

Solid waste management in the world's cities: Highlights from the UN-Habitat 2010 book

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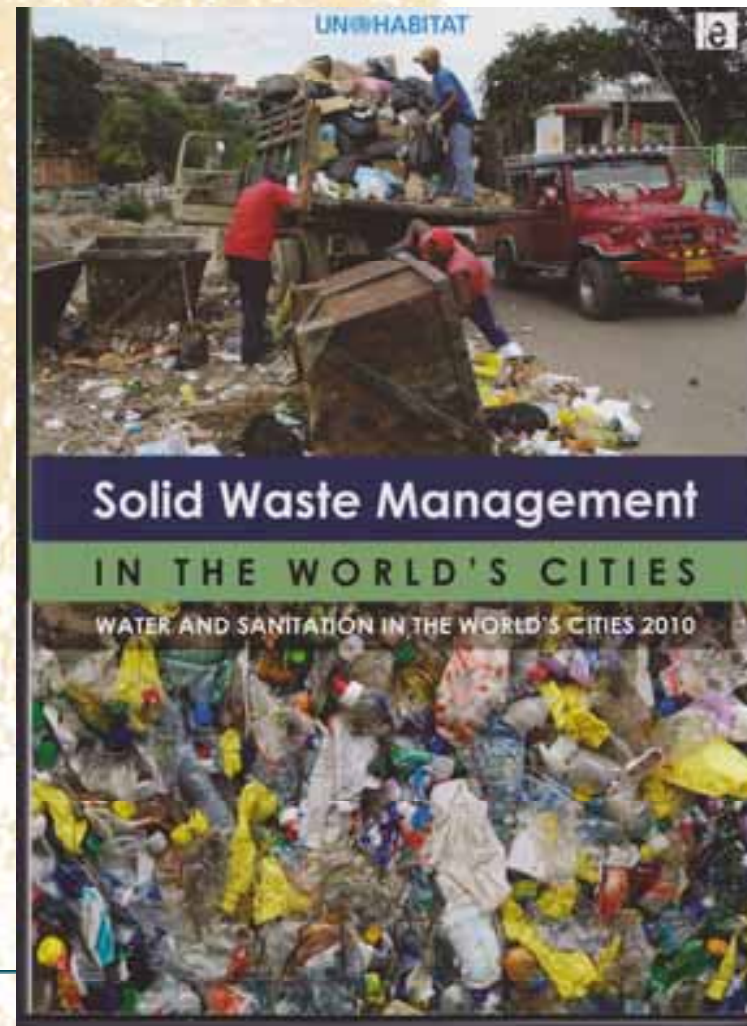
The UN-Habitat Book

Third Global Report on Water and Sanitation in the World's Cities

A major international review of SWM within UN long overdue

Compiled by a team of 30+ professionals from North and South

Launched at 5th World Urban Forum, Rio, March 2010



Filling the information gap

Preparing a critical review & guidelines would have been relatively easy

But we decided rather to face up to the critical lack of solid waste & recycling data, benchmarks, “smart” indicators

Set out to collect reliable and consistent data from 20 cities

Match indicators to “drivers” and governance

Low, middle, and high-income countries and cities in the same frame

Reliable and consistent data

- Detailed data protocol to ensure consistency

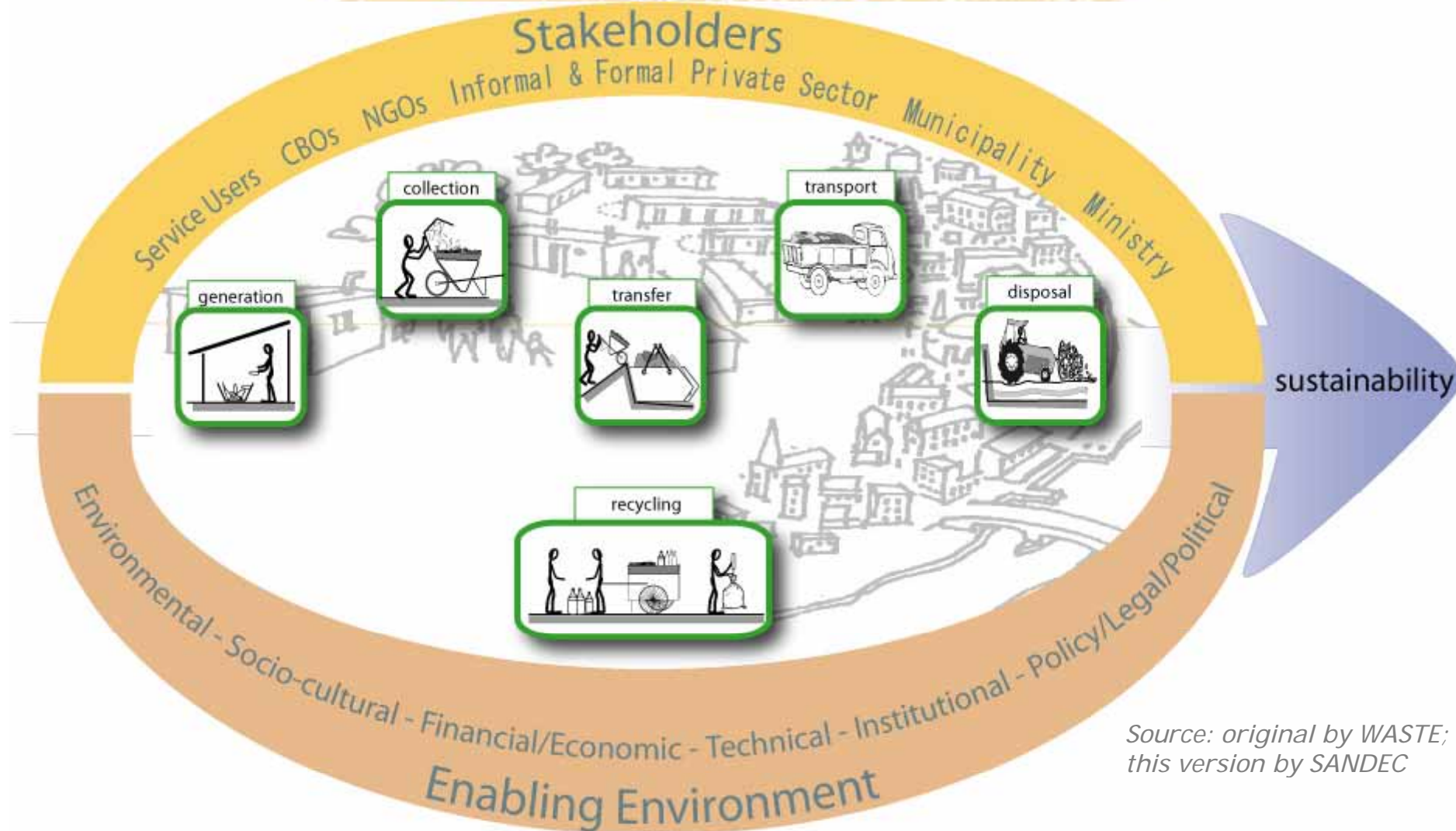
- Using a process flow (mass balance) diagram to understand entire system

- Including formal and informal sectors

- Developing indicators even for more qualitative criteria

- Designating a city profiler - critical review of the data

Integrated and sustainable waste management (ISWM)



Source: original by WASTE;
this version by SANDEC

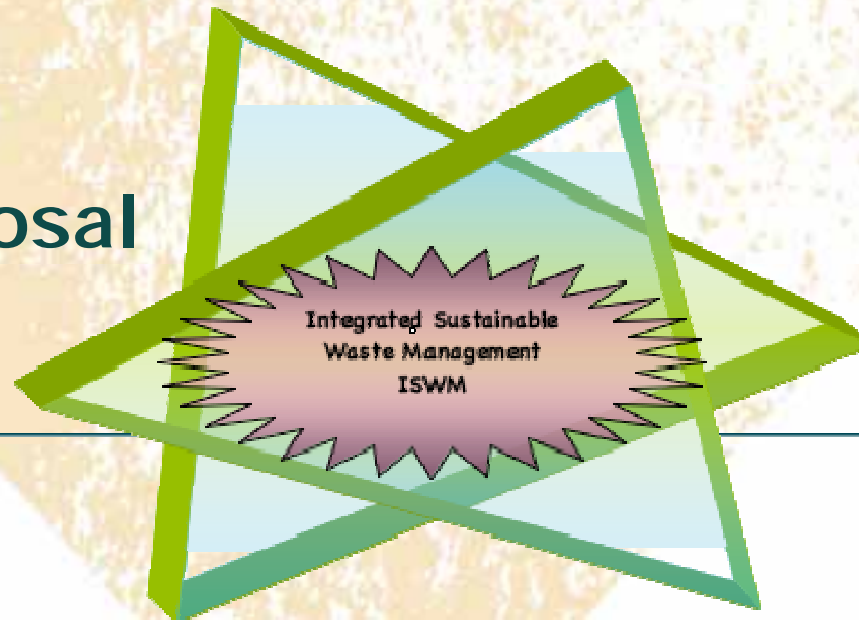
Analytical Framework

3 ISWM physical elements

- Public health/ collection
- Environmental protection/ disposal
- Resource management

3 key governance strategies

- Inclusivity, of both users & service providers
- Financial sustainability
- Sound institutions & proactive policies



The 20 reference cities



Data base, benchmarks, indicators – Accurate information but not too much

City & Country	Population	GDP (US\$) per capita, country	Kg Per Capita/ year	Kg Per Capita/ day	Paper	Glass	Metal	Plastic	Organic	Other	Total
Rotterdam, Netherlands	582,949	46,750	528	1.4	27%	8%	3%	17%	26%	19%	100%
San Francisco, USA	835,364	45,592	609	1.7	24%	3%	4%	11%	34%	21%	100%
Tompkins County, USA	101,136	45,592	577	1.6	36%	6%	8%	11%	29%	11%	100%
Adelaide, Australia	1,089,728	39,066	490	1.3	7%	5%	5%	5%	26%	52%	100%
Belo Horizonte, Brazil	2,452,617	6,855	529	1.4	10%	3%	2%	11%	66%	9%	100%
Curepipe, Mauritius	83,750	5,383	284	0.8	23%	2%	4%	16%	48%	7%	100%
Varna, Bulgaria	313,983	5,163	435	1.2	13%	15%	10%	15%	24%	24%	100%
Canete, Peru	48,892	3,846	246	0.7	6%	2%	2%	9%	70%	11%	100%
Sousse, Tunisia	173,047	3,425	394	1.1	9%	3%	2%	9%	65%	13%	100%
Kumming, China	3,500,000	2,432	286	0.8	4%	2%	1%	7%	58%	26%	98%
Quezon City, Philippines	2,861,091	1,639	257	0.7	13%	4%	4%	16%	50%	12%	100%
Bengaluru, India	7,800,000	1,046	236	0.6	8%	2%	0%	7%	72%	10%	100%
Delhi, India	13,850,507	1,046	184	0.5	7%	1%	0%	10%	81%	0%	100%
Managua, Nicaragua	1,002,882	1,022	420	1.1	9%	1%	1%	8%	74%	6%	100%
Lusaka, Zambia	1,500,000	953	201	0.6	3%	2%	1%	7%	39%	48%	100%
Nairobi, Kenya	4,000,000	645	219	0.6	6%	2%	1%	12%	65%	15%	100%
Bamako, Mali	1,809,106	556	256	0.7	4%	1%	4%	2%	21%	52%	83%
Dhaka, Bangladesh	7,000,000	431	167	0.5	9%	0%	0%	4%	74%	13%	99%
Moshi, Tanzania	183,520	400	338	0.9	9%	3%	2%	9%	65%	12%	100%
Ghorahi, Nepal	59,156	367	167	0.5	6%	2%	0%	5%	79%	7%	99%
Average	2,462,386		343	0.9	12%	3%	3%	10%	53%	18%	
Median	1,046,305		285	0.8	9%	2%	2%	9%	61%	12%	

Classifying cities -- is it interesting?

High-income	Middle-income	Low-income
<i>based on GDP/capita / year</i>	<i>- uses latest available data</i>	<i>for each country in 2009</i>
Over \$12,000	\$1,100 - \$ 12,000	Less than \$1,100
Rotterdam, Netherlands	Belo Horizonte, Brazil	Bengaluru, India
San Francisco, USA	Curepipe, Mauritius	Delhi, India
Tompkins County, USA	Varna, Bulgaria	Managua, Nicaragua
Adelaide, Australia	Canete, Peru	Lusaka, Zambia
	Sousse, Tunisia	Nairobi, Kenya
	Kumming, China	Bamako, Mali
	Quezon City, Philippines	Dhaka, Bangladesh
		Moshi, Tanzania
		Ghorahi, Nepal

Itinerant waste buyer in Ghorahi, Nepal

Mixed waste collection in Bengaluru, India



Food waste collection in Tompkins County, NY USA



“31 Flavours” of waste removal

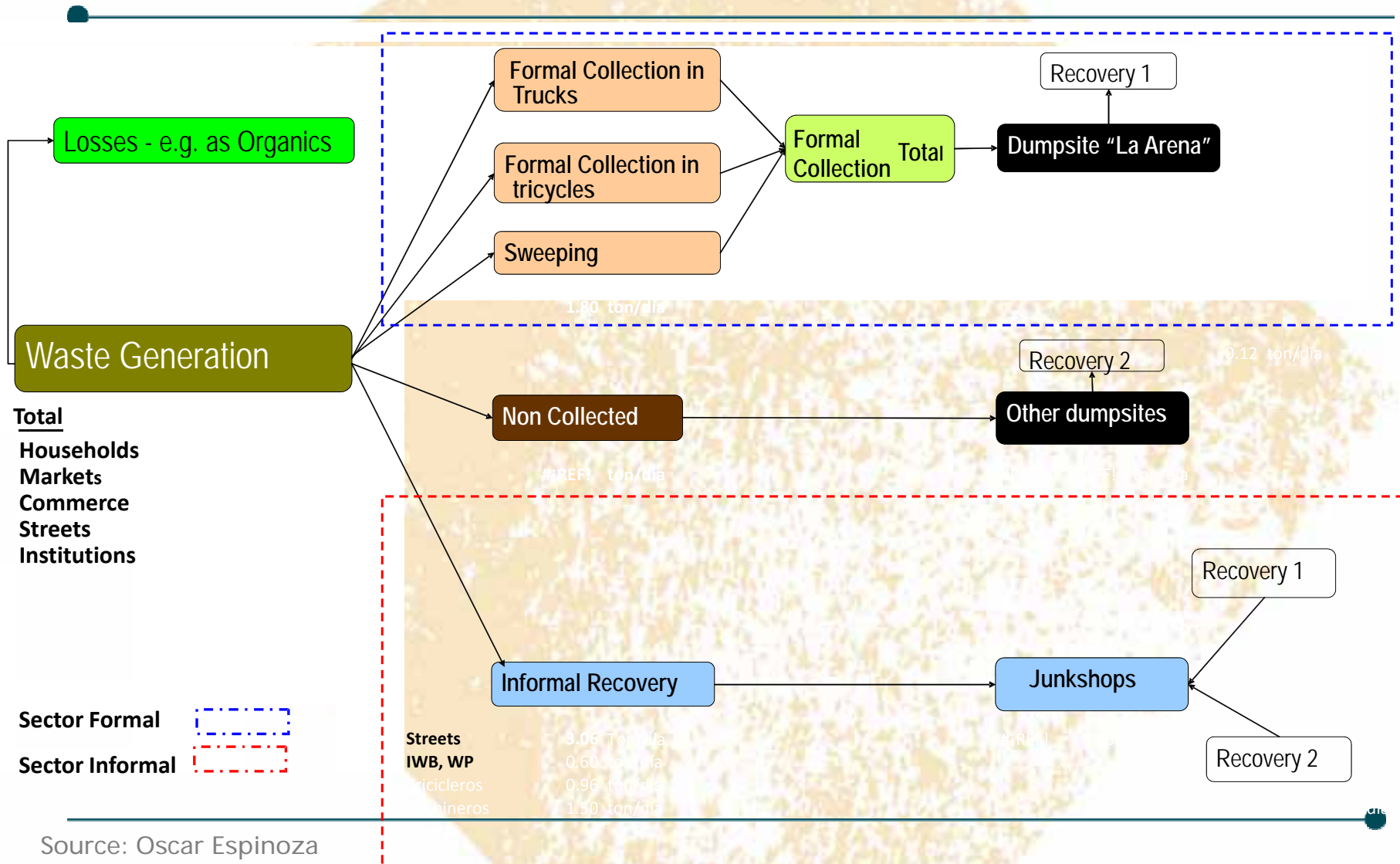
Per capita waste generation

	Minimum Kg/year	Maximum Kg/year	Average Kg/year	Average Kg/day
High-income	490	609	551	1.5
Middle-income	246	529	347	0.96
Low-income	167	420	243	0.67

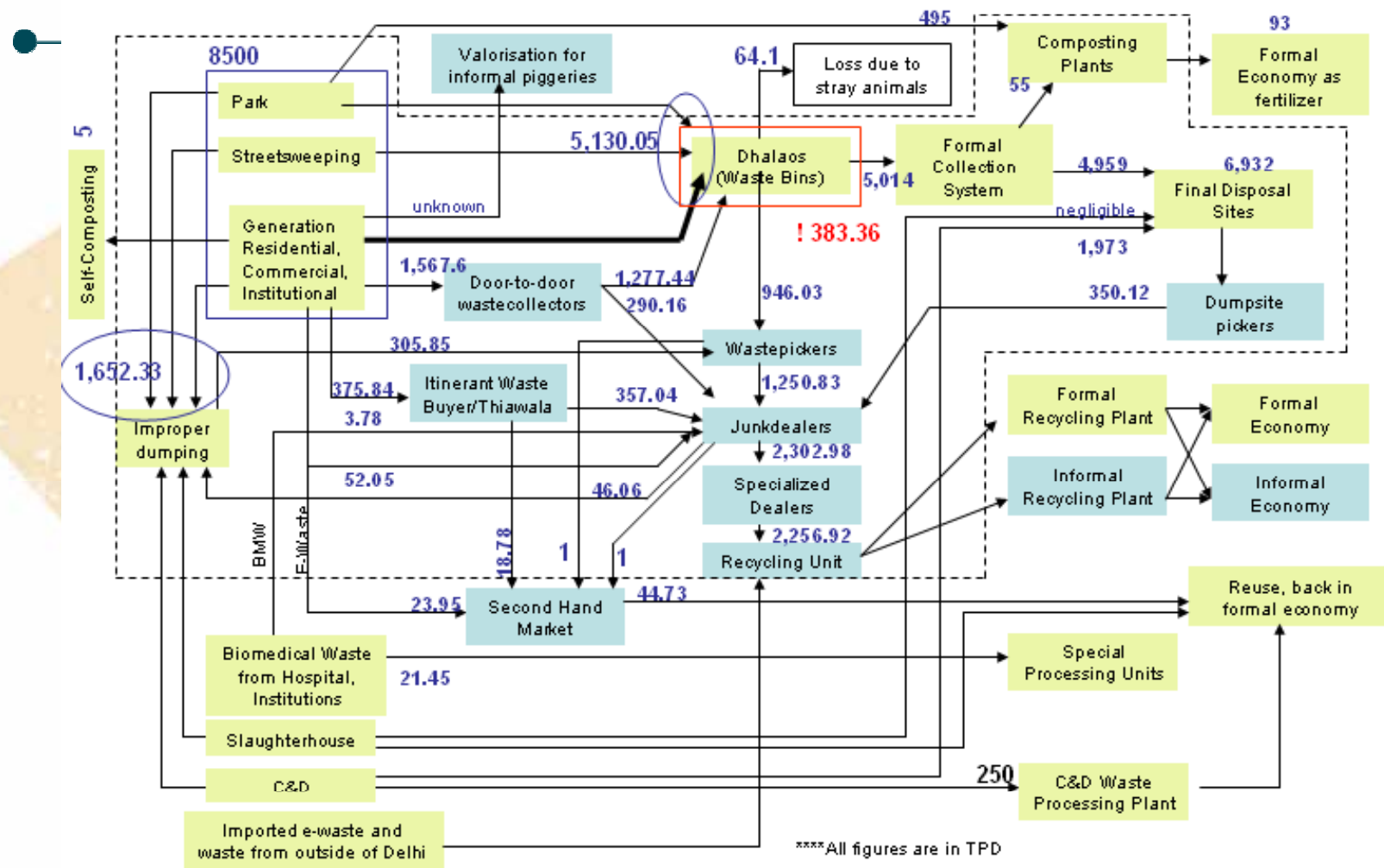
Average waste composition

	paper	glass	metal	plastic	organic	other
High-income	24%	6%	5%	11%	29%	26%
Middle-income	11%	4%	4%	12%	54%	15%
Low-income	7%	2%	1%	7%	63%	18%
Low-income excluding outliers					73%	9%

Process Flow Diagram – example for Canete, Peru



PFD– quantified example for Delhi, India



The stream from household, commercial and institutions includes the hazardous waste such as biomedical waste and e-waste which are not segregated.

There is an excess of 383.36 MT of MSW in dhalaoos. It could stand as more open dumping take place than our estimation, or it could be translated as actually lower service coverage rate at certain areas such as slum areas.

Legend: Formal Sector Informal Sector

The 3 drivers & 3 physical elements

Modern landfill in Hong Kong



**CBO collection in
Ouagadougou, Burkina Faso**



Selling recycled bottles, Dhaka

Phot
Ali

Uncollected waste - a key public health issue



Burning waste, Venezuela

Waste blocking a storm drain, Bamako, Mali



Dengue fever clean-up campaign, Quezon City



Photo credits clockwise from top left: © Károly Györfi; Erica Traub; UN Habitat; SWAPP

Waste dumped in a stream, Nairobi

Public health – collection coverage: still drives low-income country modernisation

	Minimum %	Maximum %	Average %
High-income	100	100	100
Middle-income	73	100	95
Low-income	45	90	63



Collection

Some examples of diversity in removal



Door-to-door informal collector, India

CBO collection in Bamako, Mali

Bicycle cart delivering to small transfer station in Kunming



Curepipe, Mauritius

Adelaide, Australia



Environmental control – waste disposal

	State of the art - incineration	State of the art - landfill	Disposal at simple controlled sites	Disposal at open dumps, losses, illegal dumping
High-income	25%	75%	0%	0%
Middle-income	5%	66%	26%	3%
Low-income	0%	27%	37%	36%

Environmental Protection- Focus on a range of approaches to controlling disposal

State-of-the-art



Incinerator construction in Kunming, viewed from the landfill

Simple control



Payatas site, Quezon City



Landfill construction in Lusaka

No control



Cows grazing by illegal dump in Bamako

Case Study- Ghorahi, Nepal 2009

Karauti Danda Landfill

including waste sorting / recycling



Photo credits : © Bhushan Tuladhar

Resource recovery – valorisation and high recycling rates

	Minimum %	Maximum %	Average %
High-income	30	72	54
Middle-income	6	39	22
Low-income	6	85	27

Resource recovery - formal vs informal

	Average %	Formal %	Informal %
High-income	54	54	0
Middle-income	22	8	13
Low-income	27	3	24

Building on informal recycling enterprises

- Relies entirely on the market value of materials
- Saves cities money from in avoided collection & disposal costs

Opportunity for win-win solutions

1. Build recycling rates
2. Improve livelihoods
3. Improve working conditions
4. Save the city money



Plastics recycling in Delhi

Case study: Quezon City, Philippines

- ❑ Sharp increase in recycling

Year	Total	IWBs
1997	6%	4%
2006	25%	16%
2009	37%	24%

- ❑ NGO-led 'Linis Ganda'
 - Linkages across supply chain
 - Recognition & respectability
 - uniforms, ID, access
 - politically connected
 - Organise co-operatives
 - Facilitate affordable credit



Photo credits: Embassy of Japan in the Philippines;
Government of the Philippines, 2006



Moshi – the ‘cleanest city in Tanzania’



Waste & Citizenship Forum, Belo Horizonte

Governance strategies: policy commitment matters (a lot) more than money

Inclusivity: for both users and providers

User-inclusivity

Do laws require participation of stakeholders outside the bureaucratic structures?

Are there any procedures in place for citizens to participate in the siting of landfills or incinerators?

Is customer satisfaction with the waste management service measured, reported, documented at the municipal level?

Are there any feedback mechanisms between service users and service providers? Does the city do anything about the feedback?

Are there any citizens committees in place which address waste management issues? ●

Inclusivity: for both users and providers

Provider inclusivity: Are economic niches open to private, informal, non-state actors

Do laws encourage 'PSP' – i.e. public-private partnerships or community based organisations to participate in SWM?

Are there any platforms or organisations to represent the private waste sector?

Is there any formal occupational recognition of the informal sector active in recycling?

Is there any protection of informal sector rights to operate in SWM?

Are there any legal or institutional barriers for PSP in waste management?

~~Are there any legal or institutional incentives for PSP in waste management?~~

Inclusivity – comparing indicators

	User Inclusivity Rating	Provider Inclusivity Rating
High-income	High	Medium
Middle-income	Medium	Medium
Low-income	Medium	Medium

2 cities, solid waste champions in their own countries -- scored high of both criteria

- Adelaide - Belo Horizonte

Sorting plant operated by a recyclers' co-operative in Belo Horizonte, Brazil



Photo credit: © Sonia Maria Dias

Data on nos of informal waste sector workers

City	% of total population
Bengaluru	0.5%
Belo Horizonte	0.0%
Canete	0.4%
Delhi	1.3%
Dhaka	1.7%
Ghorahi	0.1%
Lusaka	0.0%
Managua	0.3%
Quezon City	0.5%
Sousse	0.1%
Average	0.5%
Total workers in 10 cities	350,000

Financial sustainability - affordability

	City SW budget per capita	City SW budget per capita as % of GDP per capita	
		range	average
High-income	\$75	0.03 - 0.40%	0.17%
Middle-income	\$25	0.14 - 1.19%	0.53%
Low-income	\$5	0.14 - 1.22%	0.60%

Financial sustainability – fee collection for formal waste services to households

Direct charging via a waste bill or a utility bill (U)	Direct waste fee + property tax	No direct fee (financed via property tax)	No direct fee (finance from general sources)
Adelaide	Bamako	Belo Horizonte	Ghorahi
Canete	Bengaluru	Curepipe	Quezon City
Kunming		Delhi	
Lusaka		Dhaka	
Moshi		Managua	
Nairobi (U)		Sousse	
Rotterdam			

Financial sustainability – fee collection

	SW fee as % of household income	% of population that pays for collection	Reported cost recovery % via fees
High-income	0.44%	99%	81%
Middle-income	1.07%	47%	24%
Low-income	0.59%	25%	33%

Sound institutions, proactive policies

Difficult to measure, so again uses qualitative criteria to estimate 'institutional coherence'

Two relate to national and local policy commitments and frameworks

Two relate to municipal control over revenues and over services out-sourced to the private sector

How coherent and autonomous is the solid waste management function within the city? How high in the organisational chart is it necessary to go to find a manager responsible for ALL solid waste and recycling functions?

How many budget lines are there, do they talk to each other and what % of budgeted costs falls under the largest budget line?

Institutional coherence

– comparing cities

	Institutional coherence	
	Average	Range
High-income	High	All High
Middle-income	High	6 High 1 Medium
Low-income	Medium	1 High 5 Medium 3 Low

Bring bins in Varna, Bulgaria



Reflections Many approaches to separate collection for recycling

Exchanging recyclables for onions Siddhipur, Nepal



Kerbside sorting Rotterdam



Photo credit
Bhushan

If you don't measure it, you can't manage it

Triangulate all estimates: check weight-volume ratios and benchmark load size



Go to the field to estimate and analyse waste composition

GTZ project in Mozambique



Kunming – weighbridge at incinerator

Information is power, bad data are normal

- For too many numbers - not clear what they mean

Definitions not consistent: for many cities, *total costs* bear no relation to *total budget*

Recycling and recovery statistics mean different things

The most basic statistic, *cost/ton* is impossible: neither costs nor tons clear

A common methodology for data collection improves comparability – please use it!



Photo credits: © UN-Habitat, Reymar Conde; Waste Concern

Conducting household waste survey, Managua Measuring compost temperature, Dhaka

Key messages

No one size fits all – need a local solution

Commitment does more than money: several poor cities with good systems

Building on what you have works

Including informal activities in formal reporting would make cities look a lot better

Technical ambitions need to be modified to achieve affordability: a sanitary landfill is worth nothing if it pushes the cost to be recovered above 2% of household income -- the city won't use it

Thanks to ...

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*UN-Habitat for their
leadership and
funding*

*the global community
of practice who did
the work behind this
book*

*my absent co-authors
and most of all to ...*

Photo credits: © Justin Lang, Zero Waste South Australia; Oscar Espinoza



*One size does not fit all – large and small
composting plants in Adelaide and Canete, Peru*

... the millions of recycling & waste workers around the world, who are working hard -- outside of formal structures



Clockwise from top left: Canete, Nepal, Delhi, Sousse, Cairo, Bengaluru, Dhaka, San Francisco, Rotterdam

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Thank you for your attention!
Questions or comments?

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