UN-HABITAT

Solid Waste Management

IN THE WORLD'S CITIES

WATER AND SANITATION IN THE WORLD'S CITIES 2010

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SOLID WASTE MANAGEMENT IN THE WORLD'S CITIES

FOREWORD

Regardless of the context, managing solid waste is one of biggest challenges of the urban areas of all sizes, from mega-cities to the small towns and large villages, which are home to the majority of humankind. It is almost always in the top five of the most challenging problems for city managers. It is somewhat strange that it receives so little attention compared to other urban management issues. The quality of waste management services is a good indicator of a city's governance. The way in which waste is produced and discarded gives us a key insight into how people live. In fact if a city is dirty, the local administration may be considered ineffective or its residents may be accused of littering. Available data show that cities spend a substantial proportion of their available recurrent budget on solid waste management, yet waste collection rates for cities in low- and middle-income countries range from a low of 10 per cent in peri-urban areas to a high of 90 per cent in commercial city centres.

Many developing and transitional country cities have active informal sector recycling, reuse and repair systems, which are achieving 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, but they may save the city as much as 15 to 20 per cent of its waste management budget by reducing the amount of waste that would otherwise have to be collected and disposed of by the city. This form of inclusion in solid waste management shows how spectacular results can be achieved where the involvement of the informal sector is promoted.

The struggle for achieving the Millennium Development Goal and related targets for water and sanitation is being waged in our cities, towns and villages where solid wastes are generated. It is at this level that policy initiatives on solid waste management become operational reality and an eminently political affair: conflicts have to be resolved and consensus found among competing interests and parties.

This publication, *Solid Waste Management in the World Cities*, is the third edition in UN-HABITAT's State of Water and Sanitation in the World Cities series. It aims to capture the world's current waste management trends and draw attention to the importance of waste management, especially regarding its role in reaching the UN Millennium Development Goals. The publication acknowledges the escalating challenges in solid waste management across the globe. It seeks to showcase the good work that is being done on solid waste by cities around the world, large and small, rich and poor. It achieves this by looking at what drives change in solid waste management, how cities find local solutions and what seems to work best under different circumstances. The publication endeavours to help decision-makers, practitioners and ordinary citizens understand how a solid waste management system works and to inspire people everywhere to make their own decisions on the next steps in developing a solution appropriate to their own city's particular circumstances and needs. Most readers will never travel to all the 20 cities featured in this report, but through this publication they will have access to real experiences of people working on the ground. We hope it will provide a reference point for managing solid waste in the world's cities and towns, and that many will follow in the footsteps of our authors, and we can move to an improved set of global reference data.

Anna Tibaijuka
Under-Secretary General, United Nations
Executive Director, UN-Habitat

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This current production of *Solid Waste Management in the World Cities* was funded by the Water and Sanitation Trust Fund of UN-HABITAT, currently supported by the Governments of Spain, the Netherlands and Norway.

The report was prepared under the overall substantive guidance of Bert Diphoorn, Ag. Director, Human Settlements Financing Division. The conceptualization of the report and the management of its production was undertaken by Graham Alabaster who was supported by Paul Onyango.

The substantive preparation of the report was undertaken by WASTE, Advisers on Urban Environment and Development. Anne Scheinberg, (WASTE and Wageningen University and Research Centre), David C. Wilson (Imperial College) and Ljiljana Rodic-Wiersma (Wageningen University and Research Centre) were the principal authors/editors. They were supported by a team who made substantial contributions, comprising Lilia G. C. Casanova (CAPS); Bharati Chaturvedi (Chintan Environmental Research and Action Group); Manus Coffey (Manus Coffey Associates); Sanjay K. Gupta and Jeroen IJgosse (Independent Consultants); Reka Soos (Green Partners Romania); and Andrew Whiteman (Wasteaware). The report would not have been possible without the dedication, commitment, professionalism, and passion which the contributing authors undertook their work.

The report benefited from a number of consultations attended by eminent researchers and solid waste management experts. In early 2009, an outline of the report was prepared and in May 2009 the first expert group meeting took place in Gouda, the Netherlands to review the annotated outline. Participants in the expert group included Manus Coffey (Manus Coffey Associates), Edward Stentiford (Leeds University), Sonia Dias, Oscar Espinoza, Sanjay Gupta, Kossara Kisheva, Michael Simpson, Portia Sinnott, Reka Soos, Ljiljana Rodic, Anne Scheinberg, Andy Whiteman, David Wilson, Verele de Vreede, Lilliana Abarca, Ivo Haenen, Valentin Post and Alodia Ishengoma. Bert Diphoorn, Graham Alabaster and Paul Onyango oversaw the process for UN-HABITAT. A number of contributors and researchers were identified at the consultations for preparing the 20 city inserts and the key sheets for the report.

The contributors and writers for the city profiles were: Adelaide, Australia by Andrew Whiteman (Wasteaware) and Rebecca Cain (Hyder Consulting); Bamako, Mali by Modibo Keita (CEK, Cabinet d'Etudes Kala Saba), Erica Trauba (WASTE Intern), Mandiou Gassama, Bakary Diallo, and Mamadou Traoré, (CEK); Bengaluru, India by Sanjay K. Gupta (Senior Advisor and Consultant Water, Sanitation and Livelihood), Smt. Hemalatha (KBE, MTech.), BMP Environmental Engineer, Bruhat Bangalore Mahangara Palike, and Anselm Rosario (WasteWise Resource Centre); Belo Horizonte, Brazil by Sônia Maria Dias, Jeroen IIgosse, Raphael T. V. Barros (UFMG), and the team of the Planning Department of SLU; Cañete, Peru by Oscar Espinoza, Humberto Villaverde (IPES), Jorge Canales and Cecilia Guillen; Curepipe, Mauritius by Professor Edward Stentiford (University of Leeds, UK) and Professor Romeela Mohee (The University of Mauritius, Mauritius); Delhi, India by Malati Gadgil, Anupama Pandey, Bharati Chaturvedi and Prakash Shukla (Chintan Environmental Research and Action Group), Irmanda Handayani (WASTE and Chintan Evironmental), Jai Prakash Choudhury/Santu and Safai Sena; Dhaka, Bangladesh by Andrew Whiteman (Wasteaware), Monir Chowdhury (Commitment

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The production management for the team was handled by Verele de Vreede (WASTE). Ivo Haenen (WASTE), Michael Simpson (Antioch New England) and Portia M. Sinnott (Lite) were in charge of data management while the writing and research team members were Sônia M. Dias, Oscar Espinoza, Irmanda Handayani, Kossara Kisheva-Bozhilovska and Erica Trauba. Photo and graphic editors were Verele de Vreede and Jeroen IJgosse.

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This publication is dedicated to the memory of Brian Williams, who passed away during its production. Brian was heavily involved in previous editions of this report.

LIST OF ACRONYMS AND ABBREVIATIONS

3-R	reduce, reuse, recycle
3-R Forum	A programme of UNCRD
AAU	assigned amount unit
ACEPESA	Asociación Centroamericana para la Economía, la Salud y el Ambiente (Central American Association for Economy, Health and Environment)
ACR+	Association of Cities and Regions for Recycling and Sustainable Resource Management
ADB	Asian Development Bank
AECID	Spanish Agency for International Cooperation for Development
AIE	accredited independent entity
AIT	Asian Institute of Technology
APFED	Asia-Pacific Forum for Environment and Development
APO	Asian Productivity Organization
ASEAN	Association of Southeast Asian Nations
BATF	Bangalore Agenda Task Force
BCRC	Basel Convention Regional Coordinating Centre for Asia and the Pacific
BMP	Bengaluru Municipal Corporation
BMW	biomedical waste
BoI	Board of Investment
BOO	build–own–operate
3Cs	confine, compact, cover
C&D	construction and demolition
C&I	commercial and industrial
CAN	Coupe d'Afrique de Nations
CBE	community-based enterprise
CBO	community-based organization
CCX	Chicago Climate Exchange
CDIA	Cities Development Initiative for Asia
CDM	Clean Development Mechanism
CER	certified emissions reduction
CIDA	Canadian International Development Agency
CIWMB	California Integrated Waste Management Board
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
COFESFA	Coopérative des Femmes pour l'Éducation, la Santé Familiale et l'Assainissement
CONPAM	Ceará State Council for Environment Policy and Management
CSD	Commission on Sustainable Development
CTRS	Centro de Tratamento de Resíduos Sólidos (Brazil)

CWG	Collaborative Working Group on Solid Waste Management in Low- and Middle-Income Countries
DANIDA	Danish International Development Agency
DBOO	design–build–own–operate
DCC	Dhaka City Corporation
DCCl	Dar es Salaam City Council
DCCn	Dar es Salaam City Commission
Defra	UK Department for Environment, Food and Rural Affairs
DOE	designated operational entity
PDUD	Projet de Développement Urbain et Décentralisation
DFID	UK Department for International Development
DIY	do it yourself
DNA	Designated National Authority
DSD	Division for Sustainable Development
EIA	environmental impact assessment
EMC	Environmental Municipal Commission
EnTA	Environmental Technology Assessment
EPA	US Environmental Protection Agency
EPR	extended producer responsibility
ERM	Environmental Resources Management
EU	European Union
EU ETS	European Union Emissions Trading Scheme
FEAM	Federal State Environmental Authority (Brazil)
GDP	gross domestic product
GEF	Global Environment Facility
GHG	greenhouse gas
GIE	*Groupement d'Intérêt Économique*
GIS	green investment schemes
GNP	gross national product
GS	Gold Standard
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Technical Cooperation)
HDI	Human Development Index
HDPE	high-density polyethylene
HHW	household hazardous waste
HLC	High-Level Consultation (Group)
ICLEI	International Council for Local Environmental Initiatives
ID	identification
IETC	International Environmental Technology Centre (UNEP)
IFC	International Finance Corporation
IFI	international financial institution
IFP	ILO Programme on Boosting Employment through Small Enterprise Development
IGES	Institute for Global Environmental Strategies
IGNOU	Indira Gandhi National Open University
ILO	International Labour Organization
IPC	intermediate processing centre
IPCC	Intergovernmental Panel on Climate Change
IPF	intermediate processing facility
ISHWM	Indian Society of Hospital Waste Management

ISP	informal service provider
ISWM	integrated sustainable waste management
ISWMP	Integrated Solid Waste Management Programme
IUF	International Union of Food, Agricultural, Hotel, Restaurant, Catering, Tobacco and Allied Workers
IULA	International Union of Local Authorities
IWB	itinerant waste buyer
JI	joint implantation
JICA	Japan International Cooperation Agency
JV	joint venture
KKPKP	Trade Union of Waste-Pickers in Pune, India
KSTP	Keppel Seghers Tuas Waste-to-Energy Plant
LDPE	low-density polyethylene
LEI	Dutch Agricultural Economics Institute
LF	landfill
LFG	landfill gas capture/extraction
LGA	local government authority
LTS	large transfer station
MCD	Municipal Corporation of Delhi
MDG	Millennium Development Goal
MEIP	Metropolitan Environmental Improvement Programme
METAP	Mediterranean Environmental Technical Assistance Programme
MoEF	Ministry of Environment and Forests
MRF	materials recovery facility
MSE	micro- and small enterprise
MSW	municipal solid waste
MW	megawatt
NDMC	New Delhi Municipal Council
NGO	non-governmental organization
NIMBY	not in my backyard
NOC	No-Objection Certificate
NO_x	nitrogen oxide
OECD	Organisation for Economic Co-operation and Development
5-Ps	pro-poor public–private partnerships
PAH	polycyclic aromatic hydrocarbon
PAHO	Pan-American Health Organization
PBDE	polybrominated diphenyl ether
PCB	polychlorinated biphenyl
PET	polyethylene terephthalate
PFD	process flow diagram
PGAP	Multi-Annual Municipal Action Plan (Brazil)
PIL	public interest litigation
PP	polypropylene
PPP	public–private partnership
PPP-SD	public–private partnership for sustainable development
PS	polystyrene
PSP	private-sector participation
3Rs	reduce, reuse, recycle

R&D	research and development
RLP	Recycling Linkages Programme
SBC	Secretariat of the Basel Convention
SCP	Global Sustainable Cities Programme
SDP	Sustainable Dar es Salaam Project
SEALSWIP	South-East Asia Local Solid Waste Improvement Project
SEAM	Support for Environmental Assessment and Management project
SEIA	strategic environmental impact assessment
SEWA	Self-Employed Women's Association (India)
Sida	Swedish International Development Cooperation Agency
SLU	Superintendência de Limpeza Urbana (Brazil)
SME	small- and medium-sized enterprise
SO_2	sulphur dioxide
SPG	*Strategic Planning Guide for Municipal Solid Waste Management*
STS	small transfer station
SWAPP	Solid Waste Management Association of the Philippines
SWM	solid waste management
TPD	(metric) tonnes per day
TPY	(metric) tonnes per year
UBC	used beverage container
UCLG	United Cities and Local Governments
UNCHS	United Nations Centre for Human Settlements (Habitat) (now UN-Habitat)
UK	United Kingdom
UNCRD	United Nations Centre for Regional Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UN ESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UN-Habitat	United Nations Human Settlements Programme (formerly UNCHS (Habitat))
UNIDO	United Nations Industrial Development Organization
US	United States
UWEP	Urban Waste Expertise Programme
VCS	Voluntary Carbon Standard
VOC	volatile organic compound
VOS	Voluntary Offset Standard
WEEE	waste electrical and electronic equipment
WHO	World Health Organization
WHO SEARO	World Health Organization Regional Office for South East Asia
WIEGO	Women in Informal Employment: Globalizing and Organizing
WRAP	UK Waste and Resources Action Programme
WREP	Waste and Resources Evidence Programme
WTE	waste-to-energy
ZW	zero waste
ZWSA	Zero Waste South Australia

A NOTE TO DECISION-MAKERS

A good solid waste management 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.

Managing solid waste well and affordably 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.

This note to decision-makers introduces UN-Habitat's Third Global Report on Water and Sanitation in the World's Cities: *Solid Waste Management in the World's Cities*.

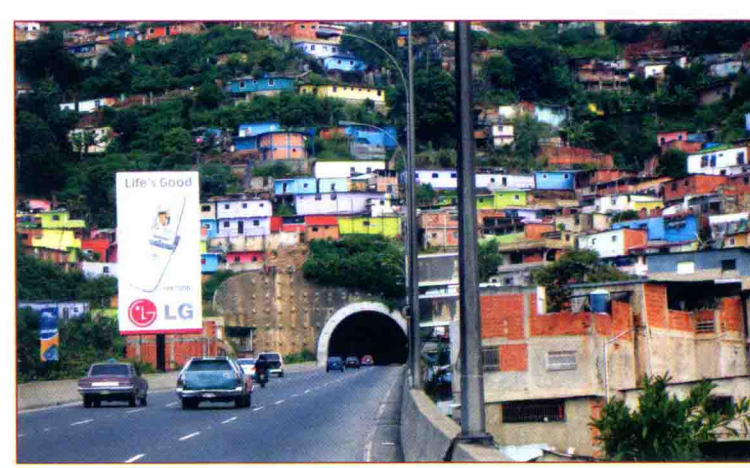
A unique feature of the book is that it is based on new information, collected in a standardized format, from 20 reference cities around the world. The cities demonstrate a range of urban solid waste and recycling systems across six continents and illustrate how solid waste management works in practice in tropical and temperate zones, in small and large cities, in rich and poor countries, and at a variety of scales.

The book shows that cities everywhere are making progress in solid waste management – even relatively small cities with very limited resources – but also that there is plenty of room for improvement. The authors are interested in understanding and sharing insights on what drives change in solid waste management, how things work in cities and what seems to work better under which circumstances.

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, say, Denmark or Canada or Japan may not work in your country. As in most other human endeavours, '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, capitalize on, nurture and improve the indigenous processes that are already working well. These may well be outside the 'formal' waste management system provided by the city – the research for his book shows that the informal and micro-enterprise sectors in many developing country cities are often achieving recycling rates, comparable to those reached in Europe and North America only after years of high investment by the city. For example, the research for this book shows that informal recyclers handle 27 per cent of the waste generated in Delhi; if they were to disappear, the city would have to pay its contractors to collect and dispose of an additional 1800 tonnes of waste every day.

The overall aim of the book is to facilitate actors in cities everywhere – the mayor, other politicians, officials, citizens, non-governmental



Urban cities continue to expand to areas with difficult accessibility, posing a challenge for collecting waste from these neighbourhoods. The example from Caracas, Venezuela is representative for many Latin American cities.

organisations, the formal and informal private sector, and indeed the national government – to make their own decisions on the next steps in developing a solution appropriate to their own city's particular circumstances and needs.

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

THE ISWM FRAMEWORK

This book is built around the concept of integrated and sustainable (solid) waste management, known as ISWM. We have divided an ISWM system for convenience into two 'triangles', the physical elements and the governance features. The first triangle comprises the three key physical elements that *all* need to be addressed for an ISWM system to work well and to work sustainably over the long term:

Solid waste is a vital municipal responsibility. You need to be able to put all three elements in place – collection, disposal and materials recovery.

1. **public health:** maintaining healthy conditions in cities, particularly through a good waste collection service;
2. **environment:** protection of the environment throughout the waste chain, especially during treatment and disposal; and
3. **resource management:** 'closing the loop' by returning both materials and nutrients to beneficial use, through preventing waste and striving for high rates of organics recovery, reuse and recycling.

Triangle 2 focuses on ISWM 'software': the governance strategies to deliver a well functioning system. Until the 1990s, this would probably have been framed primarily around technology; but there is consensus today on the need for a much broader approach. Three interrelated requirements for delivering ISWM are distinguished here under the framework of 'good waste governance'. There is a need for the system to:

1. be **inclusive**, providing transparent spaces for stakeholders to contribute as users, providers and enablers;
2. be **financially sustainable**, which means cost-effective and affordable; and
3. rest on a base of **sound institutions and pro-active policies**.

THREE KEY SYSTEM ELEMENTS IN ISWM

Public health (collection)

The safe removal and subsequent management of solid waste sits alongside the management of human excreta (sanitation) in representing two of the most vital urban environmental services. Other essential utilities and infrastructures, such as water supply, energy, transport and housing, often get more attention (and much more budget); however, failing to manage properly the 'back end' of the materials cycle has direct impacts on health, length of life, and the human and natural environment.

Uncollected solid waste blocks drains, and causes flooding and subsequent spread of waterborne diseases. This was the cause of a major flood in Surat in India in 1994, which resulted in an outbreak of a plague-like disease, affecting 1000 people and killing 56. Annual floods in East and West African, and Indian cities are blamed, at least in part, on plastic bags blocking drains.

The responsibility of municipalities to provide solid waste collection services dates back to the mid-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.

The data collected for this book, and other UN-Habitat data, show waste collection coverage for cities in low- and middle-income countries

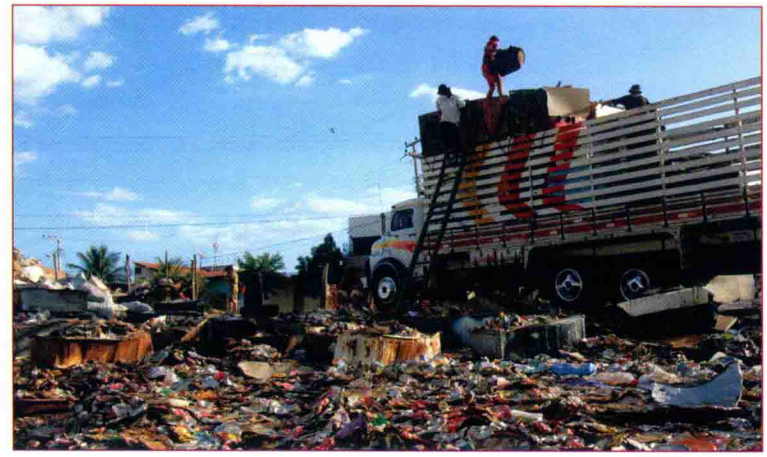
ranging from a low of 10 per cent in peri-urban areas to a high of 90 per cent or more in commercial city centres. This means that many households in many cities receive no services at all, with the result that far too much waste ends up in the environment. UN-Habitat health data also show that rates 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 that receive a regular waste collection service.

Perhaps surprisingly, even in Europe and North America uncollected waste can still hit the headlines, as in the 2008 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 protested fiercely.

The 20 reference cities in this report provide many examples of different approaches that have been successful in providing collections services across the city. For example, both Bengaluru (Bangalore) in India and Quezon City in the Philippines have collection coverage rates over 90 per cent. One key message is to adopt and adapt technology that is appropriate, and can easily be maintained locally. Just as it is amusing to picture a cycle rickshaw collecting waste in Adelaide, it is ridiculous to send a giant compactor truck designed for Australian roads into the lanes of the old city in Dhaka, or even onto the main roads which have not been designed for such high axle loading rates. Another key message is to 'mix and match' the methods of service delivery. New Delhi is an example of a city where primary collection is done by authorized informal sector collectors/recyclers, who deliver the waste by hand cart to a large private sector operator who provides secondary collection from communal bins.

Environmental protection (waste treatment and disposal)

Until the environmental movement emerged in the 1960s, most wastes were disposed of with little or no control: to land, as open dumping; to air, by burning or evaporation of volatile compounds; or to water, by discharging solids and liquids to surface, groundwater or the ocean. There was little regard for the effects on drinking water resources and health of those living nearby – the philosophy was 'out of sight, out of mind'.



Sorted and crushed ferrous and non-ferrous metals being loaded on a truck for transportation to the recycling industry (Caínde, Brazil)

Over the last 30 to 40 years, countries and cities seeking to take control of growing quantities of waste and to maintain a clean environment have built up experience about what works. Moving towards modern disposal has generally followed a step-by-step process: first phasing out uncontrolled disposal, then introducing, and gradually increasing, environmental standards for a disposal facility. In the process, controlling water pollution and methane emissions from sanitary landfills, and air pollution from incinerators, receive increasing attention.

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

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 necessary first step towards good waste management; a properly controlled landfill site is an essential part of any modern waste management system.

Whatever technologies and equipment are used, they should be appropriate for and adapted to the local conditions. The small and relatively remote city of Ghorahi in Nepal shows what can be achieved with limited local resources: their well-sited and managed facility includes waste sorting and recycling, sanitary landfilling,

leachate collection and treatment, and a buffer zone with forests, gardens and a bee farm that shields the site from the surrounding area.

Many 'new' technologies are being developed to treat solid wastes, and salesmen target both developed and developing country cities. In principle, this is fine, but it is important that decision-makers have the information they need to make informed choices. Unfortunately, experience shows that there are no magic solutions: technologies developed for relatively dry wastes with high calorific value in the 'North' may not work when confronted with wet and mainly organic wastes with low calorific value in the 'South'. If a solution seems 'too good to be true', it's probably not true.

Beware the 'magic solution' salesman, whose technology will solve your problem at little or no cost.

Resource management (valorization 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 minimized, 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 late 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 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. Their motivation is not primarily the commodity value of the recovered materials, which was the only motivation of the earlier, informal or private sector, systems. Rather, the principal driver is that the recycling market offers a competitive 'sink', as an alternative to increasingly expensive landfill, incineration of other treatment options.

Waste is a resource, and the entire waste system should be designed to maximize the benefits from the discarded materials.

Many developing and transitional country cities still have an active informal sector and micro-enterprise recycling, reuse and repair systems, which often achieve recycling and recovery rates comparable to those in the West; the average recovery rate across the 20 reference cities is 29 per cent. Moreover, by handling such large quantities of waste, which would otherwise have to be collected and disposed of by the city, the informal recycling sector has been shown to save the city 20 per cent or more of its waste management budget. In effect, the poor are subsidizing the rest of the city.

There is a major opportunity for the city to build on these existing recycling systems, to increase further the existing recycling rates, to protect and develop people's livelihoods, and to reduce still further the costs to the city of managing the residual wastes. The formal and informal sectors need to work together, for the benefit of both.

The priorities of good resource management are expressed by the '3Rs' – reduce, reuse, recycle. The last can be further split between 'dry' recyclables and bio-solids or organic wastes:

1. **Reduce** the quantities of waste being generated. This is the new focus of modernization in developed countries; but it is important also for rapidly growing cities in middle- and low-income countries to bring their waste growth rates under control.
2. **Reuse** products that can be reused, repaired, refurbished, or remanufactured to have longer useful lives.
3. **Recycle** materials that can be extracted, recovered and returned to industrial value chains, where they strengthen local, regional and global production.
4. **Return nutrients to the soil**, by composting or digesting organic wastes ('bio-solids') – plant and animal wastes from kitchen, garden and agricultural production, together with safely managed and treated human excreta. These are sources of key nutrients for the agricultural value chain, and their proper utilization is important to food security and sustainable development.

THREE ISWM GOVERNANCE FEATURES

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, including both national and local government, who organize 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 organizations that represent them in the policy and governance processes. The reference cities demonstrate a range of good practices, in areas such as:

- consultation, communication, and involvement of users;
- participatory and inclusive planning;
- inclusivity in siting facilities; and
- institutionalizing inclusivity – the solid waste 'platform'.

Service providers include the formal municipal waste organization, in partnership with a variety of private, informal and/or community actors of widely varying sizes and capabilities. They can supplement the knowledge and capacity of the local authority to implement recycling, manage organic waste and serve households with waste collection. In urban waste systems in most low- and middle-income countries, the informal and micro-enterprise collection and recycling sector is particularly important, providing a livelihood for an average of 0.5 per cent of the urban population across 10 of reference cities, and of more than 1 per cent in both Delhi and Dhaka. The numbers are much lower, but the informal sector does operate also in the US, Canada, Europe and Japan.

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 significant proportion of the total recurrent budget of the city, with figures of 3 to 15 per cent being reported by the reference cities. When the solid waste budgets are divided by the population, and this per capita figure is expressed as a percentage of per capita GDP, most of the cities are in the range of 0.1–0.7 per cent, with two greater than 1 per cent. Yet in spite of relatively high costs, collection service coverage is often low and disposal standards remain poor.

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 separated waste types of collection and more administration. As the city spreads and

The private sector includes both formal and informal enterprises, of widely varying sizes and capabilities. They can supplement the knowledge and capacity of the local authority to implement recycling, manage organic waste, and serve households with waste collection.

An appropriate time schedule of collection routes needs to coincide with local circumstances: in Managua, Nicaragua, it is early morning when citizens are at home

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