Reduction Units, which may then be traded.

Landfill; *Engineered landfill, engineered waste disposal facility*; "The engineered deposit of waste onto and into land"…[10]

Low-income Countries; *Developing countries, non-OECD countries, poor countries*; Countries with a Gross National Income per capita of $975 or less [7]

Middle-income Countries ; *medium-income countries, emerging economies*; Countries with a Gross National Income per capita from $976 to $11,905 [7]

MRF (Materials Recovery Facility; *Materials recovery facility, IPC, IPF, intermediate processing centre/facility, recycling processing centre*; An industrial facility of moderate scale that is designed for post-collection sorting, processing, and packing of recyclable and compostable materials. It is usually of moderate technical complexity with a combination of automated and hand-sorting. The inputs are usually commingled or mixed recyclables and not mixed waste. The outputs are industrial grade materials, usually crushed or baled and separated by type, colour, etc.

MSE; *Micro and small enterprise. Micro-enterprise, junkshop, small recycler,* ; The smallest businesses, smaller than SMEs, usually having less than 10 workers [11]

Municipal Solid Waste (MSW); *household waste, domestic waste*; Wastes generated by households, and wastes of a similar nature generated by commercial and industrial premises, by institutions such as schools, hospitals, care homes and prisons, and from public spaces such as streets, bus stops, parks and gardens

Municipality; *Local government, local authority, mayor's house, city hall, city council, mayoralty, city, town, village*; A unit of local government with its own level of governance, responsibility, and representation, combining elected and appointed officials

OECD; *Organisation for Economic Co-operation and Development*; OECD is an international organisation of 30 countries that accept the principles of representative democracy and free-market economy. Most OECD members are high-income economies with a high human development index and are regarded as developed countries [12]

O&M cost; *Operating and maintenance cost, operating cost*; Costs associated with ongoing operations, such as energy, supplies, labour, rents, etc.

Opportunity cost; The imputed or estimated loss associated with making a choice for option a and not choosing option b

Organic waste; *Bio-waste, green waste, wet waste, organics, food waste, putrescibles, compostables*; The decomposable fraction of domestic and commercial wastes, includes kitchen and garden wastes, sometimes includes animal products

Organised reuse; *Repair, reuse, product recycling*; A commercial or livelihood activity focused on extraction, repair, and sale of specific items in the waste stream. Example: the recovery of up to 20 different types of glass bottles in the Philippines

Pig slops; *Swill, food waste, swine feed, organic waste*; Food

wastes collected from restaurants, hotels, markets etc, and from households, which are either sold or used as food for pigs or other livestock

Pre-processing; *Sorting, screening, sieving, compaction, densification, size reduction, washing, drying*; Preparing recoverable materials from the waste stream to be used for subsequent processing without adding significant value to them [3]

Primary collection; *Pre-collection, house-to-house collection*; Organised collection of domestic waste from households, taken to a small transfer station or transferred to a truck or container

Processing; *Beneficiation, upgrading*; Manual or mechanical operations to preserve or re-introduce value-added into materials. Usually involves densification, size reduction, sorting, and packaging or transport

Recovery rate; *Rate of recycling, percentage recycled, diversion rate*; A percent relationship between the amount of recoverable materials that reach recycling, composting or energy recovery and the total amount generated

Recyclables; *Recoverables, materials to be valorised*; Materials contained in municipal solid waste which have an intrinsic value to the industrial value chain as represented by a price

Recycler; *Scavenger, waste picker, MRF, junkshop*; Entrepreneur involved in recycling

Recycling; ; Extraction, processing and transformation of waste materials and their transfer to the industrial value chain, where they are used for new manufacturing. In some definitions, recycling is only considered to have occurred when materials have been sold [4]

Recycling or composting market; *End-user industry, buyer, dealer, broker*; Business, individual, organisation or enterprise that is prepared to accept and pay for materials recovered from the waste stream on a regular or structural basis, even when there is no payment made

Residual waste; *Rest-waste, rest-fraction, residue, rejects*; The discarded materials remaining in the waste stream or on the sorting line because they are not recyclable or compostable because they are perceived to have little or no monetary value [3]

Resource recovery; *Energy recovery, materials recovery*; Process of extraction of economically usable materials or energy from wastes. May involve recycling. In English-speaking countries, the term is usually restricted to recovery of energy [4]

Reuse; *Second hand use*; Use of waste materials or discarded products in the same form without significant transformation may include a system developed to repair/refurbish items [3]

Sample; *Sub-set*; A representative part of a whole that allows conclusions to be made about the whole by investigating only a small part

Sanitary landfill; *Landfill, state-of-the-art landfill*; An engineered method of disposing of solid wastes on land in a manner that protects human health and the environment. The waste is compacted and covered every day. The landfill is sealed from below and leachate and gas are collected, and there is gate control and a weigh-bridge

Sanitation; *Waste water management, urban environment, urban cleansing*; In the "French sense" used to refer to urban environmental activities including waste water and solid waste management

Secondary collection; *Transfer, small transfer station*; The movement of wastes collected from households from their first dumping point to processing, larger-scale transfer or final disposal

Separate collection; *Segregated collection, collection of recyclables, organics collection, selective collection*; Collection of specific types of materials at a designated time, in a different container or vehicle, or in another way so as to maintain the separation potential and maximise the recovery

Shadow price; *Proxy price, hedonic price, contingent valuation*; A reasonable estimate for the value of something based on extrapolating the price for something similar

Single stream; *Unsorted material, commingled, blue bag*; System in which some combination of all recyclable materials (for example paper fibres and containers) are mixed together in a collection truck, instead of being sorted into separate commodities (newspaper, cardboard, plastic, glass, etc.) by the user and handled separately throughout the collection process. In single stream, both the collection and processing systems must be designed to handle this fully commingled mixture of recyclables [13]

SME; *Small and medium-sized business, small business*; Businesses usually having between 11 and 50 employees or workers

Solid waste; *Garbage, trash, waste, rubbish*; Materials that are discarded or rejected when their owner considers them to be spent, useless, worthless, or in excess [4]

Sorting; *Classification, high-grading, selection*; Separating mixed materials into single-material components, mechanically or manually, either at the source or after the collection process. In some cases classifying a mixed single-material stream into specific grades or types of that material

Source; *Generator, origin, waste service user*; The point at

which a material is defined as waste and discarded, usually either a house or a business

Source separation; *Separation at source, segregation at source*; Actions taken to keep and store certain materials separately from commingled (mixed) waste at the point of generation

Stakeholder; *Interested party, constituent, concerned citizen, affected party*; Individual or institution (public and private) interested and involved in related processes and activities associated with a modernisation process, plan, project goal, or desired change [14]

Street cleaner; *Street sweeper*; Formal or semi-formal worker assigned by the city authority to remove litter from streets, that can not be attributed to any specific waste generator

Street picker; *Street scavenger, waste picker*; Woman, man, child or family who removes recyclable materials from communal containers, streets and public places [3]

Tipping fee; *Gate fee, disposal fee*; The amount that is charged for disposing of waste at a facility, usually per ton, per cubic metre, or per vehicle

Transfer; *Transit, collection point, depot*; The movement of wastes from their first point of discharge to final disposal; it usually includes some very basic processing: compaction, pre-sorting or size reduction

Transfer station; *Transit point*; A place where waste from collection vehicles is aggregated and organised, before being transported to disposal sites or treatment facilities [10]

Treatment; *Decontamination, processing, incineration, anaerobic digestion, biogas production, pyrolysis, composting*; Labour based or mechanical methods to reduce the risk of exposure or reduce the impacts to the environment of toxic or hazardous materials associated with the waste stream and in some cases, can concurrently capture and increase the economic value of specific waste stream components value added

Valorisation; *Recycling, recovery, conserving economic value* ; The entire process of extracting, storing, collecting, or processing materials from the waste stream in order to extract and divert value and direct the material to a value added stream

Waste dealer; *Junkshop owner, scrap trader, consolidator, owner of a godown, waste buyer* ; Individual or business purchasing quantified (weighed or measured) materials for recycling or composting, storing them, upgrading or processing them, and then reselling them into the recycling value chain. A dealer usually has their own premises and some form of dedicated storage place

Waste generator; *Households, institutional, commercial wastes*; The agent or point via which a purchased, collected, or grown product is discarded [15]

Waste pickers; *Scavenger, rag picker*; Person or family who salvages recyclable materials from streets, public places or disposal sites [3]

Waste prevention; *Waste avoidance, waste minimization, precyling*; Strategies or activities undertaken by individuals, businesses or institutions to reduce the volume and toxicity of material discarded [16]

1. *Adapted from Simpson, Tellus Institute (1992)*
2. *Adapted from Rivas, Price and Lardinois (1998)*
3. *Adapted from Koeberlin, (2003)*
4. *Adapted from Tchobanoglous et al., 1993*
5. *Adapted from the International Labour Organization definition, adopted by the 15th International Conference of Labour Statisticians, January 1993*
6. *Resource Conservation and Recovery Act (USA 1976)*
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11. *Adapted from Arroyo, Rivas and Lardinois (1998)*
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Annex 3 City Profiles

Annex 3.1
Short Presentation of the Solid Waste Profile of Moshi, Tanzania

Moshi is the tourist, commercial and administrative centre of Kilimanjaro Region in Northern Tanzania. It is located on the southern slopes of Mt. Kilimanjaro, between 950 and 700 meters above sea level, with an area of 58sq km. Moshi municipality has grown from a small urban area of 8,048 residents in 1948 to a population of 144,000 in 2002 census, with an annual growth rate of 2.8%. Accordingly, the population is projected to exceed 190,000 in 2009. In addition, Moshi receives estimated 70,000 day residents who come and go back daily[1] from the surrounding settlements of Mwika, Marangu, Machame, Kibosho, Uru and Old Moshi, making the current populations estimates to reach more than 260,000.

What is municipal solid waste?

Household and commercial waste is characterised by high organic and moisture content. In addition, waste consists of paper, plastic, glass, bones, textile and inert material.

Waste generation is roughly estimated at 220 tonnes/day, from different sources as follows:

- Households 120 tons,
- Commercial including markets 37 tons,
- Institutions 10 tons,
- Industries 50 tons, and
- Hospitals 3 tons.

Waste generation rates range from 0.5 to 1 kg/capita/day in low-income and high-income areas respectively. Waste composition was measured in 1996-97 and in 2002. This information is based on estimates and is not included here.

Development Drivers in for solid waste in this city

Driver 1: the resource value of the waste.

As traditionally is the case, in Moshi organic waste is captured from the solid waste stream and directed to the agricultural value chain. Most is fed to animals or directly spread on land without being composted.

Recycling is done by an unknown number of street waste pickers and some 15 pickers who are active at the dumpsite. These numbers of informal recyclers are not atypical in the East African context, where markets for recyclables are weak and distant, and the waste itself is not very "rich".

Driver 2: public health.

As early as the 1950s, solid waste management in Moshi was a mandatory service for residents, which is designed to protect public health. Accordingly, in 1956, the government of Tanzannia enacted a law requiring every householder to provide a sanitary standard dustbin for their household. All the activities – street sweeping, waste collection, transportation and dumping – were financed by the central government.

Driver 3: environment.

Moshi was included in the Sustainable Cities Programme (1992 – 2006), where it received 2 skip loaders, 30 – 40 skip bucket containers (3m3) and a wheel loader/compactor. (Unfortunately, only one skip loader is still working at 50% capacity.) Also, a stakeholder forum has been established in the same programme.

State of 'Modernisation' in SWM

Moshi is in an early stage of modernisation where much of the emphasis is still on public health and environment, and not much emphasis is yet on resource management.

Key indicators

- Coverage percent of total households

Solid waste collection service is provided mainly to the domestic and commercial waste generators, achieving 85% coverage in the Central Business District (CBD) where 30% people live, and 50% coverage in peri-urban areas where 70% of people live. While collection for public health reasons was the focus of solid waste in the colonial period, emphasis has now shifted to improving the environmental footprint of disposal.

Recycling Rate as percent of total waste generated

Recycling rate is not measured, but the total diversion from disposal, through informal activities, is 15-20% of waste, which is about a third of the organic fraction. This is diverted at source either as animal feed or for spreading over agricultural land without composting.

Controlled disposal as percent of total disposal

Between 75 and 80% of the generated waste ends up in the controlled landfill..

1. *Day residents estimate varies with the day of the week, with less people coming on holidays.*

Waste handled in informal systems as percent of total waste handled

CBOs are trying to increase the current low coverage rate of 50% in peri-urban areas. Precise quantities of waste handled by the CBOs are unknown, although the franchising system may have some data or projections, as part of its contracting administration. There is no information on the waste and recyclables handled by the informal recycling sector which is not represented by CBOs.

Institutional structure: one or more budgets, divisions

Government Stakeholders include:

- Cleansing Section of Moshi Municipal Council
- Sustainable Moshi Programme Platform
- Vice President Office, Division of Environment
- Ministry of Health and Social Welfare
- PMORALG – Prime Minister's Office – Regional Administration and Local Government

The hypothesis that Moshi is in an early state of modernisation is supported by the relatively high number of government stakeholders at local level, as well as by the fact that it the relevant ministry at national level is the Health ministry, and not a ministry of Environment.

Diversity, variation, mixing: competing parallel structures

There is some parallelism or mixing in the system, at the level of collection, where Municipal Council activities are supplemented by the work of a private contractor and CBOs. It is not yet clear whether this means that there are real alternatives or choices for users.

Policy and Diversion Goals and Priorities

Cleanliness is a strong political goal and Moshi has won a prize for cleanest Tanzanian city.

Snapshot of Waste System

Public health – waste collection;

Waste collection services are provided by the Moshi Municipal Council, a private contractor on a pilot basis and CBOs. The private contractor provides services in 1 of 3 wards in the CBD (of 15 in total in Moshi). The MMC serves the rest of urban area and provides secondary collection in peri-urban areas where CBOs and individuals are doing primary collection. Solid waste collection service is provided in three ways, namely:

- Yard to yard collection, usually provided three times a week per location, mostly in Central Business District and planned or upper-income settlements. This service involves five refuse vehicles, four owned by council and one by a private operator, with at least four attendants each. The vehicles pass in the streets and normally stop every 10 to 20 meters, for people to handle their waste receptacles to the crew who empty them into the vehicles manually.
- Communal skip bucket containers, mostly in medium-income peri-urban areas, are placed at locations with high waste generation rates such as markets and schools. Either waste generators themselves or community based organisations, which usually consist of a minimum of 10 and a maximum of 15 members, bring the waste to the communical skip bucket container. The CBOs use simple local working tools such as shovel, rakes, pushcats, and locally made hard brooms. One skip loader is available to load the buckets and transport the waste to the disposal site.
- Earmarked collection points, where citizens bring their waste, mostly in low-income and unplanned settlements. There are three such points; waste is brought to the point by generators, and manually loaded into the truck by waste collectors.

Environment – waste disposal;

Solid waste is disposed off at the new controlled disposal site (semi-engineered landfill) located at Kaloleni, about 5 km from the town centre. It covers an area of about 4.5 hectares. It was constructed under the urban sector rehabilitation project started in July 2005. There is some equipment available as well, namely a roller grader, tipper truck and compactor roller. Spreading and compaction is done on a weekly basis, with soil cover applied once in two months.

Healthcare wastes from big hospitals such as KCMC and Mawenzi Hospital are incinerated on site in manually operated incinerators. Wastes from smaller healthcare facilities are incinerated also in simple manually operated incinerators, at municipal healthcare centres of Majengo and Pasua.

Industrial wastes are transported by the industries themselves to the Kaloleni disposal site.

Resource management

About a third of organic waste generated is reused at source either as animal feed or spread over agricultural land (without composting). Recyclable materials such as plastic bottles, tin cans and scrap metals are reclaimed by the waste pickers at different points in the system, including the disposal site.

Snapshot of Delivery Systems

Inclusivity (involving all the stakeholders);

Moshi is a good example of stakeholder participation, concerning the municipality and citizens, as well as CBOs. Informal recycling sector is not really yet in the picture. A stakeholder platform has been active involved since 1999, which involved some donors such as DANIDA.

Financial sustainability

The business model in use in Moshi Municipality can best be decribed as hybrid consisting of both public and private arrangements for waste management. The public arrangements include funding and expenditure based on Local Authority expenditure manual: in this model funds are disbursed from Councils own sources, Government of Tanzania grants, and other public sources which are used transparently according to formally accepted plans.

But these funds are not enough, so there is a basic issue of lack of financial sustainability. Given that funds from these sources are inadequate, there is an attempt to supplement with resources from private and community partners.

The Council's Cleansing section and Legal and Security unit are responsible for enforcing the contract. Because both the public and the private waste operations work under the instructions of the municipal section responsible for cleansing, some degree of coherence is assured.

The private arrangements are through CBOs. First each CBO must make an initial requests for acceptance as a service provider. Then they are invited to enter contractual arrangements with the Council for collection, transportation and disposal of wastes in earmarked areas or serving specific collection points. The contracts covers issues ranging from quality, type of work to be done, length of contract and mode of payments.

The role of fees from individual households is not clear.

Sound institutional arrangements and good governance.

Since the time of colonial rule and early years of independence, Moshi has considered solid waste management to be a mandatory public service that is provided to the residents by the government, under its general mandate to protect public health and promote quality of the urban environment, in support of economic productivity and employment generation. As early as 1956, the government enacted a law requiring every tenant residing in the town to provide a sanitary standard dustbin for their household.

Up until the early 1980s, as long as the serviced area was small and the population in town was low financing of all the cleansing activities – street sweeping, waste collection, transportation and dumping – was provided by the central government.

In the early 1980s the country experienced economic recession, which led to a decline in support from the central government. The government declared that the councils had to involve other stakeholders in financing the solid waste management activities.

In 1990s the Moshi Council started changing the system and introducing cost-sharing in solid waste management services. At the same time, the municipal population was growing, the trend towards rural-urban migration increased, and new housing units started mushrooming on unplanned land, making it more difficult to provide the services. All this resulted to inadequate solid waste management services in the city.

This motivated Moshi to become involved in Sustainable City Programme of UN-Habitat. In collaboration with other stakeholders, the City Council held a forum in January 1999 to discuss environmental issues in the city. The working group on solid waste management recommended a strategy comprising the following elements:

- Procurement of solid waste collection equipment;
- Outsourcing of parts of solid waste management activities;
- Establishment of a system to involve stakeholders such as community groups and informal sector in service delivery;
- Better management of disposal sites.

This strategy was translated into an action plan. Most parts of this plan have been implemented, so that the following actions have occurred to date:

1. Skip buckets and skip loader have been procured; locations without skip buckets have secondary collection points where the waste is is loaded into municipal vehicles and hauled to the dumpsite
2. Part of solid waste management activities have been outsourced to a formal private operator and CBOs;
3. There is a legal basis for solid waste management. This includes:
   - Environmental Sanitation By-Laws, 1998. The by-laws included PPP issues with involvement of private sector (including recognised CBOs) as well as direct user fee payment;
   - Environmental Sanitation and Municipal fees and charges By-laws were amended in 2006, including the peri-urban area for fees to be levied as well;
4. Sensitising the community to increase their participation in solid waste management activities;

5. Establishing and operating a semi-engineered landfill that takes the waste from Moshi.
6. Making comprehensive Council Health Plans. These have been made have been made every year since 2007, on provision of working tools , wages for temporary employees, purchase of fuel and lubricants, vehicles repair, with the latest addition of capacity building for CBOs.

In the process of enforcement, some 150 fines have been issued in Mawenzi ward for street littering, and some business waste generators have been prosecuted for resistance to pay the SWM fee.

Some key benchmark numbers

	Moshi, Tanzania (data from 2002 census and other docs)
Pop/nr households	Projected to exceed 190,000 in 2009 (based on 2002 census), + estimated 70,000 day residents
Total tonnes MSW generated	Crude estimate: 220 tonnes/day
Total tonnes to informal	Not clear, but it is possible to say that CBOs manage a significant amount of waste
Total tonnes to formal	40,150 tonnes per year
Goals for coverage	100%
Percent of population/ households covered for collection*	60% of population, with a big difference between: 85% coverage in Central Business District where 30% people live, and 50% coverage in peri-urban areas, where 70% people live
Goals for safe disposal	100%
Total disposed	40,150 tonnes
In controlled disposal	40,150 tonnes = 100%
Lost or to uncontrolled disposal	At least 10% burnt, buried or illegally dumped; 3650 tonnes per year are managed at household level; this is about 8%.
Recycling or diversion goals	not established
Total valorised or diverted as percent of total generated	15-20%
Valorised by informal	All; by street picking and dump site picking; and org. waste use by waste generators)
Valorised by formal	none
To ag value chain as feed	15-20%, together with direct spreading on land
To ag value chain as compost	direct spreading on land, without composting
Reused	see ag value chain above.
Recycled	
Prevented	

** One house might have many households, and also some businesses like shops. Waste from households in an area including small and big businesses/ commercials will be mixed residential-commercial. It is, moreover, not clear how the coverage information treats polygamous families consisting of one husband with up to 4 wives in one or different houses on the same compound.*

The Good, the Bad, and the Special

Really good features

1. **Cleanliness** – Moshi has the official title of the cleanest city in Tanzania, several years in a row. The Council is committed to achieving higher levels of cleanliness and maintaining the status and the good image of the cleanest municipality in Tanzania. Also other stakeholders from the grass root to the Municipal level are involved. For example, Moshi is inhabited by the Chaga and Pare tribes, who hold cleanliness in high esteem in their culture, regardless of income.
2. **Active stakeholder participation** – Several participative strategies and action plans have been developed and have been implemented since, with stakeholders using their own resources, time and expertise. An illustrative example includes siting on the new landfill, where protest by the local residents was part of the reason why landfill was sited elsewhere (relative proximity of the airport being the other reason).

   Different forums are in use for debates and discussion regarding environmental improvement. Councilors (who represent wards) and other political leaders have forums where they discuss the level of services provided. Technical personnel such as the Council Management Team, District Health Management Team and Region Health Management Team also have forums to discuss environmental health issues. So there is always room for improvement through suggestions and criticisms. In addition to representation through Councilors from their respective wards, citizens can actually themselves attend the meetings - anyone is allowed to attend the full Council meetings.
3. **Learning by doing** – A pilot project served to initiate the relationship between the private waste contractor and the Council. This approach allowed for moderate-scale experimentation, and was an opportunity for the Council to gain the experience with PPP. As a result, the contracting possibility is now recognized in amended by-laws.

   A similar pilot project process created space for CBOs to be engaged to perform primary waste collection in unplanned settlements: to collect and transport domestic waste from households to the communal collection centre and earmarked points. This idea was

presented at ward level in different locations and when the users showed their approciation, pilot CBO collection was implemented in a few areas areas. The strategy including involving the community from the beginning – from the stage of formulating the project to the implementation.

The capacity of SWM CBOs was built in terms of equipping them with operating skills and simple tools. They have also become recognised and legally protected by By-laws. They started to deliver solid waste collection service from households to the communal collection centres and earmarked points. The work was promising as they were accepted by majority of the people.

Not so good features

1. **Lack of willingness to pay** – Even some high-income waste generators resist to pay for the services received, such as numerous cases in Mawenzi ward in Central Business District illustrate. Some argue that the fee is already included in property tax (it is not). Interestingly, women owners of waste generating businesses do pay SWM fee! Residents in peri-urban areas just don't see the point in paying for primary collection. (Whereas the fee charged of 200 TZS/week is affordable to them.)
2. **Littering and dumping** – Littering, burying, burning and illegal dumping are a common problem in peri-urban areas.

Main priorities for improvement

Financing, public awareness about the need to pay. Local gvt being intertested is not good enough, because it is for all cities or the same employees are usually transfered from one city/local gvt to another.

Special or unique features

Moshi's cleanliness is also attributed to the culture of local local ethnic groups (tribes). Moshi is inhabited by the Chaga and Pare who are among the main tribes in Tanzania. Most residents have low and middle level of income but at the same time with high interest in education, business and among tribes possessing a cleanliness culture. This tribe also feel responsible to the extent that confrontation of anyone littering is common. Most other tribes never care.

Unusual financial or institutional features

Stakeholder Platform active over a decade!

Contributions to global sound practice

- Commitment by Municipal Council and dialogue with citizens and other stakeholders;
- Learning by doing (practicing stakeholder dialogue, pilot with private contractor; initiatives to engage CBOs and recognize their status),
- Active stakeholder participation (discussion forums, stakeholder platform, involvement in decision-making).

Formal and informal waste management and recycling jobs with wage range[2]

Occupations	Number of Jobs	Wage/year Low (TZS Million)	Wage/year High (TZS Million)
Solid Waste Manager	1		7.5
Supervisor	5	2.0	6.24
Driver	8	1.2	1.8
Street Sweeper	80	1.08	2.0
Waste Collector (truck crew)	35	1.08	2.0
Equipment Operator	3	2.4	4.2
Dump Worker	4	1.08	2.0
Dumpsite Waste Pickers	15		
Street Waste Pickers	N.A.		

Business model and financing

In accordance with the action plans made, enabling legislation for private sector participation has been enacted, namely Environmental Sanitation By-Laws 2006:

Section 22 provides legislative framework governing the activities of public companies, utilities, or public-private partnerships

Section 35 and 41 provide legal protection for contractual arrangements in general, and for solid waste and related activities in specific.

Funding and expenditure are based on Local Authority expenditure manual, where funds are disbursed from Council's own resources, Government grants and other public sources and are used according to plans. The resposiblity for using and planning for this model is bestowed to the Health department and Urban Development and Environmental Management (UDEM), following directions from the Council's Cleansing section.

However, as these funds are inadequate, efforts have

2. *Moshi Municipal Council Staff inventory June 2009*

been done to supplement them with resources from private partners.

The private arrangements consist of both big and small (Community Based) groups. The groups after initial requests and acceptance, enters contractual agreement with the Council for collection, transportation and disposal of wastes in earmaked collection points/areas. The contracts cover issues such as type of work to be done, quality, length of contract and mode of payment. The Council's Cleansing section and Legal and Security unit are responsible for enforcing the contract.

Equipment	Working	Non-Working	Used to capacity (%, only working)	Age (years)
Skip buckets	10		100	3
Skip buckets	20	16	75	10
Wheel loaders		1	100	4
Roller compactor		1	100	2
Grader		1	75	15
Vehicles				
Mitsubish FVR	2	1	50	22
Isuzu tipper	1		100	2
Compactor truck	1		100	5
Skip loader	1	1	50	10

All the equipment and vehicles listed except the grader are acquired from a donor. The grader is acquired from the Council's own resources.

According to the MMC Council Plan 2009/2010, the following investments are planned:

- Procurement of Communal containers (Skip buckets) from Council own resources (Tshs. 50 Million)
- Procurement of Skip Loader truck through Government grant (Tshs 200 Million)
- Construction of composting yard (Tshs 10 Million)

The fee is paid on a monthly basis, as follows:

Category of Property	Tshs
Households and multi-family properties	1,000
Commercial, Informal/ Small	3,000
Commercial, Medium	6,250
Commercial, Large	15,000
Institutions	65,000
Industrial	65,000
Collection per trip	15,000 Tshs.

Affordability and fairness of services for low, middle, and upper income groups

There are fees associated with waste services, which are free for low-income households, and set at 0.3% of average income for middle-income houseolds and 0.1% of average income for upper-income households. Different levels of service are associated with the differential fees, which suggests transparency and accountability. It is not clear why fees are more advantageous to upper- than to middle-income households.

Type	Low income	Middle income	Upper income
Households	17,143	23,029	6,776
Typical income/ month (Euros)	60	150	500
Typical fee/ month €	Nil	€0.5	€0.5
Typical income/ month (Tshs)	120,000	300,000	1,000,000
Tshs	Nil	1,000	1,000
Fee as % of income	0%	0.3%	0.1%
Type of collection / other service	Basic	Collection collecting sites and street sweeping	Yard to yard waste cllection, street sweeping, provision of litter bins and sanitary lane cleaning

Valorisation of materials in the recycling value chain [3]

Material name at this level of the chain	Value chain level	Min. and unit	Price per unit	Specifications or conditions
Plastic bottles	Street picking, dump site picking	10 bottles	Tshs. 100 per 10	Clean
Glass bottles	Street picking, dump site picking	25kilo	Tshs. 500 per 25kg	Clean
Paper	Street picking, dump site picking	10 kilo	Tshs. 700 per 10kg	Clean

3. *MMC Survey 2009*

Annex 3.2
Short Presentation of the Solid Waste Profile of Quezon City, Philippines

The volume of waste being generated by a megacity like Quezon City is staggering. Each of Quezon City's 2.6 million people (as of 2007) generates over 0.7 kilogram of garbage everyday. That's a total of 8,667 cubic meters per day, 260,000 cubic meters per month, or over 3.12 million cubic meters of garbage a year that the City collects. A year's worth of Quezon City's garbage would cover a 256-hectare area with four feet of waste.

Yet despite this volume of waste generated, Quezon City has been able to maintain a near perfect garbage collection efficiency rate of 99% and has kept to a minimum the number of backlogs. This can be attributed to an innovative system developed by the City Government as the cell-based "Package Clean-up System" of garbage collection.

Under the new system, the contractors are paid on the basis of the computed hauling requirements of their assigned cells. A cell is an imaginary area whose waste generation is equivalent to the full capacity of one 10-wheeler dump truck or 16 cu.m. Three cell sources were identified: barangay cells for residential sources; main road cells for sources located along the main roads; and stationary cells for high refuse generating sources such as markets and schools.

The system also includes the provision of street sweepers, conduct of information and education campaigns on solid waste management, bulky waste collection, and a subsystem of garbage collection for inaccessible areas, which garbage haulers must follow.

This system allows the City Government to determine exactly how many trucks are needed each day to collect the garbage. It facilitates the coding of service areas, and provides a rational basis for scheduling collection.

All in all, the City's partnership with the garbage contractors and the community has been translated into huge savings for the city. In 2001, before the system was implemented, the City was shelling out no less than PhP70 million per month on garbage collection. Now, the City is only spending around PhP 47 million per month as a result of the package clean-up system.

What is municipal solid waste?

Table A3.2.1. MSW composition in the city

Component	Residential	Commercial	Combined
Paper	13.33%	20.65%	17.00%
Cardboard/ Paper Bags	5.15%	6.79%	6.09%
Newspaper	1.14%	0.83%	0.92%
Office Paper	0.17%	2.52%	1.38%
Mixed Paper	6.86%	10.51%	8.72%
Glass	3.90%	2.64%	3.00%
Bottles	2.83%	1.87%	2.23%
Other/ Composite	1.06%	0.77%	0.88%
Metals	3.93%	2.86%	3.24%
Tin/Steel Cans	3.15%	2.34%	2.65%
Other Ferrous	0.57%	0.23%	0.36%
Aluminum Cans	0.21%	0.28%	0.23%
Plastic	15.17%	16.70%	16.00%
Pet	1.04%	2.56%	1.87%
Hdpe	2.00%	1.34%	1.61%
Film Plastic/LDPE	12.13%	12.81%	12.45%
Diapers/Cigarette Butt	6.70%	3.17%	4.55%
Other Composite	0.61%	1.12%	0.88%
Other Organic	50.85%	46.56%	48.00%
Kitchen/Food Waste	37.17%	38.63%	39.19%
Yard/Landscape	9.80%	3.64%	6.00%
Wood	1.18%	1.50%	1.41%
Textiles	2.70%	2.80%	2.88%
Leather	0.47%	0.30%	0.36%
Rubber	0.38%	0.32%	0.33%
Animal Remains	0.08%	0.56%	0.43%
Other/ Composite	1.03%	0.76%	0.88%
Fines	0.65%	0.63%	0.62%
Other Inorganic	2.47%	2.27%	2.29%
Rock/Concrete/ Brick	0.50%	0.64%	0.56%
Ceramic/Stone	0.94%	0.47%	0.66%
Ash/Charcoal	0.04%	0.08%	0.07%
Other/ Composite	0.03%	0.08%	0.07%
Fines	0.95%	0.99%	0.95%
Hazardous	0.34%	0.79%	0.59%
Paint	0.08%	0.58%	0.36%
Small Batteries	0.09%	0.10%	0.10%
Other/ Composite	0.17%	0.11%	0.13%
Special	0.08%	0.34%	0.20%
Medical Waste	0.00%	0.20%	0.10%
Electronic Appliances	0.08%	0.14%	0.10%
Total Residual	13.05%	10.26%	13.00%
Total	100%	100%	100.00%

How much municipal solid waste?

Per capita generation in 2008 – 0.73 kgs/day.

Development Drivers in for solid waste in this city

The main development driver is Republic Act 9003, which specifies coverage and recycling goals. The drivers behind this law, a key instrument of modernisation, were public health and environment.

State of 'Modernisation' in SWM

Quezon City is in an intermediate to advanced state of modernisation: the emphasis of its laws are on reducing landfilled waste, which suggests that the public health focus on collection and the environmental focus on safe disposal have already been addressed, shifting the policy focus to resource management.

Key indicators

- Coverage percent of total households: is close to 100%, not considering waste treated at source.
- Recovery Rate as percent of total waste generated is 39.12%*
- Controlled disposal as percent of total disposal: 100%
- Waste handled in informal systems as percent of total waste handled, is 31.23%*.

Institutional structure: one or more budgets, divisions

All nodes of the formal waste management structure come together under the Environmental Protection and Waste Management Department, indicating a high degree of organisational and institutional consolidation and confirming the fact that modernisation is rather advanced. Main subdivisions are garbage collection, monitoring, inspection and enforcement, special cleaning, pollution control, plans and programs development, administrative, and Payatas operations (final diposal). The fact that

Diversity, variation, mixing: competing parallel structures

The situation in Quezon city represents a clear modernised mixture: under operations, there are public sector environmental services and private haulers. In recycling processing, there are both formal and informal actors, MRFs and junk shops, and even a process for formalising junk shops and standardising them.

Policy and Diversion Goals and Priorities

The 2008 City Report for Quezon City lists 20 different laws or amendments related to solid waste management. The priorities appear to be related to the mandated 25% diversion goal, designed to remove at least 25% of waste from disposal, with a focus on enabling recycling and composting activities to achieve a (?)

Snapshot of Waste System

Public health – waste collection;

Waste collection is organised in an innovative cell system, where the sub-districts are designed to optimise the economy of scale for collection and transport.

Environment – waste disposal

Quezon City uses the Payatas Controlled Disposal Facility, which is physically within its borders. Payatas represents a medium level of controlled disposal, but cannot technically be called a state of the art landfill.

According to the Process Flow Diagram, 100% of households are covered, and close to 100% of all waste reaches the disposal facility, although after that a significant amount is removed to valorisation by dump pickers.

Resource management.

Recycling and composting are strong drivers of the whole system, which also has a focus on reserving physical space for recycling and composting facilities. Quezon City's "Junkshop Standardization Programme" is a successful and highly effective instrument for bringing informal and semi-formal recycling businesses into the city waste structure. With its reported 37.78% diversion, Quezon city is already exceeding its 2008 goal of 33% diversion from disposal.

Snapshot of Delivery Systems

Inclusivity (involving all the stakeholders);

Republic Act 9003 calls for each village (Barangay, or local political unit) to create its own Solid Waste Management Committee, to supervise management of waste in the city. As of May 2009, 86% of barangays had done this. The city gets a very high satisfaction rating from its citizens in relation to waste removal and other services.

Financial sustainability

This is difficult to assess, as the city has made a primary commitment to cleanliness, service, and protection of public health, within the framework of providing a free service.

Sound institutional arrangements and good governance.

Republic Law 9003 provides a strong basis for institutional development, including feedback mechanisms for users.

Some key benchmark numbers

	Quezon City, Philippines
Pop/nr households	2,767,511 (CPDO Projection for 2008 based on 2007 Census)
Total tonnes MSW generated	736,083
Total tonnes to informal	250,455*
Total tonnes to formal	476,407*
Goals for coverage	100%
Percent of pop/ households covered for collection	99%
Goals for safe disposal	
Total disposed	438,889*
In controlled disposal	438,889*
Lost or to uncontrolled disposal	9,221*
Recycling or diversion goals	33%
Total valorised or diverted as percent of total generated	39.12%*
Valorised by informal	229,842*
Valorised by formal	58,130*
To ag value chain as feed	13,343*
To ag value chain as compost	5,185*
Reused	
Recycled	272,066*
Prevented	

The Good, the Bad, and the Special

Really good features

In the study conducted by the Center for Health Development of the Department of Health in 2007, Quezon City received the highest satisfaction rate of about 104% from its residents in terms of garbage collection and services rendered. The above-perfect rating may be due to the subsystem of garbage collection for inaccessible areas, mostly in depressed areas.

This goes to show how much commitment the City has placed in delivering free garbage collection services to its residents. As of 2006, there are 239 identified inaccessible areas in the City, 88% of which are now serviced by push-carts and pedicabs – all integrated under the "Package Clean-Up System."

Not so good features

There are still improvements to be made at the Payatas dumpsite.

Main priorities for improvement

The main priorities for improvement are the dumpsite. Much improvement was done in the period following the slide at Payatas on July 10, 2000. One of the innovations undertaken by the City was the improvement of the living conditions of the wastepickers or scavengers. More than 2000 scavengers at the dumpsite were organized into 11 groups to implement a more peaceful, orderly and equitable system in their waste picking activities. Each group is assigned an area in the dumping table and incoming garbage trucks are consecutively assigned to these groups. This system not only stopped in-fighting among the scavengers, but more importantly, facilitated a more efficient recovery of recyclable wastes at the disposal facility.

More than 500 families living along danger zones adjacent to the disposal facility have voluntarily relocated either to a permanent relocation site or staging area, through the Balik Probinsiya (Back to the Province) and Lipat Bahay (Change of Residence) programs. These families were assisted in voluntary relocation and in the dismantling of their shanties and were extended the necessary financial assistance through the auspices of the private contractor, IPM Environmental Services, Inc.

Special or unique features

In its drive to build up to clean the environment, the City believes that nothing should be spared from its standard of cleanliness, not even the junkshops whose very livelihood depends on handling waste. In fact, the City believes that the requirements on cleanliness should be more stringent on this sector because they are the sorting and storage places of wastes. The operations of these junkshops should be regulated in accordance to existing environmental laws and regulations thru proper accreditation procedures.

It was in this context that the Junkshop Standardisation Program was conceptualized and enacted as City Ordinance No. SP-1711, S2006 – An ordinance regulating the operation of junkshops in Quezon City and imposing penalty for violation thereof and for other purposes. Shortly after, in 2007, its implementing rules and regulations (IRR) was ratified.

Among the objectives of the program are the following:

- To enjoin the active participation of Junkshop Operators to the City's Waste Reduction Program;

- To organize and standardize the activities of these junkshops in accordance to existing policies and provisions of the law;
- To regulate the operations of junkshops in accordance to existing environmental laws and regulations thru proper accreditation procedures; and
- To establish a data base on the actual number of junkshops operating in the City as well as their waste diversion thru a uniformed and systematic recording of wastes that go to them.

As a result of this program, the City was able to conduct a survey of existing junkshops in the city whether legal or illegal, thus developing a directory of junkshops. By the end of 2008, the City was able to identify all 740 junkshops in the city and their respective waste diversion contribution.

The project also reinforces the junkshop sector as a legal business entity and facilitates junkshop owners' access to incentives under the Barangay Micro Business Enterprises Act of 2000 and City Ordinance No. 1576, S-2005.

Source: The Junkshop Standardization Program: A Collaborative Effort Between Junkshops and the City Towards Waste Reduction, December 2005; Quezon City's Environmental Protection and Waste Management Department Accomplishment Report, 2008; and City Ordinance SP 1711, S 2006, An Ordinance Regulating the Operation of Junkshops in Quezon City and Imposing Penalty for Violation Thereof and For Other Purposes

Unusual financial or institutional features

The City was also able to continuously monitor and record the recyclable materials recovered by the junkshops which can be attributed to the City's total waste diversion. For instance, from the waste diversion of 333,615.42 kilograms per day or 20.32% of the City's total waste generation as of August 2005, the City's waste diversion as of December 2008 increased to 668,092.88 kilograms per day or 37.78%. This includes the waste diversion of 740 junkshops operating in the City. The junkshops are also required to comply with the standardization requirements such as securing business permits, clearances, and other environmental requisites provided by law.

Contributions to global sound practice

Encouraged by the Payatas Operations Group to form a cooperative that would look out for their welfare, the scavengers were able to establish and register the Payatas Alliance Recycling Exchange (PARE) Multi-purpose Cooperative to obtain collectively financial assistance, education and skills training.

In addition, in coordination with various city government departments and agencies such as the Sikap Buhay Entrepreneurship and Cooperative Office, Public Employment Services Office, Social Services Development Department and the Scholarship and Youth Development Program, local NGOs, public and private business and educational institutions, the wastepickers have availed of financing and skills training that allowed them to go into minor business ventures and prepare for alternative livelihood.

* Based on 2009 Process Flow Diagram

This publication is the third in the UN-Habitat's "State of the World Cities" series. Its purpose is to capture the world's current waste management trends and to draw attention to the importance of waste management especially regarding its role in reaching the UN Millennium Development Goals. The language and content of the book are designed to prompt policy makers worldwide to do something for waste management modernisation or change waste management policy for the better.

Most books on solid waste treat developing and transitional country solid waste systems as imperfect or incomplete copies of an ideal system that operates in developed countries like Canada, Denmark, or Japan. Many, if not most, waste interventions seek to perfect or improve the copying process and spread the ideal. This book takes a somewhat different view, and responds to a growing global consensus that cities in low-income, middle-income and transitional countries need to take charge of the modernisation process and to develop their own models for waste management that are more and other than simply 'imperfect copies' – models with focus and approaches that fit their own conditions.

Low and Middle-income countries deserve better than an imperfect copy

The easiest part of this is to understand that the state of the art landfills or other expensive 'best practice' technologies, as used in high-income countries, have taken those countries up to 40 years to evolve – they did not move from open dumping to current best practice in one step. Whatever 'next step' a city takes, needs to be appropriate to the local situation, maintainable locally, and financially affordable.

But modern waste management is about much more than a 'technical fix'. The technologies that are visible evidence of humanity's best intentions to transform solid waste into a safe, inert, substance – if they work at all – do so because of the far less visible the institutional, governance, policy and participative frameworks that are highly varied and complex, and directly related to local conditions.

Finally, if we take a step back and look with a fresh perspective at urban waste management in the 21st century, we might dare to ask the question: how much progress have we really made, even in the best European solid waste systems, when we still generate ever increasing amounts of waste, and still rely on burying our discarded products under the ground as a legitimate 'method' of waste management?

This book's ambition is to look at solid waste and the world's cities in a new way; to see what the data tells us about what works and what does not; and to let this inform the policy process and contribute to re-thinking the whole waste management concept. The authors see an urgent need for this in transitional, low- and middle-income countries, but it may well be that looking from another viewpoint gives new insights to developed countries as well. The goal is to provide an honest look at how cities – large and small, complex and simple, coastal and inland, in rich, poor, and transitional countries – do and do not succeed to make reasonable choices that serve their citizens and protect their environment at acceptable financial cost.

In this undertaking, we are taking an inductive approach built around some 20 city profiles, using that information to look at, analyse, and reflect upon solid waste management in cities worldwide. The method used is a combination of data collection, analysis, modelling, reflection, and comparison. For this reason, the data that being sought may not be part of a city's management information system. It may not be easily available, or even available at all. But in seeking it, we are prompting cities' managers – and the future readers of this book – to look differently at management of waste in cities, and to dare to think outside the box – or in this case outside the waste bin or trash barrel.

This pre-publication version of the book seeks to set the scene on the solid waste management challenge facing cities worldwide; to examine three key physical elements of an integrated and sustainable waste management (ISWM) system; to elaborate on three ISWM delivery strategies; and to provide a flavour of the final book by interspersing a number of early city profiles through the text. The 'preview' is based on more than 300 person-years cumulative experience of an international group of solid waste management practitioners; it will be updated in the light of the final city profiles to become the decision maker's guide in the final book.

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