Economic Aspects of the Informal Sector in Solid Waste Management

Main Report

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Executive Summary: Economic Aspects of the Informal Sector in Solid Waste Management

Background

This document presents the results of the study entitled "Economic Aspects of the Informal Sector in Solid Waste Management". The "informal sector in solid waste management" refers to individuals, families, and private sector (micro-) enterprises working in waste management services and valorisation, whose activities are neither organised, sponsored, financed, contracted, recognised, managed, taxed, nor reported upon by the formal solid waste authorities. Businesses which work informally in the waste sector are treated as informal even when they are formally registered in some other sector, such as transport, construction or livestock production.

The study focuses on analysing informal economic activities in two closely related sub-sectors, the informal service sector, and the informal valorisation sector. Services include waste removal, transport, and disposal, as well as various urban cleansing activities such as street sweeping and drain clean-outs. Valorisation, also referred to as recovery, refers to the extraction, processing, transport, and sale of reusable and recyclable materials in the recycling value chain, together with commercialisation of organic waste as animal feed, compost, or soil supplement in the agricultural value chain. Together, these two sub-sectors comprise the solid waste informal sector.

The main purpose of the study is to inform policymaking related to upgrading and modernising solid waste systems in low- and middle-income countries. Modernisation is an integrated process of upgrading solid waste management to include more than a dumpsite. A key element in modernisation is conforming to global standards or ideas of how solid waste management should function in a "modern" city. It can consist of purchasing new infrastructure, introduction of service fees or privatisation of certain services, and usually also requires institutional reform to accommodate the new system elements. It is necessary because the process of modernisation often creates competition between formal authorities and informal enterprises for materials. This competition can have both beneficial and problematic effects: on the one hand the profile and political interest in recycling and valorisation increases, and that can make things happen. On the other, without taking the informal sector into account, cities risk lowering their cost efficiency, and everyone's profitability drops when parallel systems don't take each other into account.

The report has a focus on understanding the nature of formal and informal waste management and recycling operations, and the costs and benefits to society of the work of the solid waste informal sector. For this purpose it is also necessary to understand how the informal sector interacts with formal governmental and private sector solid waste management (SWM) activities. A special focus is on understanding the risks and problems created by the modernisation process, especially as they lead to formulation of policies to restrict the access or rights of the informal sector to valorise materials, or sometimes even to eliminate this sector.

Methodological Approach

The study uses a systems analysis approach. The system is defined as the current (2006-2007) waste management system in each of the six cities, including both formal and informal waste services and valorisation. The analysis is designed to map, measure, model, and monetise costs and benefits of informal activities, including costs and benefits of operations and indirect ones related to carbon footprint, and socio-economic impacts of these activities in the cities. This current situation analysis is referred to as *the baseline.*

The potential impacts of future decision- and policy-making are explored through modelling two scenarios, one in which the informal sector is significantly restricted or completely stops its waste and valorisation activities, and the other where the formal authorities recognise the informal sector and work together with it on optimising the system and professionalising the informal workers. These are referred to respectively as *the subtraction scenario* and *the addition scenario.*

The study is based on field work, analysis, and modelling done in six cities in 2006-2007:

1. Cairo, Egypt

2. Cluj-Napoca, Romania
3. Lima, Peru
4. Lusaka, Zambia
5. Pune, India
6. Quezon City, the Philippines

In each of the six cities, the informal sector was studied and analysed as part of the overall solid waste system, using an approach based on process flows and materials balances. The action research in the cities, combined with the synergies of working with local experts in six cities on five continents, provided a number of insights in relation to both economic and non-economic aspects of the informal sector in solid waste. In 2010, some corrections were made to methodology and modelling of the Cairo data, and limited supplemental analysis was done to prepare this report for publication. All numbers from the cities are based on the 2006-2007 information.

The main conclusions are presented in terms of economic aspects or the informal sector, performance and economic characteristics of the sector, socio-economic characteristics, and carbon footprint. The recommendations include policy recommendations, recommendations about solid waste management and recycling implementation, and methodological recommendations about using action research.

Results

The results cover economic, technical, environmental, and socio-economic aspects of the informal valorisation and service sector.

Activities and scope of the informal sector

All six cities have a large and active informal valorisation sector, and a smaller informal service sector. The six cities together have a population of almost 23 million, with approximately 73,000 informal sector workers who valorise more than 3 million tonnes per year.

The informal waste and recycling sector in the cities is comprised of two distinct sub-sectors,

- an informal service sector, consisting of individuals and micro enterprise informal service providers (ISPs) earning fees for removal of waste, excreta, litter, and, more broadly considered, 'dirt'.
- An informal valorisation sector, consisting of individuals, co-operatives, and family and micro-enterprises which functions as an extractive resource industry. The main activity of this sector is identifying and removing valuable materials from the waste stream and the commons where waste accumulates, and valorising (extracting value added from) it.

Both the informal service sector and the informal valorisation sector, are private sector micro, small, or medium-sized enterprises (MSMEs).

There are several main forms of valorisation in the informal private recycling sector, which were found in different combinations in the cities:

- Personal or commercial reuse: Using materials for household maintenance, including as food for persons or animals, or as household, agricultural, or business inputs. Second hand shops and flea markets are examples of this.
- Reuse with repair: Repairing items and materials and marketing them to others. This activity was identified but not examined in detail during the research for the study.
- Recycling: collecting separately and/or identifying, sorting, processing, aggregating, storing and trading materials into the global industrial value chain,
- Organics valorisation: collecting separately or sorting and processing kitchen, garden, restaurant, industrial and agricultural plant and animal wastes and paper, and marketing it to the local agricultural value chain as animal feed, compost, or other growth media.

Most forms of informal service provision relate to removing waste from households and businesses and dumping or burning it.

There are a number of distinct informal occupations and earnings profiles, with more occupations in the valorisation and recovery sector than in services. Moreover, there are key and recognisable differences

between the informal service sector and the valorisation occupations.

a. **Service occupations** tend to be paid as waged or piecework labour.
b. **Valorisation occupations** are usually treated like other resource extraction industries and are paid by the kilo or by the item. These businesses focus on extracting materials based on what is profitable, not what is good for the environment.

Materials recycled by the informal valorisation sector are sold directly into the industrial value chain, together with those recycled by formal institutions.

Many more tonnes come into the value chain via informal channels in the cities, than via formal channels, recycling programmes, and other initiatives with an environmental motivation. But materials coming from informal and formal sources end up in the same value chain, and at a certain point become indistinguishable.

Comparison of material recovery by formal and informal sector in the six cities in the baseline scenario (in tonnes and percent of total waste generated)

	Formal sector		Informal sector	
City	**Tonnes**	**Percent of total**	**Tonnes**	**Percent of total**
Cairo	433,200	13%	979,400	30%
Cluj	8,900	5%	14,600	8%
Lima	9,400	0.3%	529,400	19%
Lusaka	12,000	4%	5,400	2%
Pune	-	0%	117,900	22%
Quezon City	15,600	2%	141,800	23%

Informal organics recovery tends to supply animal feeding operations, while formal organics recovery tends to supply composting. Both are in the agricultural value chain, but serve different 'markets'. So these tonnes end up in different places.

Cost and effectiveness aspects of informal SWM activities

A comparison of the formal and informal sectors shows that the formal sector primarily works in service provision (collection and disposal) and does not achieve high recycling rates. This results in high operational costs. The informal sector, on the contrary, primarily works in recovery and recycling of valuable materials. This results in a much lower cost per ton, in most cases a net benefit. Even in Lusaka, where the informal sector is primarily working in service provision and not in valorisation, the net cost is only 2 Euro/ tonne and is 13 Euro/ tonne less than in the formal sector. In all other cities, the difference is much more pronounced. The costs are shown below:

Differences in costs per tonne, net costs per tonne (with revenues for materials sales included), for formal and informal sectors

	Formal Sector			Informal Sector		
	Total cost /tonne €	**Total net cost (benefit)/ tonne €**	**Difference (Revenues from materials)**	**Total cost /tonne €**	**Total net cost (benefit) tonne €**	**Difference (Revenues from materials)**
Cairo	13	5	(8)	55	(90)	(145)
Cluj	25	7	(18)	288	(108)	(396)
Lima	42	41	(0.5)	110	(8)	(118)
Lusaka	35	15	(20)	7	2	(4)
Pune	23	21	(2)	251	(46)	(297)
Quezon	31	28	(3.5)	48	(51)	(93)

Source: Project baseline workbooks. Note: parentheses indicate net revenue

Informal valorisation businesses only extract, process, and sell those materials which have a high intrinsic value and on which they can make a profit. All informal valorisation activities along the entire value chain are profitable. The informal sector in the six cities together makes a net profit of about 130 million Euro. The large profit is able to sustain or add valuable income to sustaining about 73,000 informal sector workers.

The informal sector saves the formal authorities a great deal of money, in total €39 million in the six cities. Most of this is avoided collection costs, €14 million per year in Lima, €12 million in Cairo, and € 3.4 million in Quezon city. The average savings in avoided costs per worker is €571, which in many cities is more than that same worker earns in a year. By engaging in the valorisation activities, the informal sector creates environmental benefits for the municipal authorities, helping them to reach recycling targets and save valuable and expensive landfill space. In all cities except Lusaka, where the informal sector is very small, the informal sector is responsible for diverting more materials from disposal than the formal sector.

Formal selective collection ('recycling') programmes handle materials to keep volumes out of disposal, or because there is a policy for 'recycling'. Formal selective collection usually comes at a net cost per tonne, ranging from a cost of €85 per tonne in Lusaka to a cost per tonne of €8 in Cairo and Lima even including revenues from material streams. We can conclude that recycling may not usually be profitable for formal selective collection programmes, either because:

a. avoiding disposal and its environmental consequences is their main driver, or
b. because the volumes recovered are too small for efficient logistics related to selling the recovered materials to an industrial buyer, or
c. because the formal sector knows too little about how to market to the industrial value chain, and so makes a loss in the trading activity.

Regularising and integrating informal recovery into the overall solid waste system, as modelled in the addition scenarios of the cities, has its main benefits in terms of overall solid waste system costs. The addition scenario modelling results in an increase in tonnes recovered in all cities except Quezon, where the number stays the same. And indeed in the addition scenario, the net costs go down for Lima, and the net benefits rise significantly for Cairo, Cluj, and Quezon. In Pune, tons recovered go up more in the subtraction scenario than in the addition scenario, and the introduction of new higher-cost recovery technologies in both scenarios (incineration in subtraction, composting and digestion in addition) induces higher costs.

Total costs, total costs per capita, and tonnes recovered for the three scenarios

	Baseline			Subtraction			Addition		
	Total cost incl material revenue	Cost per capita	Tonnes recovered per year	Total cost incl material revenue	Cost per capita	Tonnes recovered per year	Total cost incl material revenue	Cost per capita	Tonnes recovered per year
Cairo	(€ 103.963.000)	(€ 13)	1.413.000	(€ 110.001.000)	(€ 14)	1.128.362	(€ 207.990.000)	(€ 27)	1.902.000
Cluj	€ 494.000	€ 1	23.000	(€ 849.000)	(€ 2)	49.000	(€ 13.714.000)	(€ 36)	56.000
Lima	€ 68.786.000	€ 9	539.000	€ 75.270.000	€ 10	376.000	€ 67.815.000	€ 9	549.000
Lusaka	€ 1.168.000	€ 1	17.000	€ 12.761.000	€ 10	12.000	€ 12.904.000	€ 10	60.000
Pune	€ 2.081.000	€ 1	118.000	€ 4.611.000	€ 2	428.000	€ 3.023.000	€ 1	386.000
Quezon	€ 7.292.000	€ 3	157.000	€ 5.161.000	€ 2	126.000	(€ 3.113.000)	(€ 1)	157.000

The viability of informal businesses depends on their ability to identify unoccupied niches in the waste and materials chain in the city. For example, ISPs identify and exploit niches for collection in areas which are not served. They find and extract materials from disposal facilities and waste generators that are not already part of a materials cycle, and complete that cycle.

Environmental aspects of informal sector activities

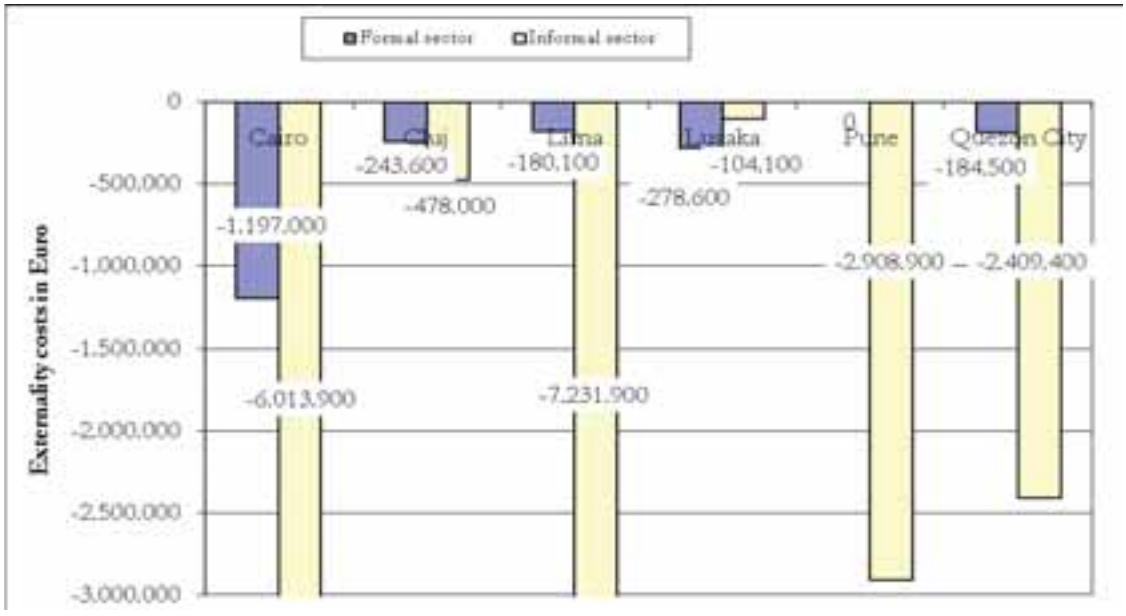
Both formal and informal material recovery and recycling in the six cities are sources of positive environmental impacts. They lead to avoidance of pollution and savings of primary raw materials and

energy, through using secondary materials for the manufacture of new products. The study shoes that the informal sector generates more of these impacts than the formal sector, because they recover more materials.

The carbon benefit of recovery activities comes from avoiding disposal, using less energy, and preventing extraction of raw materials and returning secondary raw material to the production cycle for less energetic volume. These benefits are significant, but their monetary significance depends strongly on the capital/labour ratio and on the financial organisation of the recovery activities themselves. It is not possible to say, for example, that there is always a net carbon benefit in all cities from existing informal activities, nor that integrating the informal sector will produce direct or indirect financial or carbon benefits.

Both formal and informal recovery result in improving the carbon footprint of waste management, by reducing decomposition and methane formation in landfills. But in low- and middle-income cities, most recovery operations are completely or partially informal, so that informal valorisation is the source of many more avoided carbon emissions.
Informal recovery scores considerably better than formal recovery in terms of reduced fossil energy use. This is because many informal activities rely on human or animal muscle traction, rather than on motorised transport. While this is significant, there are some questions as to whether it is sustainable over the longer term.

The carbon benefits from extraction in terms of avoided externality costs are shown below:



Environmental benefits associated with material recovery in six cities, shown as reducing the negative externality costs in Euros

Social aspects of informal sector activities
Average earnings in the informal valorisation sector in Pune, Lima and Cluj, and in the informal service sector in Lusaka, are 110% to 240% above the legal minimum wage. Egypt does not have any legal minimum wage; in Quezon City they are slightly below (but the legal minimum wage is reported to often not be respected by private companies).

Informal valorisers and service providers have unpleasant and dangerous working conditions, but these are compensated by earnings which usually exceed minimum wage. The autonomy and relative freedom of the activity is sometimes also attractive.

Informal enterprises by definition are unregistered, which makes them vulnerable to competition and to exploitation. For this reason many of them would prefer to be recognised as formal businesses, including being willing to pay taxes, but they often do not know how to make this happen.

In five cities, the informal sector provides more livelihoods than the formal sector: in Cairo five times as many, and in Cluj 10 times as many, although not all of these are full-time. Lusaka is the only city where there are more people employed or having livelihoods in the formal sector than in the informal.

Informal and formal livelihoods in the cities

City / Indicator	Total no. of livelihoods in informal waste sector (persons)	Total employment in the formal waste sector (persons)	Ratio of persons working in the informal waste sector to those employed in the formal waste sector	Informal sector households depending fully on income from informal waste and recycling activities
Cairo	33,000	8,834	3.7	91%
Cluj	3,226	330	9.8	31%
Lima (1)	17,643	13,777	1.3	88%
Lusaka	480	800	0.6	69%
Pune	8,850	4,545	1.9	63%
Quezon	10,105	5,591	1.8	82%

(1) Including persons working at informal pig farms. The ratio of persons working in the informal waste sector to those employed in the formal waste sector, when excluding these persons, would be 0,8.

The earning potential for individuals and/or families involved in full-time informal valorisation generally exceeds minimum wage, and almost always exceeds other individual or family livelihood options.

The role of informal recovery in family income and maintenance varies. Certain occupations are full-time family or individual enterprises, others are part-time, often seasonal alternatives to economic activities in agriculture or industry. On average, 71% of all informal sector households where someone works in the informal sector depend fully on the income of that person.

More women earn livelihoods in the informal waste and valorisation sectors than in similar formal occupations. In all cities, more women are involved in informal valorisation than in the formal recycling sector. No women are involved in formal collection, and few or no women are involved in informal service provision in any cities, except in street sweeping, a traditionally female occupation. Women in the valorisation sector tend to be involved at the level of family-owned junk shops or as traders of materials, or as initiators of community-based enterprises.

Owners and workers in these businesses are subject to work-related illnesses and injuries. They seldom protect themselves, and usually do not have access to health care or hygiene – such as washing facilities, protective equipment, or health services. There is room for improvement of conditions and access to health and safety conditions, but it may affect the profitability of the enterprises.

Conclusions

The baselines for the cities have been a key factor in understanding the relationships between different parts of the system: formal and informal, private and public, valorisation and service. But above all they have shown that all parts are related to one system, and that interventions designed for one specific part usually affect all other parts as well. In many cases, formal and informal waste management activities are complementary, but they might also be competitive.

The study shows that the informal solid waste management sector contributes significantly to the productive use of waste materials. It can implement recycling activities at a much lower cost than the formal sector. Because of their long dependence on the industrial value chain, informal entrepreneurs are experienced with valorisation, and can relatively easily learn to divert and process whatever material is not already claimed and valorised. It is clear that those working in informal recycling, in particular, have a high degree of specific knowledge about identifying materials and marketing them and making use of them in a flexible manner.

Working with the informal sector is a sub-activity in a private sector participation (PSP) or public-private partnership policy or strategy for cities. But informal workers have much less general business knowledge, and are often socially disadvantaged groups. For this reason, proposed interventions or policy changes need to be consider the specific circumstances of the informal sector, in order to avoid unexpected impacts specific to their characteristics.

Most recovery operations are completely or partially informal, and many more tonnes pass through the informal valorisation systems than are counted in formal recovery statistics. This makes the informal sector a source of considerably smaller carbon footprint.

By engaging in valorisation activities, the informal sector creates social benefits and indirect economic benefits for the municipality. Had there not been this potential source of income for this mostly unskilled, marginalized group of people that are informal sector workers, authorities would likely need to provide social assistance to them.

The policy modelling exercise clearly indicates that a stronger integration of the informal sector in the cities' solid waste system has the potential to not only increase the informal sector revenues, but also to reduce the formal sector costs and the total solid waste system costs in a city. In Quezon City, the formal sector would see its costs reduced with a subtraction scenario, but these benefits would have to be economically balanced with a much higher loss in informal sector income opportunities.

Policies that facilitate stronger integration of the informal sector can be expected to result in an increase in the rate of material recovery. Such an increase would be modest in some cities, and dramatic in others, but in all events, disposal rates can be predicted to drop, allowing for modest savings in investments for transport to landfills, landfill space and landfill operation.[1]

Recovered, disposed and lost proportions of the total tonnages handled (%) in relation to policy analysis

	Baseline			Subtraction			Addition		
Scenario	**Recovered**	**Disposed**	**Lost**	**Recovered**	**Disposed**	**Lost**	**Recovered**	**Disposed**	**Lost**
Cairo	43%	32%	35%	35%	40%	35%	58%	17%	35%
Cluj	13%	74%	18%	27%	55%	18%	30%	51%	18%
Lima	20%	79%	2%	14%	84%	2%	20%	78%	2%
Lusaka	6%	57%	38%	4%	58%	38%	20%	57%	24%
Pune	22%	59%	19%	79%	11%	10%	71%	11%	18%
Quezon	25%	73%	2%	20%	76%	4%	25%	73%	2%

Note: The percents may not add to 100% for several reasons. First, they may not exactly add to totals because of rounding operations. Secondly, some tonnages disposed are then recovered, so that they are counted twice.

Integrating the informal sector in the addition scenario would lower overall costs in three cities: Cairo, Cluj, and Quezon. In Lima, costs would stay the same. The subtraction scenario also reduces costs and/or increases benefits in the same three cities. In the other two cities, both scenarios increase costs substantially, with the subtraction scenario increasing them more for Pune. This is related to higher costs associated with more technologically complex and capital-intensive treatment technologies in recovery (incineration and composting/digestion) foreseen in the subtraction and addition scenarios.

This shows that the overall system costs do not only depend on the question whether informal stakeholders are included or not, but on the logistical and treatment options applied. Nevertheless, the study shows that the informal sector often has a broader experience in identifying profitable ways for valorising waste.

Recommendations for policy and practice

The information from the six cities offers us many ideas about how to improve performance and equitability of waste management policies, to optimise both the performance of the system and the returns

[1] Reduction of tonnages going to landfill may increase specific disposal costs for remaining waste, but net disposal cost savings and a delay in the need to invest in new disposal capacity are still among the benefits that can be expected.

to the informal sector entrepreneurs.

Investigate and track the performance and impact of the existing informal valorisation and service sectors: Understanding the sector is only possible if there is data. It is important to include the economic and technical performance of these sectors – together with their socio-economic profile – in annual reports, reviews, and as the baseline for planning. Once the amount of valorisation that is happening is recorded, it is easier to track whether the modernisation process actually results in increased levels of valorisation, or merely a shift of the tonnes from the informal to the formal and at what cost. Seeing, understanding, and measuring informal valorisation activities is important because it provides a basis on which to build recycling activities and meet national or international recovery goals. If the baseline shows convincingly (and not merely by assuming) that there is no recovery happening, there is full scope for municipal innovation. Thorough market and value chain research is also advisable to avoid collecting recyclables for which there is no market.

If it ain't broke, don't fix it: This English proverb highlights that it is better to build on what is working, than abandon or destroy it in favour of something unknown that might or might not work. Where there are robust levels of recovery already occurring, the supply chain is working. The resource recovery goals may already be met and just need to be documented. In this situation, municipal (or NGO) activities to 'set up' recycling are likely to disturb existing supply relationships. Either the supply relationships will 'win' and the municipal programme will be ineffective, or the municipal programme will 'win' and many poor people will lose their livelihoods.
Where a careful investigation finds little or no informal valorisation activity, the supply chain is weak or missing, or there are geographic or demographic reasons for no valorisation. In this situation, contacts and consultation with informal entrepreneurs can result in legitimising and building on existing efforts or supporting informals to diversify their business models.

DO fix what doesn't work: Not every aspect of the informal sector is ideal, and problems need to be recognised, and confronted. The highest on the list are: the health and safety conditions; negative environmental effects from recovery and recycling processes, the transaction costs in terms of harassment, bribery, and the effects of criminalisation; the involvement of children; the lack of available shelter, hygiene, and social and health protections; and, perhaps the most critical, the lack of formal recognition. Many informal entrepreneurs need support in order to organise new market relationships or longer-distance logistics, or to improve the efficiency and scale of collection and processing systems.
These problems must be fixed, or improved, but informals themselves need to be treated as key actors in this process. Often, it requires facilitation, leadership, advocacy, inter-agency co-operation and an inter-disciplinary team to find solutions. The municipality – often in combination with NGOs, can organise sourcing, horizontal linkages, and certain kinds of social and political protections that the informal sector cannot usually manage on their own. With some organisational help, recovery rates can rise and the working conditions of the informal sector can improve.

Build structures that link the formal and the informal: It is essential for local authorities to create structural relationships between the solid waste system and the formal and informal valorisation sector. In OECD countries that went through modernisation 20 years ago, the practical way of doing this was to appoint a "recycling coordinator" whose job was to be the liaison with the informal and formal private recycling sector on the one hand, and to improve the municipality's understanding of the value chains, and critical technical and logistic issues. The structures in which stakeholders in removal services work can provide models of good practice for new relationships between formal and informal sector.

Affordable technologies are the most practical and sustainable: The study shows that expensive technologies create reverse institutional and systemic linkages that drive out the informal sector in order to pay for themselves. It is therefore key to moderate technical ambitions for new disposal and processing technology, so as to keep them affordable in the short- and middle- term.

Light Regulation: Create a portfolio of low-threshold formalisation measures, which combines regulation with facilitation of improvements, and documentation of results. Light regulation can provide the city with key data and points of influence, without requiring things that informals may not have, like a street address or an identity card or a bank account. It involves creating instruments, policies, or institutional contact

points that are able to work with informals to modify or improve their activities.

Some Examples of light regulation:

- The "Linis Ganda" model, which authorises an NGO or union to issue identity cards for its members that give them access to areas which have high generation of valuable recyclables.
- "The Lusaka model." Allow documented informal sector entrepreneurs, such as the unregistered collectors in Lusaka, to dispose of their residues (or collected wastes) in formal skips or controlled disposal facilities, and so they can stop illegal dumping of the collected wastes, a source of environmental problems.
- The "Swatch model" creates instruments that improve working conditions and reduce transaction costs for individual informal entrepreneurs, while improving overall quality. This Pune approach involves creating micro collection and recycling zones for pairs of informals. In Pune, the city provides health insurance, and the union has designed a wet-dry source separation protocol. The system is based on a minimal form contract, and a standard for calculating service tariffs. There is a standard model for wet-dry collection. Service fees are paid directly by the households to a service provider whom they know personally, and the service provider also has the right to valorise both the dry recyclables and the organic waste.
- The "Lima model" also combines service and valorisation by providing tricycles or push-carts for larger informal groups in middle-class areas. In Lima, uniforms, gloves, and transport equipment are provided, and the informals have the rights to the access of the materials.
- The "Quezon model" is a model of organised acceptance of informal activities, and comes out in two ways. First, truck pickers are formal workers who are authorised to pick and valorise materials. In return for this right, they accept a sub-minimum wage salary which lowers city and Barangay (village) budgets for solid waste. In a similar way, informal junk shops can receive an authorisation to function as materials recovery facilities (MRFs). This semi-formal status channels formal recovery activities to the private recycling business, and both the city and the junk shop benefit.

Use the comparative carbon advantage of the informal sector: This study makes it clear that the informal valorisation sector is more active and more effective than the formal one. In low- and middle-income cities, even though informal and formal recovery have the same impact per tonne on reducing the carbon footprint or resource management and on reducing decomposition and methane formation in landfills. Furthermore, informal recovery scores considerably better than formal recovery in terms of low or no fossil energy use. This is because many informal activities rely on human or animal muscle traction, rather than on motorised transport. While this is significant, there are some questions as to whether non-motorised approaches are considered to be acceptable to cities over the longer term. Interventions and research supporting the design and procurement of low-energy and small-scale collection, transfer, processing and disposal systems is a helpful input.

Enable scaling up existing organic waste handling: In low- and middle-income countries, there is usually substantial re-directing of organic waste to animal feeding, composting, or land-spreading and other uses. This reduces the generation of methane, which has a direct impact on reducing methane formation and eliminating greenhouse emissions. New plans for diversion and/or valorisation need to take existing practices into account. Special attention should be paid to open markets, food and beverage producers, and agricultural, silvacultural and horticultural businesses not only as generators of organics, but as potential users of valorised organic waste as well. Here again, the involvement of formal authorities in facilitating increased "market development" for compost and animal feed is a win-win situation.

Develop Carbon Financing Projects: Carbon financing is already a reality for co-financing the first of the three carbon footprint reductions strategies: limiting fossil energy use, and avoiding methane formation, can already earn certified emission reductions (CER) credits. There is also hope for carbon financing to reduce extraction impacts, but at the moment the only methodology, for plastics recycling, is still in development (10-2010). Only one recycling methodology exists: for plastics recycling, but no credits have yet been issued. Carbon financing could thus become an instrument supporting integration of the informal valorisation sector, but only if municipal and national authorities, and multi-lateral institutions, invest in developing it further.

List of abbreviations

AMA	Arab Management Association
ANPE	Agence Nationale pour la Protection de l'Environnement
AWP	Authorized Waste Pickers
BMZ	German Federal Ministry for Economic Cooperation and Development
BMZ	German Federal Ministry for Economic Cooperation and Development
CBE	Community Based Enterprise
CBO	Community Based Organisation
CCBA	Cairo Cleansing and Beautification Authority
CDM	Clean Development Mechanism
CEDARE	Centre for Environment and Development for the Arab Region and Europe
CID	Community and Institutional Development Consulting (an NGO in Egypt)
CIWMB	California Integrated Waste Management Board
CONAM	National Environmental Council (Peru)
COP	Kyoto Protocol Committee of Partners
CPHEEO	Central Planning Health & Environmental Engineering Organisation
CWG	Collaborative Working Group on Solid Waste in Low and Middle Income Countries
DANIDA	Danish International Development Agency
DIGESA	Environmental Health National Directorate (Peru)
DOC	Degradable Organic Carbon
ECOROM	Name of Cluj Recycling Initiative
ECZ	Environmental Council of Zambia
EEAA	Egyptian Environmental Affairs Agency
EHDR	Egypt Human Development Report
EIT	Economies in Transitions
EM	Effective Micro Organism
EPA	Environmental Protection Agency (Romania)
EU	European Union
EU ETS	European Union Emissions Trading Scheme
FCC	Fomento de Construcciones y Contratas
FOCARFE	Fondation Camerounaise pour une Action Rationalisée des Femmes sur l'Environnement
GCR	Greater Cairo Region
GDP	Gross Domestic Product
GHG	greenhouse gas
GoE	Government of Egypt
GTZ	German Technical Cooperation
HDPE/ PEHD	High Density Polyethylene
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
HUDCO	Housing and Urban Development Corporation
IETA	International Emissions Trading Association
IETA	International Emissions Trading Association
ILO	International Labour Organisation
INA	Information Not Available
IPCC	International Panel on Climate Change
IPES	Promoción del Desarrollo Sostenible (an NGO in Peru)
IPM	Organisation in Quezon
ISP	Organisation in Pune
ISWM	Integrated sustainable waste management

ISWM (Cairo)	Integrated solid waste management
IWB	itinerant waste buyer
JI	Joint Implementation
KKPKP	Kagad Kach Patra Kashtakari Panchayat (waste picker union)
LCA / LCI	Life Cycle Analysis / Life Cycle Inventory
LDPE	Low Density Polyethylene
LGU	Local Government Units
MDGs	Millenium Development Goals
MoU	Memorandum of Understanding
MPCB	Maharashtra Pollution Control Board
MRF	materials recovery facility
MSE	Micro and small enterprise
NA	Not applicable
NBCC	National Building Construction Company
NGO	Non-Governmental Organisation
OANDA	Online Currency Converter
OCC	Old corrugated containers
OECD	Organisation for Economic Cooperation and Development
ONP	Old news print
PARE	Payatas Alliance for Recycling Exchange
PET	Polyethylene Terephthalate
PFD	process flow diagram
PMC	Pune Municipal Corporation
PP	Polypropylene
PPP	Purchasing Power Parity
PPP	Public-Private Partnerships, (PP)PPP: *Pro-poor* public-private partnerships
PROPOLI	MSE support organisation in Peru
PS	Polystyrene
PVC	Polyvinyl Chloride
RDF	refuse derived fuel
REPA	Regional Environmental Protection Agency (Romania)
RMG	Regional Management Group
SFD	Social Fund for Development
SME	Small and medium enterprise
SW	Solid Waste
SWAPP	Solid Waste Management Association of the Philippines
SWM	Solid Waste Management
ToR	Terms of Reference
UK	United Kingdom
UNEP	United Nations Environment Programme
UNFCC	United Nations Framework on Climate Change
UNICEF	United Nations Children's Fund
US or USA	United States (of America)
USEPA	United States Environmental Protection Agency
WB	The World Bank
WEEE	Waste from Electronic and Electric Equipment
WMU	Waste Management Unit (In Zambia)

1. Chapter 1. Introduction

In many low- and middle-income countries, collecting, sorting and recycling provides income to hundreds of thousands of people worldwide, as it did in Europe and North America until the late 20th century (Scheinberg 2003). They work on the streets, at dumpsites, in transfer stations, separation plants or at the landfill. They are the principal actors in recycling, collecting and valorising recyclables and organic waste from households and businesses and scavenging from containers. In cities where the formal waste collection system does not provide collection to all areas and households, the solid waste informal service sector makes service agreements with individual households or businesses to remove their waste.

What is the economic impact of the informal sector in solid waste on society as a whole? The reason for needing an analysis of the informal sector is that, because of its informal nature, there is little reliable data on this sector, and even less systematic analysis of its impact on society in general, and on the formal solid waste system in particular. Gaining insight is growing in importance, due to the pressure for rapid modernisation of the solid waste management sector, but also because of the global interest in poverty alleviation and the MDGs. Exploring the issue and beginning to find answers is becoming a pressing need.

Informal sector waste pickers and recyclers tend to work long hours, with primarily muscle-powered equipment, and are responsible for most waste recycled in cities in the South[2] (Anschütz and Scheinberg 2004). The solid waste and recycling informal sector came into being in the period of industrialisation and urbanisation in Europe and North America in the 1880s. "Ragpickers", now referred to as 'waste pickers' or 'scavengers', operate in parallel to, or in competition with, formal, government-sponsored solid waste and recycling systems. Low social classes and castes, ethnic minorities, refugees, and others who have few skills or resources can enter the solid waste informal sector with relative ease, and, if they are willing to work hard, suffer social stigma and risk their health and safety, can earn a reasonable livelihood recycling the discarded resources that make their way into the commons. The income that these micro-entrepreneurs earn supports them and their families. Income from waste picking is sufficiently attractive for most of them to keep working in the sector despite very poor working conditions and health hazards (Rivas, Price and Lardinois 1998). The cities they serve get the operational and environmental benefits of recycling activities and the social and governance benefits of reduced poverty among vulnerable populations (Anschütz and Scheinberg 2004).

Informal waste workers make an economic contribution in their cities by recovering materials to feed local, regional, or international industries. This has a positive environmental benefit in terms of reducing the resource and extraction impacts of industrial activity, and an energy benefit because the processing of recycled materials usually takes less energy than extracting and processing virgin materials, but this impact has not been quantified prior to this study in 2006. Waste picking makes an additional environmental contribution by reducing the volume of material reaching the legal or illegal disposal site, avoiding emissions from disposal and extending the life-time of waste facilities. Informal waste and recycling activities also have local environmental costs, most of which have to do with burning waste materials, or discharging residues and pollutants from processing activities.

Since the 1980s, a range of social scientists and waste management specialists have worked on developing new approaches to integrating the informal sector into the modernisation process. By now there is a considerable body of literature concerning the operations and social circumstances in which the informal sector operates (Wehenpohl 2005, see also IPES 2004, Anschütz and Scheinberg 2004). Much of the socially motivated activity has a focus on eradicating child labour, or on social improvement strategies which seek to facilitate an exit from waste work to "something better." In general, these well-motivated interventions appear to have pleased few stakeholders, in part because they advocate exit without income replacement, which is a net economic loss in most cases. Moreover, many such interventions fail to consult the waste pickers themselves, who may choose to continue to pick waste because it provides the highest possible income or the best range of options in their circumstances (Anschütz and Scheinberg 2004).

[2] The term "South" is used to refer to developing countries, sometimes it is called "Global South".

A number of advocates for the informal sector, in Brazil, Manila, India, Mexico, and Cairo (and a range of other cities) have worked along different lines, focusing on documenting, recognising, and ultimately legitimising the activities of the informal sector and integrating them into the formal solid waste system, which is usually also undergoing growth, modernisation, and/or privatisation. This attempt at integration of informal sector activities into formal solid waste management systems has met with mixed success, and has often failed or been abandoned. This may have to do with the fact that advocates and planners are hampered by the lack of reliable economic data with regard to costs and benefits of informal sector activities in relation to the formal solid waste sector. Annex 2 presents an annotated bibliography of this literature.

1.1 Goals of the Study

The goal of this report is to support waste management and development practitioners, public sector policy-makers, donors and investors in making good decisions about how to handle and work with the informal solid waste sector during the modernisation and improvement processes in cities. "The aim of the study is to provide reliable arguments within discussions about the impact of informal sector activities in municipal solid waste management in economic terms. As the informal sector often is regarded as little profitable, not organised or not trustworthy, only few cooperation models between public, private and informal private sector have been initiated so far. An economic argument within this discussion is supposed to be fruitful and positive" (Terms of Reference - ToR). This report seeks to support policy-making in the solid waste modernisation process by providing reliable information about economic aspects of the solid waste informal sector, with a focus on how this sector interacts with formal governmental and solid waste management (SWM) structures.

The report presents four different types of information:

1. **information and analysis of the six cities** provides a framework for other cities to understand their informal solid waste sector and the costs and benefits associated with its activities.
2. the **results from the analysis and calculation of operational, environmental, and socio-economic costs and benefits from informal waste activities** in the six cities provides a strong basis for policymaking that results in integration, rather than exclusion, of the informal sector in the modernisation process.
3. the **methodology** used in the study to get the information and make the analysis **is being made available** to policymakers, advocates, planners, donors, and others, to use to make their own analysis of their own situation.
4. the **process experience** of the six city partners and their cities, and the innovative approaches they have created and modelled, suggests a mode for local authorities and others to engage in processes and ways of (potential) conflict management conductive to win-win modernisation strategies.

1.2 Key Concepts

The study focuses on analysing informal economic activities in two closely related sub-sectors, the informal service sector, and the informal valorisation sector. A number of key concepts are used in this report, which are introduced here, and then further defined and explained in the Glossary in Annex 1.

The "**informal solid waste sector**" refers to individuals or enterprises who are involved in private sector recycling and waste management activities which are not sponsored, financed, recognised, supported, organised or acknowledged by the formal solid waste authorities, or which operate in violation of or in competition with formal authorities[3].

The "**formal solid waste sector**" refers to individuals, enterprises or institutions engaging in formal

[3] Based on the following definition agreed on by project partners: "In this context "informal" refers to those who make a living from solid waste but are not formally in charge of providing the service, i.e. having contracts with a municipality or being paid by it. For example a co-operative working under a contract with the municipality should not be regarded as "informal" whereas a co-operative working without recognition of the official system is part of the informal sector."

public or private sector solid waste management, recycling, composting, or related activities which are planned, sponsored, financed, carried out, contracted, franchised, regulated and/or recognised by the formal solid waste authorities or their agents.

"**Impacts**" refers to the effects, both positive and negative, of formal and informal solid waste sector activities in general and on the solid waste system in that city. The main impacts analysed include (1) operational or practical impacts, related to the costs operations, efficiency, and effectiveness of the solid waste and recycling systems themselves, (2) carbon footprint of positive and negative environmental impacts, referring to positive and negative environmental externalities flowing from the systems, and (3) socio-economic impacts, referring to social and other effects on the people in the system, and on the society at large. A much broader discussion of the impact analyses, and how they have been developed, is presented in Annex 4.

"**Valorisation**", also referred to as *recovery*, refers both to the extraction, processing, transport, and sale of reusable and recyclable materials in the recycling value chain, and to the commercialisation of organic waste as animal feed, compost, or soil supplement in the agricultural value chain.

"**Services"** include waste removal, transport, and disposal, and other urban cleansing activities such as street sweeping, green space maintenance, and drain clean-outs.

"**The solid waste informal sector**" refers to both informal service providers and informal valorisation businesses, enterprises, and individual or family entrepreneurs. The businesses and individuals in the informal solid waste sector are in the "**private sector.**"

"**Micro and small enterprises (MSEs)**", "**Community-based Organisations (CBOs)**", and "**Non-governmental organisations (NGOs)**" may be considered as belonging to either the formal or informal sector depending on their status in the specific city, and whether they are involved in providing services or trading materials on the one hand, or in capacity development, advocacy, and research on the other.

Solid waste modernisation[4]

'Modernisation' is used the term to mean a series of (desired) changes in a socio-technical system, such as solid waste management, energy or transport, which appear to follow a generally similar path in many different places. What is not meant is "improved or higher technology." Modernisation here goes beyond its common interpretation 'modernisation as westernisation': the further development/ modernisation of socio-material infrastructures along lines of centralisation, advanced technologies, larger scales, more market involvement and stronger relying on expert systems Nor is it the case that the "modernised" system is necessarily better than the one it replaces or from which it has evolved.

'Modernised mixtures' refers to socio-technical complexes of infrastructures, institutions, and payment systems which combine large-scale, centralized, high-technological, low citizen-consumer participation models, with small-scale, decentralized, less technologically advanced and more participative models. Such a mixture is comprised of a variety of economic actors offering a variety of technical solutions that respond to growing demands for improved environmental performance, higher levels of client participation, increased competition associated with de-regulation and liberalist politics, and new insight on economies of scale. In solid waste management practice, the term "integrated solid waste management" is often used to cover the same phenomenon. Well-functioning waste management systems in more "developed" countries are usually a mixture of technologies, scales, approaches, and economic niches. This suggests that modernising and upgrading these systems in a sustainable way involves adapting and improving the infrastructures in the specific local situation, and adapting the mix to the needs and wants of the stakeholders, rather than copying the large-scale systems that have dominated western service provision during the former century.

Multi-provider and multi-model systems are increasingly advocated in solid waste collection services in

[4] Parts of this section are drawn from a paper on the study submitted for publication by Habitat International, entitled "Assessing urban recycling in low- and middle-income countries" by Scheinberg, Spies, Simpson and Mol

developing countries in much of Africa, Asia and Latin America, often under the heading of 'pro-poor Public-Private Partnerships (PPPs)', micro-franchising, and the like (Ishengoma and Toole 2003, Slater, R., *et al* 2007). Recycling, resource management, and a variety of activities to valorise materials and items found in the waste stream are less easy to understand, because unlike collection service, the business model for recycling relies on income from trading materials. In developing countries, the informal sector is a main source of materials for the recycling supply chain.

A process flow-materials balance approach, because it is a visual representation of which steps are formal and which are informal, and how the processes interacts across sectors, is ideal to capture the degree of mixing in such a system. Moreover such a way of viewing solid waste and recycling systems provides a basis for understanding a modernisation model where recognition and integration of the informal sector is simply one more variation that leads to optimal functioning of the whole system.

1.3 Methodology

While the research study is not primarily an academic document, there are some theoretical and methodological concepts which are helpful to explain, with some reference to theory, methodology, or underlying disciplines.

1.3.1 Multi-city action research

This study has been carried out by an international project team using the strategy of multi-city action research. In multi-city action research, the focus is on the work of research partners in a network structure, each of whom takes responsibility for investigating and analysing his or her own local circumstances, with a common, agreed-upon set of tools and approaches.

The strategy used to investigate and model the economic aspects of the informal sector is based on a case analysis of the solid waste formal and informal sector, and the interactions between them, in six cities on four continents.

The six cities studied are:
1. Cairo, Egypt
2. Cluj-Napoca, Romania
3. Lima, Peru
4. Lusaka, Zambia
5. Pune, India
6. Quezon City, the Philippines

In this study, each of the **city partners** has been responsible for its own team composition, scoping, work approach, schedule, relations with formal and informal stakeholders, and for producing the main products. Data collection, analysis, and report and workbook generation have been done in a decentralised way by the six autonomous city partners.

In this approach, choosing the partners becomes the means for selecting the cities. The proposal team sought a balance not only of different types of organisations, but of principal researchers with different qualifications, who together comprise a multi-sector and multi-disciplinary project team as shown in Table 1 below.

Table 1. City partners

City	Pune	Cairo	Lima	Cluj	Quezon	Lusaka
Partner	KKPKP	CID and Dr. El-Sherbiny	IPES	Green Partners	SWAPP	Riverine Associates
Type of organisation	Waste pickers association	Consultant and advocacy organisation	NGO institute consultant	Private environmental consultant	Solid waste association	Private urban planning consultant
Researchers	Social scientist, social worker	Educator, waste management	Industrial Engineer, economist	Environmental Economist, social worker	MSc. Public Administration, researcher	Architect, city employee

		specialist				
Role of organisation	Advocacy	Bus. /social Development	Consulting, Research, Lobbying	Consulting and Research	Trade Association	Urban and environmental planning
Core areas of expertise	Informal waste sector, social activism	Informal waste sector, education	Solid waste, economics, informal recycling sector	Environmental policy, water, fiscal policy	Solid waste/ recycling organisations, policy, operations,	Urban and master planning, sustainable development,

The research process included an accompanying action research and capacity-building strategy, focused on strengthening the capacities of the six city partners to act as agents of change in their cities. By doing their own research and modelling, each city partner increased their own abilities to collect and analyse data, strengthening their capacity to understand and analyse the informal solid waste sector, and to assess relationships and effects on the formal sector. This became the basis to formulate policy and programmatic responses to improve both the condition and position of the informal sector on the one hand, and the performance and cost-effectiveness of the total solid waste system on the other.

The method falls under action research because it is designed to change the situation at the same time it studies it. By this we refer to the fact that the project created a necessity for each of the city partners to engage with their city authorities, not only to get information on systems and plans, but also in terms of exploring problems and co-designing hypothetical scenarios based on plans or legislation. At a minimum this created a political awareness that the city was participating in an international project, and engages local authorities and other stakeholders in formulating scenarios and evaluating policy options for the future.

In most cities, participating in the study has already begun the process of influencing decision-making. Several cities even anticipated the study results by enacting laws, regulations, or policies that support integration of the informal sector in the modernisation process.

The case analyses, or **City Reports**, are based largely on existing data, supplemented by fieldwork done to verify or triangulate desktop information[5]. Limited field work includes:

- sampling of waste
- interviews with waste pickers and junk shops
- household focus groups
- block census exercises to count the informal sector collectors active in the city.

The emphasis throughout the research, analysis, and reporting phases of the study has been on transparency and traceability. The strategy is to choose an estimation or extrapolation approach that is a traceable and transparent approximation, rather than a less transparent but potentially more accurate manipulation of existing data.

1.3.1 Process flow modelling and cost analysis

The second element of the research strategy was to use a modelling approach, rather than relying on measurement, experimentation, direct observation, forensic techniques, or other types of investigative strategies. The core of the analytic approach is a process flow and materials balance for the entire solid waste and valorisation system in each city. The city partners research and diagram their waste systems, and then do additional economic research on the process steps to be able to model costs and benefits, effectiveness, efficiency, energy use, employment, and other operational aspects of their solid waste systems. The process flow diagram (PFD) presents the movement of materials through **process steps** in the solid waste system. Process steps begin with **generation** at the household (or business) level, the point at which a decision is made that a useful item is no longer useful and should be discarded. Other common process steps include **primary collection** or **separate collection from households**, by city or private collectors or by itinerant waste buyers **(IWBs)**; **disposal** in a **landfill** or in a **managed** or

[5] Where data were not available, the city partners were encouraged to make transparent assumptions, based on best available regional, international, or local information and benchmarks, and to explicitly state these assumptions in their reports and in the workbooks. The city partners take responsibility for their assumptions, and these were not verified by the project team.

unmanaged dumpsite, **transfer**, and **processing**.

The process flow steps in the PFD are then subject to a simplified pro-forma activity-based unit cost analysis, which is designed to provide a snapshot of what is the current cost of handling waste materials in the formal and in the informal waste sector within the Partners' cities. The main output of the operations analysis is a total system cost or benefit, and a system cost or benefit per ton, based on input tonnes. Revenues are included in the net cost when they are revenues for materials. Revenues for services are not included in the net cost calculation, but they are analysed separately to see whether there is cost recovery.

1.3.2 Policy analysis using scenarios

To serve the goals of policy analysis, the team used the baseline scenario as the platform for modelling and evaluating the results of two different types of policies. The *subtraction scenario*, represents one possible and plausible interpretation of a newly enacted law, a newly endorsed plan, or other planned modernisation activity in which the activities of the informal sector are severely restricted, via laws that forbid or criminalise valorisation, or claim a monopoly for the local authorities or their agents, or that denies informal valorisers access to materials. In this scenario, informal valorisation activity declines, and the city bears the positive and negative consequences of having to handle all the materials going through informal channels.

The *addition scenario* is an alternative, but equally possible and plausible interpretation of a newly enacted law, a newly endorsed plan, or other development, in which the policy environment expands its focus on recognising, including, and working with the informal sector, with the largest focus on valorisation. In this scenario the role of the informal sector increases, but does not necessarily become formalised.

1.3.3 Carbon Footprint analysis

The availability of the International Panel on Climate Change (IPCC) guidelines on greenhouse gas (GHG) emissions has allowed the project team to identify and use a single method for monetising the carbon footprint of formal and informal activities. However, this does not mean that it was possible to do a full environmental impact analysis[6]. The main indicator used to estimate and subsequently quantify the environmental impact is greenhouse gas (GHG) emissions. The GHG emissions at each process step of the mass balance model were calculated. The GHG emissions arise directly and indirectly from:

1. Extraction of raw materials and their use as inputs to production of various goods and services, compared with the use of recovered material which originated in the waste stream, as compared to virgin materials.
2. The use of energy in the form of fuel and electricity in the process of collection, recovery/recycling and other process steps.
3. Emissions, based on the generation of methane associated with disposal of putrescible materials at dumps, landfills or final disposal sites, compared to the emissions if materials are recovered.

This method of analysing environmental impacts was chosen to allow for a single method to compare six very different cities with different resource profiles and emissions factors. By choosing for comparability, the project team also understood that we were structurally underestimating the specific, local, non-energy-related positive and negative environmental impacts of both waste services and recycling. Negative impacts are associated with emissions to air, water, and land of the recycling processes, illegal disposal in the cities, and related health and livelihood impacts. Positive impacts are on local resource flows and local economic development, as well as in terms of the simple impacts of less waste in air, water, and as litter.

The GHG emissions have been converted to metric tonnes of CO2 and multiplied by the international price of carbon credits to reach a monetised value of the environmental impact.

The main output of the environmental impact analysis is a monetised cost or benefit per tonne for the

[6] The IPCC guidelines available date from 1996. The 2006 update had not been released at the time of the methodology development, and at the time of the update, is still not widely in use in the carbon financing expert community (Reka Soos, personal communication).

formal and informal sector activities in each city, which is, in a further step, integrated with the output of the operational cost analysis[7]. Ultimately, the benefits for the informal sector come, on the one hand, from the fact that it recovering more recyclables than the formal sector. On the other hand, the benefits to the entire system come from the fact that without informal sector activities, far less would be recovered and more would be discharged to disposal.

1.3.4 Socio-economic aspects of informal waste management and recycling

The socio-economic analysis is based on indicators and qualitative information gathered by the city partners, and is an analysis of what happens to people in the system. In contrast to the environmental impacts, therefore, the socio-economic impacts are primarily qualitative, since the information was not robust or consistent enough to lend itself to modelling and monetisation.

The major issues covered include:

- Earnings and livelihoods
- gender,
- child labour,
- income,
- occupational health, and
- level of organisation.

The six cities varied considerably in the availability and reliability of this data, and in the basis for making estimates or assumptions. Traceability is a challenge, so this qualitative information should be interpreted as being indicative.

1.3.5 Sources and agreements about data and information

When modelling complete waste systems in six cities at the same time, are many types of data and information which are needed for calculations, but are unavailable or available only as assumptions and estimates. This means that the "proof" that the study offers about economic aspects of the informal sector in solid waste lies in the critical mass of information that points in particular directions, and not in the details of any one number. Most quantitative information is indicative, rather than precise. The effect is similar to looking at a low-megapixel photograph: from a modest distance it is clear, and presents an accurate and understandable image. But as the distance shrinks, it is more and more difficult to understand the details, and how each one contributes to the overall picture.

At the same time, there is no point to do the study unless it can provide solid conclusions, and these conclusions need to be connected to real world data – and also information which the authorities recognise as coming from the formal sources that they are using for planning and policy-making. So the project has adopted an approach to research based on the following strategies:

- Always looking for the best data and information available for each city, even if it is not available for all cities;
- Choosing official figures and relying on public authorities' data and information when it is less than five years old, and unless there is a compelling reason not to do so;
- Adjusting official figures based on existing field data where available, supplemented by existing desktop estimates, calculations, and studies;
- Supplementing desktop information with strategic new field research designed to triangulate conflicting information and increase confidence in trends and estimates;
- Adding the insights and experience from a broad selection of both published sources and grey literature;
- Referencing practical experience of the study team and other practitioners, analysts and theoreticians, when no other formal source of such experience has been available; and
- Making transparent assumptions, where no references serve.

[7] In addition, it has been in some cases possible to attach environmental costs and benefits to specific process steps. However, these figures are more complex to interpret, because of differences between informal and formal recovery operations. For example, the informal recycling supply chain in South cities usually has more steps, and thus more intermediate actors, than formal recycling. Also there are many cross-overs.

The main criteria in choosing between competing or conflicting sources of data and information has been reasonableness, plausibility, transparency, and traceability. Making judgements about this has been a responsibility clearly given to each city partner organisation, in consultation with the project support team.

1.3.6 Precision, verifiability, and traceability

Verifiability in this methodology rests on cited documentary sources, internal consistency of the mass balance calculations, transparent and traceable assumptions and analysis, and the familiarity of the city partners with the situation on the ground in their cities. Modelling is designed to simplify reality, and in the process precision to two decimals is confusing, since many of the numbers are estimated or triangulated. Therefore the numbers used for spread-sheet calculations, as well as cost information, are rounded in the report itself. with one or two decimals. Specifically:

1. Numbers presented in tables and graphs are presented as whole numbers.
2. Percents are presented with rounding to whole percents, except when there is a percent less than 1 but greater than zero, in which case rounding is to one decimal
3. References in the text are based on rounding to the nearest whole number, or in the case of large numbers to the nearest tens, hundreds, or thousands.

A modelling exercise by its nature does not produce absolute truth. The outputs of any model are only as valid as the combination of the input assumptions and the overall construct of the model itself. Based on limitations of the scope of the project, a hierarchy of data assumptions was developed as part of the modelling protocol. The focus of this hierarchy was to make the best possible approximations, that is, to get as close as possible to probable truth; but also to keep sources, assumptions, and calculations always accessible and open to the readers and researchers who will use the report.[8]

With this said, the overall construct of the modelling approach is on traceability and transparency. Excel methodology is a relatively easy tool to allow for simple linear calculation. And because of the ability to create multi worksheet workbooks, a single spreadsheet can be used for a specific set of input data or for a specific process steps. Also because of its linear construct, it is ideal to construct a cost analysis as inputs-outputs, which reflects the flow of materials in the process flow diagrams and associated mass balances.

1.3.7 Treatment of labour costs in the informal waste and valorisation sector

A key analytic ambition has been to compare informal valorisation (and service) systems with formal ones. This creates a dilemma about how to handle informal labour costs. While informal service providers usually are paid for their labour, informal valorisation workers get paid via supply chain revenues from trading materials. In this the informal recycling sector is similar to other resource-based sectors: farmers get paid per kilo for their products; fishermen get paid per fish or per kilo; and they take their labour costs out of the price. No clear wage is paid.

This requires some manipulation to allow for comparison. If the cost line for labour is missing from the informal business, it means that the earnings of that business are artificially high. To take this into account, informal operations without wages are shadow priced in the workbooks. A shadow price is the true value of a good or service that may be different from its market price. This value is always estimated, and never certain. The shadow price we are trying to identify is the cost of labour to the informal sector work. In many cases this will be the cost of his own labour to the informal sector business man, other times the cost of labour of family members or informal employees. There is additional information on shadow pricing in Annex 4.

[8] If there was a possibility to actually complete field analysis to create, confirm or refine previously used coefficients this was seen as preferable to utilizing existing literature resources and studies of the local solid waste system. If local studies were not available, then the researchers used regional studies, with a preference for studies conducted within similar situations as scale, climate and economic factors. If no such alternative studies existed, then the researchers fell back on internationally held benchmarks and other sources of estimation. Each City-Partner developed an individual city report based on the best available information, supplemented by field work and triangulation. All such studies reference their sources for information. This research became the basis for development of the individual process flow diagrams and associated mass balances. Which in turn form the basis for the final comparative cost analyses.

1.3.8 Boundary conditions and restrictions

A study such as this one is bounded by the available time, and the general lack of recent, accurate, and verifiable quantitative information that does justice to the complexity of real-world solid waste system[9] it seeks to describe. These boundary conditions create both a context and real-world limitations on what a study can achieve and what it leaves for future work. In this study, some key boundary conditions that have affected the results include:

1. A terms of reference, time frame, and budget explicitly based on the use of existing data and desktop analysis;
2. A subject group, the informal sector, which by definition remains largely outside of the formal statistical, informational, and planning resources in the cities;
3. An urban environmental sector, solid waste management, which is notorious for the poor quality of data and information used in decision-making and planning;
4. A need to balance analysing each city's solid waste sectors according to their own internal logic with achieving some level of comparability; and
5. A focus on quantitative and monetised impacts even when the level of precision of the data do not necessarily support this.

1.4 Structure of the Report

This report is designed to present the rather large quantity of information that resulted from the research exercise in a way that is maximally useful to readers and researchers. Volume 1 is the main report and printed annexes, and Volume 2 includes the rest of the annexes and excel workbooks on a CD-Rom.

Following Chapter 1, this introduction, there are four additional chapters in Volume 1, the main report. Chapter 2 introduces the cities, first as a group, with general features, and then one by one in alphabetical order. The sections on each individual city include a summary of their geographic and solid waste characteristics, and an overview of the entire solid waste and recycling system, formal and informal, as seen through the lens of a process flow and materials balance analysis. Each city summary closes with a presentation of the city partners' choice of scenarios to be used to model possible future policies in relation to the informal solid waste and recycling sector.

Chapter 3 provides the most important information and insights, on economic aspects of the solid waste and recycling informal sector, the main focus of the research and reporting activity. It is divided into sections on informal operations, performance, informal sector occupations, social profile of the informal sector, and carbon footprint of informal recycling and solid waste activities.

Chapter 4 uses this base information to do an exercise in policy analysis, by modelling the impacts on the city of the addition and subtraction scenarios in each city. Chapter 5 presents conclusions, insights, and recommendations, based primarily on the information presented in Chapters 3 and 4.

Printed Annexes to Volume 1 are limited to Annex 1, Glossary of Terms, and references, in the form of Annex 2, Annotated Bibliography, and Annex 3, the Process Flow Diagrams and summary sheets of all the cities.

Volume 2 of the report is a CD-ROM that contains the electronic version of the main report, of Annexes 1-3, Annex 4, Methodology instructions, the city reports, and all the excel workbooks.

[9] In the UN-Habitat book process, for example, it became clear that most cities have poor information, which is seldom updated, and that even within countries, there are few standard methods for measuring tonnes or calculating costs. UN-Habitat 2010)

2 Chapter 2. Orientation to the Six Cities

The six city studies were chosen in a way as to capture a broad scope of variation in size, socio-cultural and political systems, climate, topography and physical footprint. These factors have both a direct and indirect impact on managing solid waste systems, and on the informal sector itself.

Cluj is the only one of the cities that is located in a temperate climate zone. Cairo and Lima have arid-semiarid climates with very little rainfall. Quezon City, Lusaka and Pune are tropical, and experience strong seasonal variations between dry, hot season and a monsoon season with torrential rains.

The six cities range in population from Cluj with 0,4 million to Cairo with nearly 18 million. The variation in size is important for this study, since it is important to note that strong informal solid waste sectors exist in all cities, irrespective of their size, demographics, or, as will be shown later , economic conditions. The variation in density of households per km2 is also quite marked, ranging from 560 to 4.605 hh/km2, both between cities and within single cities. Just within Cairo there are 98 persons per km2 in the peri-urban area and 2.136 persons per km2 in metropolitan Cairo. Table 3 suggests that there is a fundamental difference between the densely populated Asian cities of Pune and Quezon City, and the other four cities. Density of housing is important to solid waste logistics, and it is useful to notice that informal sectors function in a wide range of densities.

Table 2. City demographics

	Population	Population Growth (%)	City area (Km2)	Number of Households	Average number of persons per household	Households per Km2
Cairo	7.899.391	1,7	3.085	2.078.787	3,8	2.400
Cluj	380.000	0	180	116.884	3,3	649
Lima	7.765.151	2	2.817	1.810.614	4,3	643
Lusaka	1.238.227	3,5	360	252.699	4,9	702
Pune	3.000.000	4	138	656.455	4,6	4.605
Quezon City	2.487.098	3	161	550.243	4,5	3.418

Source: Project baseline workbooks, City Reports

The variation in projected population growth rates also suggests that the presence of the informal sector is independent of rates of population expansion. A significant informal sector is present in Cluj, with its flat or shrinking population growth rate, in the moderate-sized cities of Lusaka, Pune and Quezon City with their annual population growth rates projected between 3% and 4%, and in the mega-cities of Cairo and Lima, larger in absolute terms but with lower growth rates.

2.1 Economic situation

The six cities represent variation in size, type, and robustness of their economic sectors.

Table 3. Aspects of the economy in the six cities

	Country GDP (PPP)* in billion €	City Leading Economic Sectors	Projected City Annual Economic Growth Rate
Cairo, Egypt	241	Manufacturing, finance, insurance, service-based	2,7%
Cluj-Napoca, Romania	146	Industrial manufacturing and processing	9%
Lima, Peru	131	Commerce, financing, manufacturing, construction	6,3%
Lusaka, Zambia	8,4	Mining, wholesale, retail, service-based	5%
Pune, India	2,87	Auto manufacturing, education	7%
Quezon City, Philippines	359	Wholesale distribution, service-based	2%

** GDP is Gross domestic product (GDP): The value of all goods and services produced domestically. PPP is Purchasing power parity.*

The PPP method involves the use of standardised international dollar price weights, which are applied to the GDP produced in a given economy. For this study, the dollars are then converted to Euros. The data derived from this method provide a better comparison of economic well-being between countries than conversions at official currency exchange rates. Source: The World Factbook, 2005.

2.2 Snapshot of the Solid Waste Systems in the Six Cities

In spite of significant variations in geographic conditions, population and economy, all six cities have functioning formal sector solid waste systems that focus on removing waste and protecting public health. None of the cities have full-fledged sanitary landfills; but all have both formally designated, controlled disposal facilities, and illegal, informal, or unregistered dumping places.

Resource management, the valorisation of recyclables and organic waste, is primarily a private sector activity in all cities, with Cairo's formal sector composting facilities, Cluj's ECOROM containers, and Quezon's MRFs forming the most notable exceptions. The informal and formal recycling sectors co-operate in the recycling value chain in most cities, but in Pune, there is no recycling or recovery in the formal sector at all. In all cities organic waste is valorised informally for animal feeding. There is no informal composting in any of the cities, but there are well-developed informal value chains for swine feeding in Cairo, Lima, and Quezon, with some animal feeding in the other three cities as well. Formal public sector recycling and composting recover small volumes at rather high costs, which confirms observations in many other cities that formal municipal recycling systems in low- and middle-income countries tend to be weak and immature, with recovery rates that are symbolic rather than significant.

All of the cities show more than one variation of primary waste collection modes, with some mix of private and public actors involved in waste removal and cleaning. The four largest cities show some form of transfer or secondary collection where the waste from households is pooled or combined into larger vehicles; this is missing in Lusaka and Cluj. Lusaka is unusual in having a very significant number of informal service providers (ISPs) who collect and remove a third of all waste generated in the city.

In Table 4, the elements of the formal solid waste systems in the six cities are summarised and compared. Some collection systems are operated by the municipality, some are contracted or franchised to private sector companies, and some involve an arrangement or authorisation with informal sector entities. Pune is unique among the six cities, but typical of Indian cities, in that there is no formal private sector involvement in collection activities. This is compensated by the large-scale participation of the informal private sector in collection. In Lusaka there is a special license arrangement for waste generators to collect and transport their own waste to the landfill. This concerns only institutions that generate more than 12 kg of waste per week, and a licence is needed for collection, transport and disposal.10

Table 4. Formal solid waste system elements

Waste element	**Present in city**
Primary waste collection from households	All cities (except Pune, where it is being introduced)
Private sector participation in collection	All cities except Pune
Transfer points/ secondary collection	Four large cities
Selective collection of recyclables from households	All cities except Cairo and Pune
Valorisation of organics for animal feed or compost	Four largest cities
Recycling processing	All except smallest city Cluj
Disposal	All cities

Source: City reports and project baseline workbooks.

There are a number of distinct occupations and earnings profiles, with more occupations in the valorisation and recovery sector, as shown in Table 5.

[10] According to the Environmental Council of Zambia, there are in total 14 licensed waste generators, who collect, transport and disposed 11.000 tonnes in one year. Most of these 14 generators are large manufacturers who need more regular services, such as a bottling company and the railway company. Source: Lusaka Baseline Workbook, Annex 6, Lusaka City Report, p.32, Annex 6.

Table 5. Occupations in the formal and informal sector

Services	Formal sector occupations	Main informal occupations	Description of informal or formal sector work in this occupation
	collection vehicle drivers	drivers of motorised or animal transport	are paid a daily or hourly wage for driving the vehicle that collects the waste
	small collection companies, one-man trucks	house on house waste collectors, private, MSE, CBO/CBE	are paid a fee by households or the local authorities, to collect waste at a variety of scales and technologies, ranging from a basket on the head to a truck, and take it either the official dumpsite or dump it illegally
	collection vehicle crews, loaders	loading crew	are paid a daily or monthly wage for lifting waste from set-outs on the streets, or taking from household members and businesses, and loading it into a vehicle
	street sweepers	street sweepers and drain cleaners	are paid a daily or monthly wage or on a piecework basis (per km or per meter) for sweeping streets and/or cleaning out drains, and preparing the waste for collection by a vehicle
Valorisation	Separate collection initiatives for recyclables or organic waste	Itinerant waste buying, micro-collection routes, tricycle collectors	informal collectors who use a vehicle or their feet to move from house to house to collect and pay for recyclables (in Romania, to collect them as donations), and are paid when they sell the collected materials
	separate collection crews and loaders	itinerant waste buyers and licensed waste pickers	collectors who go house on house to collect separated recyclable and organic materials for own use or valorisation
		truck pickers	members of the formal paid collection crew who, in addition to their paid work, separate valuable materials for own use or valorisation, that have been set out for collection by the formal or informal collection services.
	none	Street and container pickers	Travel through the city by foot, bi/tricycle, or with animal or motorised vehicles. Use manual labour to extract re-usables, recyclables, or organic wastes from containers, dumpsters, or waste heaps; the materials are later processed and sold, and the pickers are paid at the time of sale
	none	animal herders	graze their goats, cows, horses, sheep, or pigs at transfer stations, dumpsites, and landfills, or in India, graze cows on the street
	collectors of frying oils/ collection of organic wastes (Pune)	swine feeders/swill or pig slop collectors	collect source separated organic waste from households, restaurants, hotels, and markets for animal feeding, either their own animals or they sell the materials to animal raising businesses
	workers at Materials Recovery Facilities (MRFs)	workers in small, medium and large junk shops	piece rate or salaried employees in small junk shops (or working for mobile traders) who process the materials
	operators of MRFs or Intermediate Processing Centre facilities (IPCs)	owners of mobile purchasers & small junk shops	the smallest level of buying business in the industrial value chain, with respectively a vehicle or premises, but usually not both. Most of them are informal, paid by selling materials

2.3 Generation and composition of waste

Generation of waste refers to the amounts of waste which households and businesses generate and discard into the waste stream. Composition of waste is particularly important in this study because it is used as the basis for calculating environmental impacts, which are based on both extraction and emissions effects. In solid waste system planning, as in this study, waste composition is also important for calculating revenues from recycling activities, because different materials command different prices. Table 6 summarises the information regarding generation and composition in the six cities.

Table 6. City-wide generation of solid waste[11]

City	Generation of MSW (t/y)	Daily generation per household (kg/hh/day)	Daily generation per capita (kg/cap/day)
Cairo	3.262.500	2,6	0,6
Cluj	184.700	2,3	0,7
Lima	2.725.400	3,1	0,7
Lusaka	301.800	2,6	0,5
Pune	544.200	1,5	0,3
Quezon City	623.400	3,1	0,7

Source: Project baseline workbooks, from existing city data. In two cases generation figures are established by utilising coefficients for generation per household and per business or per capita multiplied by data regarding number of households, businesses and population within the cities. In other cities the generation came from existing city data. See Annex 6 for full City Reports and references to type and source of data

Waste generation rates in the cities, on a household basis, range from 1,5 to 3,1 kg/hh/day. This reflects per capita generation rates of between 0,3 kg/capita/day in Pune and 0,7 kg/capita/day in Lima and Cluj. These ranges are well below generation rates in OECD countries.

Table 7 summarises the composition of the waste stream in the study cities. In spite of differences, the relative proportions of categories such as organics, glass and metal show significant similarities. The organic fraction is above 40% (weight) in all cities. In all of the cities, recovery of non-organic waste would reduce the total waste requiring disposal by at least 20%, and in Quezon as much as 40%.

This table presents only a snapshot of composition at a moment in 2006 (or the most recent date of a study in a particular city) and does not make any projections for the future. Composition is directly influenced by the time of year the study is conducted, particularly in cities with a wet-dry annual climatic cycle, and by moisture variation between the seasons. In a climate with cold winters such as in Cluj, ash from domestic burning of bio-mass is a significant component of the waste stream during certain times of the year, while the widespread local practice of post-harvest home pickling and conservation activities in the period from August to November create an enormous peak of organic wastes. Longer climactic or economic cycles, such as economic contraction and expansion following a transition to a market economy, may cause the amount of material and the associated composition of the waste stream to vary significantly.

Table 7. Solid waste composition percent by weight of most commonly recovered materials

City	Paper	Plastic	Glass	Metal	Organics	Other	Total
Cairo	18%	10%	3%	3%	60%	6%	100%
Cluj	20%	8%	5%	3%	50%	14%	100%
Lima	13%	11%	2%	2%	52%	20%	100%
Lusaka	9%	7%	2%	2%	40%	40%	100%
Pune	15%	13%	1%	9%	55%	7%	100%
Quezon City	17%	16%	3%	3%	48%	13%	100%
Simple average	15%	11%	3%	4%	51%	17%	

Source: project baseline workbooks

[11] The information in this table is a summary of much more detailed information developed in the City Reports in Annex 6, which may have disaggregated generation figures by density of housing stock, such as in Lusaka, or by governmental sub-areas within the city, such as seen in Lima's data. See the City Reports for additional detail and specific sources.

2.4 Regulatory and institutional framework

At the national level, specific solid waste policy is often set through the enactment of waste policy laws. However, regulation may occur at the national level and as regional or local entities. Lima, Lusaka and Cairo, have a responsibility of national laws and associated rules. Cluj and Pune have regional oversight. Quezon City, even to some extent Lima and Lusaka indicate that more authority may lie below the regional level.

Table 8. Formal solid waste governance

	National	Regional (1)	Municipal	Municipal Districts
Cairo	Policy development, SW and pollution rules, capitalisation assistance, disposal site selection, education and technical assistance	Privatisation policy implemented at the level of the Governorates	delivery of services, contracts and licenses, budgeting	
Cluj		Policy development, solid waste planning, permitting, pollution compliance, technical assistance	SW budgeting and delivery of services; contracting with private firms for collection and disposal	
Lima	Sanitation & health policy and rules, permitting	Information dissemination	SW budgeting and oversight	Delivery of services
Lusaka	Health policy, SW and pollution policy; laws and regulations		SW planning, contracting landfill management, and for collection services, technical assistance	Delivery of services in peri-urban areas
Pune	Policy development, SW and pollution rules, major capitalisation assistance	SW rules & pollution rules compliance, supervises municipalities, permitting	SW budgeting and delivery of services	SW budgeting of local services
Quezon City	Policy development	SW planning and coordination, large capitalisation	SW implementation, compliance, coordination and contracting of services	Delivery of services, processing facility siting

(1) "Regional" can refer to state, province or even a mega-City district, such as for Cairo and Quezon City, the latter being in the greater Manila City district.

Policy development affecting solid waste management at the regional and local level may not come directly from solid waste management enabling legislation, but may be found in sanitation, health and environmental pollution laws. The implementation of solid waste services occurs at the municipal level, except in those cases where there is shared jurisdiction with sub-municipalities, wards, villages, or the like. Multiple implementation jurisdictions can be seen in Lima, Lusaka, Pune and Quezon City.

2.5 Status of the Modernisation Process in the Six Cities

The six cities can all be characterised as being in some intermediate stage in the modernisation of the formal solid waste system. All cities except Cairo have solid waste regulations or laws passed since 2000; in Cairo the policy decision to privatise the waste management system pre-empted the passage of such legislation, but has had a similar effect, since the criteria for selection of private companies was related to their ability to modernise collection and construct new landfills. In Cluj the modernisation of the laws and policies has a strong relationship to Romania's accession to the European Union.

Text Box 1: Indicators for modernisation of waste management systems

- Coverage: the percent of all generated wastes entering the formal or informal solid waste system via primary or secondary collection channels.
- Losses: waste which escapes from a process step or a series of steps, and cannot further be tracked. In this report it serves also as a different approach and means to quantify coverage. Cluj and Lusaka would be, by this indicator, the least modernised because of their high percentage of pre-collection losses12.
- Institutionalisation: Existence of a solid waste plan, regulation, or law that has been recently implemented, or is in the process of being implemented.
- Controlled disposal: existence of a controlled disposal facility in use, under construction, or in the planning stages which has controlled access (fencing), a weigh-bridge (scale), and for which the fees are related to weight or volume tipped. A sanitary landfill has all of these plus a technical standard of a geo-textile or clay liner, leachate collection, and leachate treatment systems.
- Priced disposal: Rules or regulations that require a payment of a fee, based on weight or volume for disposal..
- User inclusivity: consultation with and/or communication with system users is either required or a regular practice
- User differentiation: options exist for users – individually or at community/ward level – to influence the frequency and type of collection of waste in their areas. Differentiation also means that there are different types and levels of services and adapted fees for different household income levels
- Formal resource management goals and drivers: There is a documentable interest in recycling and composting in the formal sector, that is expressed in concrete laws, policies, goals, or actions sponsored by the local authorities, leading to the valorisation of recyclables and organic waste
- Cost recovery: households, businesses, and institutional and industrial waste generators are required to pay (and actually do pay) fees or tariffs which go into a designated fund that is used for waste purposes
- Institutional coherence: the solid waste functions are consolidated within the formal public sector organogram, so that there are (semi)- autonomous solid waste units or divisions
- Financial sustainability: these semi-autonomous units have authority to raise fees and use them to make budgets and pay for operations.

All six cities have controlled disposal to a certain extent, showing that they are in an intermediate stage of modernisation (UN-Habitat 2010). According to this and the process flow diagrams and other data from the cities, Quezon City and Lima have the most modernised solid waste systems, and Cluj and Lusaka the least. Although Lusaka has done a lot of work on modernising its institutional arrangements, the physical system is not modernised and the losses from the system are significant. Indeed, in the study results, Quezon City, Pune, and Lima on the one hand, and Cluj and Lusaka on the other, tend to cluster together. Cairo has very different values from any other city, and tends to be either 'off the scale' for indicators, or have a quite different mix of results.

2.5.1 Modernisation of waste collection: privatisation and mechanisation

Generally, as cities move to modernising their solid waste systems the informal sector may be adversely affected in any number of different ways. Privatisation or franchising of the formal solid waste collection system may displace informal sector workers. More technology, professionalisation, and the presence of dangerous equipment at the landfill often lead to prohibiting waste picking.

Contracts where a formal private company is paid by the tonne to deliver waste to the landfill, as is the case in Cluj, create incentives for the private sector to claim a monopoly and seek to eliminate "competition" from the informal valorisation sector. A growing interest in revenues from recyclables may induce local authorities to set up their own formal recycling programmes and compete with the informal sector; sometimes this is aided by forbidding waste picking via anti-scavenger ordinances, or through tacit approval for police harassment of informal recyclers. All the cities, except Pune has indicated some formalisation of collection systems through franchising to private companies.

Cairo's situation reflects a kind of one-dimensional collection system modernisation where the decision to privatise pre-empts and dominates the modernisation process, and anything that the private companies

[12] "Coverage" is usually expressed in terms of households and businesses, or "connections", which have access to solid waste management service. For a materials balance based analysis, this is not sufficient, because access to the system does not mean tell whether (a) the users use it at all, (b) how much they use it, and (c) what happens to it after primary collection. Following the materials tells a great deal more, and so the term "losses" is a preferred way of understanding coverage in this report.

are not interested in does not get modernised. The result is physical modernisation of collection vehicles and disposal and composting sites, without any of the political, institutional, or financial aspects of modernisation.

However, in all cities, there is some acceptance of the usefulness of informal sector collectors in parts of the city that the formal sector is not servicing: peri-urban or densely populated slums, but also central parts of cities, where the density of housing, steep inclines, lack of paving, and/or narrow streets allow passage of informal sector collectors.

2.5.2 Modernisation of disposal: controlled disposal and sanitary landfills

A shift to controlled landfilling is a key modernisation indicator, and usually includes fencing and controlling access; installation of a weigh bridge; charging of a tipping fee; and generally improved operations through compaction, daily and final cover. Such operations may not allow the landfill pickers the opportunity to sift through the waste in such a manner that they can generate a survival wage through recovered material.

All cities indicate a move to more formal "controlled" sanitary landfill rather than just dumps, although construction of an engineered landfill for Lusaka has begun. For Cairo, Cluj, Lima, and Quezon City, some or all landfill operations are contracted to private companies. All the cities' landfill operations have room for continued modernisation so to control pollution, and in rare instances to capture methane or produce biogas. Quezon City demonstrates clearly, and the others to a more limited extent, a growing appreciation of the value of extending existing landfill life and a corresponding policy decision to keep recyclables and organics out of the landfill whenever possible.

2.5.3 Modernisation of resource management: strengthening recycling and organics recovery

The third area of modernisation is the recognition of the role of recycling in waste management, and this often goes together with creation of formal public sector recycling institutions or policies. In Cluj, a formal sector agency has started a recyclables collection pilot project servicing households, and Lima, Lusaka, and Quezon City are all moving in this direction. Quezon City is requiring the establishment of formal sector MRFs, which receive and process material directly for the market. Some of Lusaka's franchised waste collection companies are also involved in the recovery of materials for sale to recycling industries. Pune indicates plans for a refuse derived fuel (RDF) plant that would target both the paper and plastic fractions of the waste stream.

2.6 Room for the private sector: participation of private formal and informal actors in waste and valorisation activities prior to the study

The degree of integration of both the informal sector and the formal private sector into formal sector solid waste activities prior to the study[13] is quite varied across the cities. In Quezon City, in Pune and Lima, one sees a concerted effort by the public sector to organise and integrate informal sector workers and recycling businesses to maximise recovery of material, with national legislation or policy as a driving force. In all three cities, we observe a shift from a focus on protecting public health (through collection) to environmental protection, in the form of a growing understanding of the need to conserve existing landfill space and do something else with recyclables and organic waste. Pune has gone beyond integration of informal sector workers into an overall solid waste management strategy: the municipality is now providing identity cards and health insurance for these workers.

[13] The distinction between the situation before and after the study is important because participation in the study and especially the scenario modelling proved to have a measurable impact on the attitude of the city authorities towards the informal service and recycling sector.

Table 9. Formal solid waste sector support and integration of informal sector activities

	Formal Sector Recognition of Informal Sector Contribution	Integration of Informal Sector into Formal Sector Activities	Assistance to Informal Sector	Organising of Informal Sector Labour	Percentage of informal waste sector people who are members of an association/ cooperative	Plans / Strategies Threatening the Livelihood of the Informal Sector
Cairo	Yes	Yes	No	Yes	2,5%	Yes
Cluj	No	No	No	No	11%	Yes
Lima	Yes	Yes	No	Yes	7%	No
Lusaka	No	Yes	No	No	0%	Yes
Pune	Yes	Yes	Yes	Yes	60%	Yes
Quezon City	Yes	No	No	Yes	37%	Yes

Lusaka and Cluj are the only two study cities that do not appear to have any formalised initiatives for organising for the informal sector. In the other cities, the lack of visible organisation in the informal sector poses a challenge to integration. Organisation of collectors and/or informal sector businesses (junkshops), where it exists, is associated with the work of NGOs. In Quezon City, Lima and Pune, this may also be initiated by the municipality in order to meet national or regional policy initiatives. In Cairo NGOs and civil society organisations are key to maintaining channels of communication between the Zabbaleen and City efforts to manage the solid waste stream. Such organisations also provide needed micro-financing to informal sector businesses.

In Pune, KKPKP is a labour union that supports waste pickers and itinerant buyers. Its efforts have been key to the acceptance of integration of waste pickers in municipal modernisation efforts. Formalisation and organisation of collectors at the sub-district level for parts of Lima and Callao is just beginning, and there is not yet any overall strategy on how best to accomplish this city-wide. Lima and Quezon City have recently begun a registration and certification of junkshops.

The following six sections present short extracts from the city reports, which are presented in full in Annex 5. The main reason for presenting the city-specific information is that it offers a great richness of information on the workings of the informal sector in solid waste. For each city, there is an introduction, a short description of the waste system, and a narrative description of the process flow. In addition, relevant facts or aspects of the situation are included where relevant and useful. Each city section closes with a description of the two policy scenarios.

2.7 Cairo

With over 17,5 million inhabitants, Cairo is the tenth largest mega-city in the world and will grow to over 20 million by the year 2017[14]. According to Egypt's Second Millennium Development Goals Report (2004), Egypt as a whole contains 909 slum areas, inhabited by more than 5,5 million people. Most Cairo slums appeared in the mid-1960s, as a result of the population explosion that took place post-World War II.

This study limits its focus to within the boundaries of the Cairo governorate, which includes representative operations of the formal and informal sectors within its borders. The governorate constitutes the majority of the Greater Cairo Region population. In addition, demographic data, waste generation data, and waste management data are better defined and available for governorates than for cities.

The Cairo governorate is situated on an area of 3.085 km^2 along the east bank of the Nile river just south of the Nile Delta. It consists of one city, the city of Cairo, which is divided into 31 districts including five "new" urban communities. Cairo has a total population of approximately 7,9 million according to the

[14] CAPMAS, [1997 a], Population, Housing, and Establishment Census 1996, Preliminary Results, Cairo, June 1997.

2006 population and housing census[15]. The population density in Cairo is considered the highest nationwide: approximately 2500 persons per square kilometres against 70 persons per square kilometres in Egypt as a whole. In inhabited areas of Cairo density is effectively 41.000 persons per square kilometre. The annual population growth rate in Cairo is estimated at approximately 1,9% (2005), while the average family size is estimated at 3,8. Education is free and compulsory for ages 6 through 15.

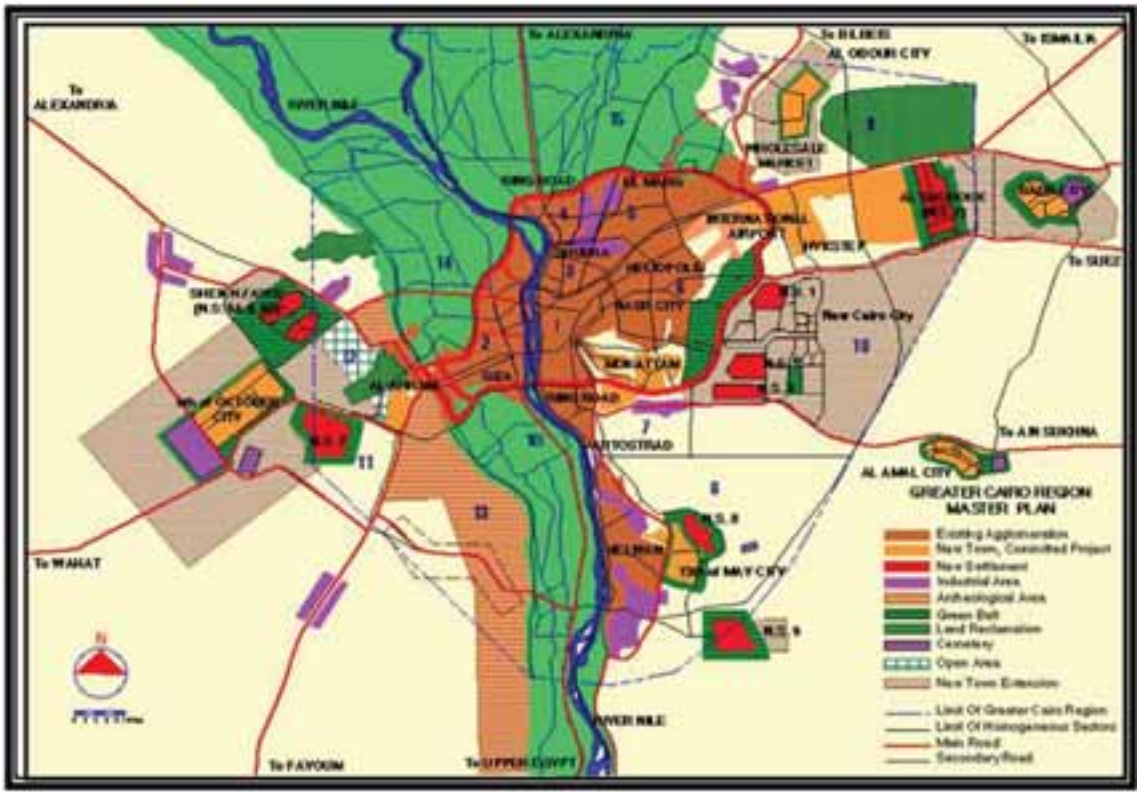


Figure 1. The Special Configuration of Greater Cairo Region

Cairo is beset by many of the same urban problems as other large cities in developing countries: problems of transportation, solid waste, lack of adequate drainage and sewerage, and lack of usable spaces.[16] The current GDP, according to the World Development Indicators database 2006, is $78,8 billion. The annual GDP growth is 4,2%.

The main elements of the government's national development policy are the central role of the private sector in Egypt's development, human resources development, and conservation of the environment, and an economic growth target of 7,6% by 2017[17]. Cairo contains the highest concentration of government jobs, as well as private sector companies. With the establishment of the new industrial zones in 15th of May, Tenth of Ramadan, and Badr cities, Cairo has also become the focal point of modern manufacturing and a major tourist destination, catering to both Western and Arab tourists.

The two most significant pieces of legislation are Law 38 of 1967 and its subsequent amendments and Executive Regulations and Law 4 of 1994 and its Executive Regulations. In its *National Strategy for Integrated Municipal Solid Waste Management of 2000*, the Governorates are responsible to implement the national strategy. Since 2000, the Egyptian government has focused on enhancing the private sector's role in solid waste management through privatising waste management, restricting the role of government agencies to that of monitoring, and involving the citizens in paying the costs of cleaning services. Local

[15] Central Agency for Public Mobilization And Statistics (CAPMAS), www.msrintranet.capmas.gov.eg
[16] Arandal and EL-Batran [1997]."The Informal Housing Development process in Egypt", DPU Working Paper No.82, University College London.
[17] Egypt Human Development Report 2005 – United Nations Development Programme

(municipal) government is legally responsible for the provision of solid waste collection, together with disposal services in mostly unmanaged dumpsites. Few transfer stations exist and the development of state-of the art sanitary landfill has yet to be realised.

At the local level for Cairo, collection and transfer services are contracted to formal private companies by tendering. The informal waste workers that work in conjunction with the franchised businesses are licensed. The private sector actors range from informal micro-enterprises to medium-sized businesses. They collect waste, and transfer it, but do not manage final disposal sites. Non-Governmental Organisations (NGOs) operate collection and transport services in a few neighbourhoods. Recycling is performed mostly by the informal sector while composting is performed by the formal sector. Composting plants are owned by the local authorities and operated by formal private companies.

Final disposal is performed in controlled dumpsites operated by the formal private sector or the local authority, as well as the informal sector which disposes of residual waste in controlled dumpsites owned and operated by the government.

Prior to multinational privatisation of waste services, waste was collected and transferred as follows:
- One third by the CCBA (waste pooling sites in low income neighbourhoods) and local formal private companies (door to door)
- One third by the traditional Zabbaleen collectors (door to door)
- One third uncollected, dumped on streets and empty lots

The solid waste sector in Cairo has the following major stakeholders, shown in Table 10.

Table 10. Stakeholders in the solid waste sector in Cairo

Stakeholders	Areas of Activity, Responsibility, interest
Central Government institutions, ministries:	Is responsible for establishing the institutional and legal frameworks for SWM and ensuring that local governments have the necessary authority, powers and capabilities for effective SWM. ♦ Provides guidelines and/or capacity building measures in administration, financial management, technical systems and environmental protection. ♦ Ensures environmentally sound performance of waste management systems and facilities. ♦ Solves cross-jurisdictional issues between local government bodies, ♦ Channels subsidies and donor aid to cater to the needs of municipalities providing waste collection services ♦ Ministry for Housing, Utilities and Urban Communities participates in the selection of waste disposal sites. ♦ The Egyptian Environmental Affairs Agency (EEAA) has responsibility for ensuring the environmentally sound performance of waste management systems and facilities.
Governorates:	Set the strategies based on national policy, including training, monitoring and inspection
Municipalities:	legally responsible for the provision of solid waste collection and disposal services in mostly unmanaged dumpsites
Formal sector private waste companies and informal sector private companies:	collect and transfer but do not manage final disposal sites. They enter into agreements with municipal authorities
Informal sector:	Waste pickers in streets, dumpsites, transfer station plants, landfills, itinerant waste buyers, piggeries and junkshops).
NGOs and Civil Society organisations:	Operate collection and transport services in few neighbourhoods.
Recycling industry:	Includes all kind of enterprises which process recyclables.

2.7.1 Process Flow Description

Residential waste is collected at two points: door to door by the traditional collectors, and from waste pooling sites by multinational waste companies. Waste collected by multinationals is transported in compaction trucks to transfer stations which have recently appeared in the city, then transported to landfills or to sorting and composting facilities run by the multinationals. Non-organic recyclables sorted at such facilities are mostly sold to waste traders. The organic portion is composted and sold as soil conditioner. The residual waste at the end of the sorting and composting process is sent to landfills.

Traditional waste collectors use open trucks to collect waste and transport it to their homes where the family and hired labourers sort it manually. The organic portion (estimated to be 60% of the waste) is used to raise pigs and the non organic portion (estimated to be 40% of the waste) is recovered for further sorting, trading, processing and manufacturing. Of the two portions of waste – organic and non organic – a residual of around 10-20% is transported by the traditional collectors, at their own expense, to the one government controlled dumpsite that is open to them. The three landfills established by the multinational private contractors receive waste only from their own collection routes and composting plants.

2.7.2 Formal Sector

Two multinationals FCC (Spanish) and AMA (Italian) and one Egyptian private company emanating from the Cairo Cleansing and Beautification Authority (CCBA) are responsible for collecting from three quarters of the city. The fourth quarter was contracted to the Spanish multinational Enser but they left and AMA took over operations in the quarter. In officially contracted parts of the city, middlemen link the traditional collectors to official contractors and exploit them as they do not pay them what they get paid on their behalf for their labour in door-to-door collection. The traditional collectors meanwhile continue to service their customers door to door in order to have access to the recyclables.

Collection operations performed by the formal sector rely on placing containers at waste pooling sites where residents are required to dispose of waste. Depending on accessibility, waste is removed from the pooling sites either in compaction trucks or in small open trucks. The waste is then transported to transfer stations for transfer to large transfer trucks that move the waste to the landfills or the sorting and composting facilities. Waste collected by contracted traditional collectors is generally diverted to the informal waste collection stream.

Nine transfer stations serve formal waste collection in Cairo. Waste collected by the formal sector is transferred to large trucks at these stations then transported to the landfills or to sorting and composting facilities. Waste collected by sub-contracted waste collectors is transported by small open trucks which are covered by a cloth when filled at the end of the route. The waste is then transported to their homes for recovery and recycling without passing through transfer stations.

A portion of the waste collected by the formal sector is recovered and recycled into compost at sorting and composting facilities operated by the private sector. Three sorting and composting facilities serve Cairo with a total operating capacity of 1.700 tonnes per day, which accounts for 17% of the daily generated waste. Non-organic recyclables sorted at such facilities (estimated at 2% of the total waste generated) are mostly sold to waste traders. Some part of the total fraction of 60% organic waste is actually recovered by pickers at the sorting belt of the companies. It is less than the total theoretically available 60%, because the sorting in plants is less meticulous than that (formerly) done by families in the Zabbaleen areas of Cairo, who valorise it as animal feed to earn their living. Organic waste recovered via the formal system is composted and sold as soil conditioner, with residuals sent to landfills. The fraction of waste recovered at government operated dumpsites is uncertain as this activity occurs informally by truck pickers, followed up by dump pickers.

Six waste disposal sites are located in Cairo which are operated by CCBA and multinationals. The multinational companies operate landfill sites which receive waste arising from their collection activities and from residual of composting plants. The waste collected by municipalities is delivered to government managed dumpsites. The residual waste from Zabbaleen activities is transported at their own expense to the government managed dumpsites.

2.7.3 Informal Sector

There are currently an estimated at 33.000 people in Cairo working as collectors of mixed household waste. These informal sector waste workers are engaged - directly or indirectly - in the collection, transport, recovery and recycling aspects of managing the solid waste in Cairo Governorate[18], and

[18] The approximately 33.000 informal sector waste workers are engaged - directly or indirectly - in the collection, transport, recovery and recycling aspects of managing the solid waste in Cairo Governorate only, whereas the total estimate for Greater Cairo is 40.000.

together they collect one third of the daily 9.800 tonnes of waste generated by Cairo's inhabitants. They recover and recycle about 80% of household waste on a daily basis, providing the more affluent neighbourhoods of Cairo with door-to-door service at a minimal fee, paid directly to the collectors by households and/or institutional units with no direct involvement of the Government. Through their informal markets they have developed extensive links with value chain businesses throughout Cairo and Egypt. The recycling industries in their settlements have developed extensive backward and forward linkages with other informal and formal markets throughout the country. In addition to collecting mixed household waste, they also purchase source segregated waste from commercial and institutional waste generators, as well as roamers, middlemen, etc. These are sold either as end products or inputs for other manufacturing activities to large scale industry or informal sector small enterprises.

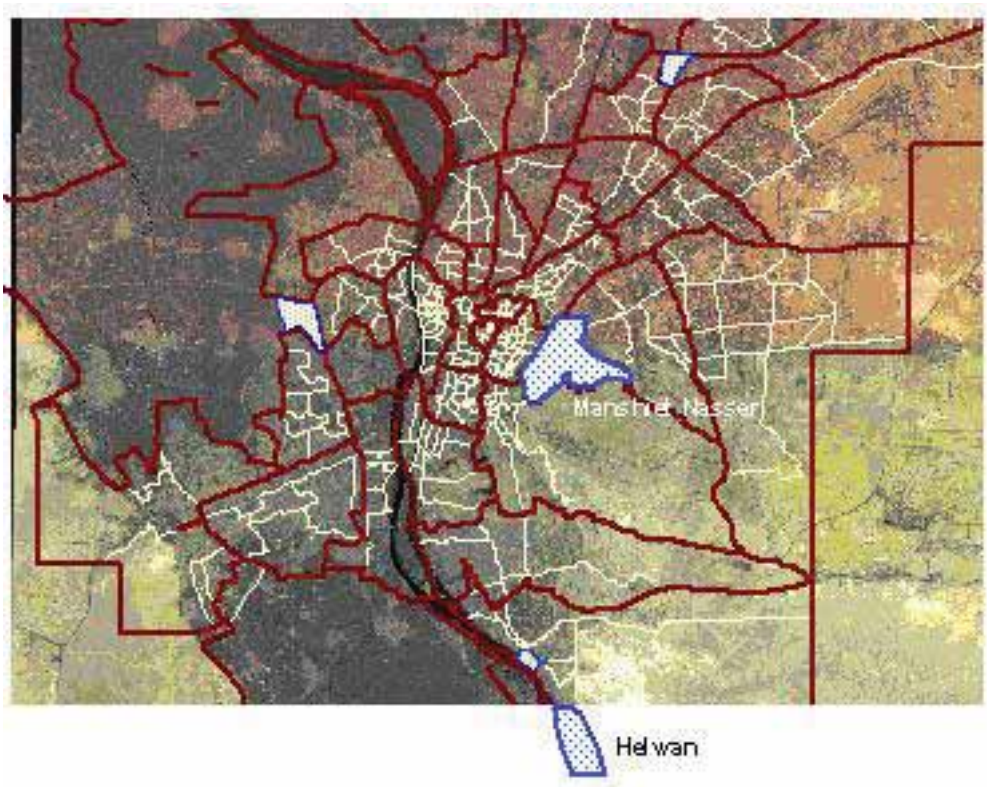


Figure 2. *Zabbaleen* (garbage collectors) neighbourhoods form a ring around the city of Cairo

These four neighbourhoods are:

- Mokattam - with an estimated population of 20.000;
- El Baragiil - estimated population of 3.000 ;
- Tora - estimated population of 2.000 ; and
- Ezbet el Nakhl - with an estimated population of about 8.000.

Most collectors live in informal settlements entitled 'garbage neighbourhoods'. Many young men from other neighbourhoods seek and find employment in the small and medium enterprise recycling workshops owned and operated by the Zabbaleen.

The 33.000 workers include the following informal occupational categories:

1. Collectors of household and commercial waste based on a door to door, daily collection system.
2. Middlemen and Intermediary Buyers/dealers. These live in, and outside of the garbage collectors' neighbourhoods. Some used to be garbage collectors themselves. They were able to accumulate capital to acquire space to store large quantities of recoverables.
3. Wholesale Merchants of Recoverables from Roamers. These buy in bulk from small merchants who roam the streets of Cairo and from the middlemen who live in low income and garbage

neighbourhoods. They are large-scale dealers, own warehouses and often specialize in one type of non-organic item.

4. Recycling Workshops and Enterprises. This is where the recyclables are processed into final recycled products, or intermediate materials for further value chain purchase. Most are unlicensed, small, family owned MSEs, who function as buyers of source segregated waste, a critical input for their businesses. These, in turn, depend on their customers in the supply chain to large industries. A survey conducted in 2006 in two of the neighbourhoods where traditional recyclers live and work, indicated that a total of 1.000 recycling small and medium enterprises (SMEs) are engaged in this industry.
5. Other minor informal sector operators include: scavengers, Roamers (Sarreeha), Robabekia and Saxonia Merchants

Non-profit organizations have played important roles in the solid waste management system of Cairo. They operate credit programs directed at recycling micro-enterprise industries for the garbage collectors, manage a community-wide composting plants, rag recycling cottage industry and paper recycling centre[19], advocate on behalf of the traditional sector and seek to provide them with health care and alternative learning opportunities as well as legal literacy.

2.7.4 Cairo: Analysis of Scenarios and Impacts

The context for the scenarios in Cairo is that in the last five years, Cairo's waste collection and disposal have been partially privatised through tendered contracts to international and national waste management companies. Three of the four districts of Cairo have such international companies doing the waste collection and disposal. In most cases they employ or subcontract the traditional waste informal sector, the Zabbaleen, to do the house-to-house collection. In the fourth district, no international candidates could be found, and so the original system is still largely in place. However the city has placed intermediaries between the Zabbaleen and the clients, so that the informal sector earns less.

Subtraction Scenario

The subtraction scenario revolves around prohibiting the collection and processing of organics by the informal sector, which causes the removal of pig breeding activities. It is assumed that the informal sector handles 21% and no longer 35% of the generated wastes. 10% will be done by scavengers and the rest will work under contract, supporting the formal collection with door-to-door service provided by informal workers. However, only 11% and not 15% of the collection will be subcontracted and around 30% less informal workers will be engaged by the multinationals, the payment even being more irregular. These informal workers process the wastes, recovering the recyclables and transporting the organics to the disposal site. On the other side, the former contracted informal people remain working in the sector but scavenging from the waste containers provided by the formal sector and placed in the public domain. They take only around 40% of the materials and leave in the containers the unrecoverable fraction.

Because more wastes will be collected and handled by the formal sector, they need more infrastructures. The number of transfer stations will be increased from 9 to 12, while the efficiency of the composting plants is assumed to increase to 90% and 1 additional facility including 3 additional lines will be built. However, because the composting capacity is limited, the rest of the organic wastes go to the disposal site. The number of dumpsites remains unchanged. The recyclable materials of the formal sector chain will be sorted out and sold to informal waste traders, whose activities will not be prohibited.

Increasing the coverage of the formal sector means re-calculating the cost of the formal collection services. We estimate the higher cost of the service due to its mechanization and the resultant reduction in the number of jobs. Because the informal waste traders receive recyclables from both the informal and the formal sectors, the quantity to be processed and sold will probably increase. However, the income of informal collectors and scavengers will be reduced because the number of people remains the same, while the available quantity decreases.

Residents of the areas exclusively covered by the formal sector will become more accustomed to

[19] Iskandar, Laila. *A New Model of Solid Waste Management in Egypt Based on at Source Separation,* South Sinai Update.

disposing of their waste in waste pooling sites rather than the daily door-to-door service from the traditional garbage collectors. They will also become accustomed to paying the relatively higher fees for service as compared with when the traditional and municipal actors performed the service.

Private (presumably international) companies, seeking cost effective systems, will design and establish waste pooling sites or containers to reduce collection costs. The availability of waste in the public domain increases the activities of a new class of informal sector operators, who scavenge the bins for items for recovery. This will exacerbate the phenomenon of competition for the waste by scavengers. This is expected to continue as poverty levels in the country and city are not expected to decline sharply over the next 10 years.

Addition Scenario

The addition scenario is built around the informal and traditional sector covering 75% of the city. Source segregation will be established, so that citizens have to separate their wastes into organics and inorganics; though, this will be only launched in the part of the city covered by the informal sector and will be supported by awareness raising activities. It is assumed that only 50% of the households in the areas where segregation is practiced will participate and that the percentage of capture around 90% will be achieved. The resulting quality of the collected materials will be higher due to the source segregation, causing that less materials go to the disposal sites.

The number of informal workers in each process step will increased in order to be able to handle the increased quantities. Because the quantity of available recoverable material and the quality increases, the revenues of the informal sector are expected to raise. This will result in part to the improvement of their working conditions because they will be able to invest in protection equipment.

The actors in that sector will enter in formal arrangements with the city to service small zones in a manner which breaks up the mega city to hundreds and thousands of small areas, with each being serviced by a family owned traditional operator who would now become formalized. It gives local neighbourhood councils the power to contract traditional waste workers but assumes the system is transparent and fair. It removes the danger of the informal sector having to bribe local council officials in order to get 'licenses' to operate in specific neighbourhoods. It also eliminates the harassment by police which that sector is exposed to.

More waste would be available for trading, processing, and recycling. More small and medium enterprises would be established among the poor, more employment would be available to offer unskilled and semi skilled youths, more trading with the rest of the country would occur and more exports to other countries would take place.

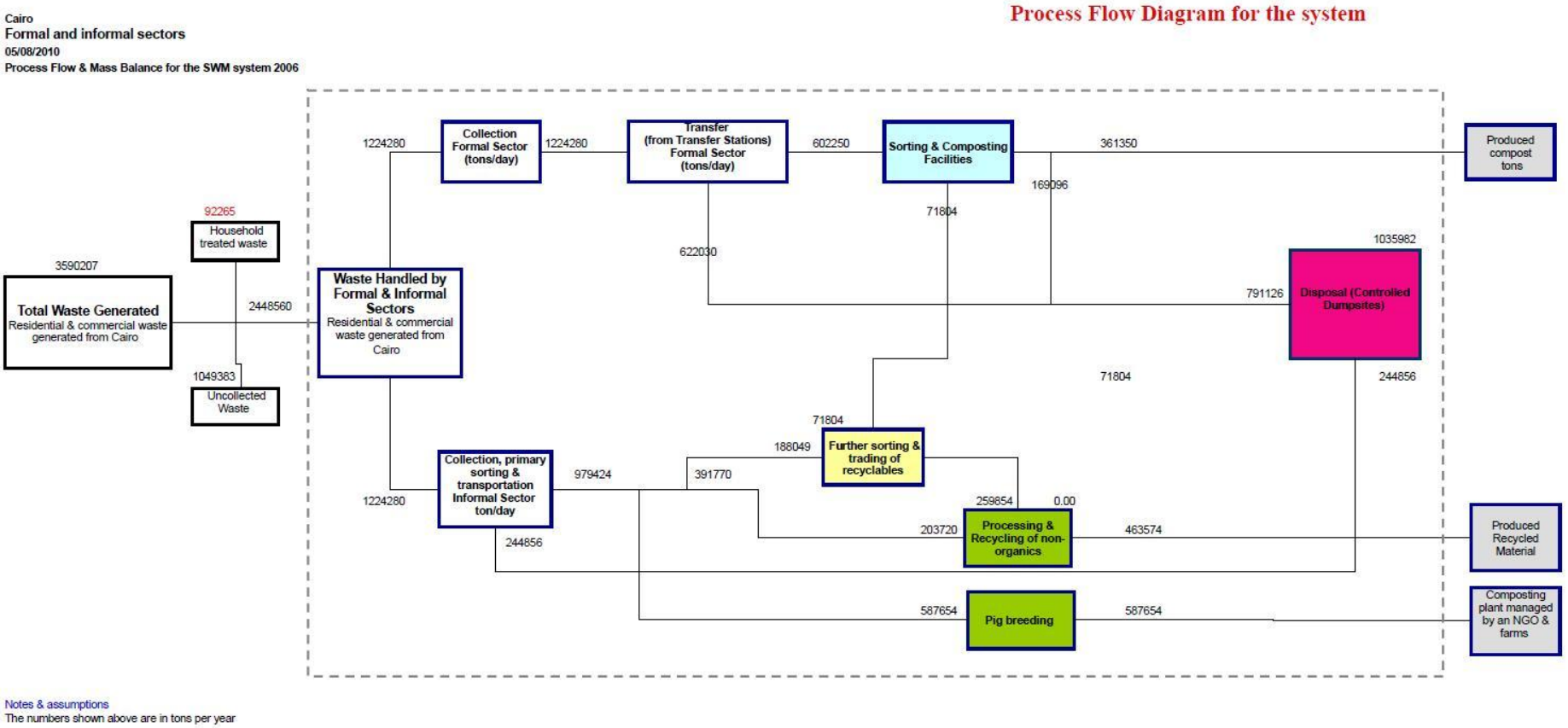


Figure 3. Process Flow Diagram for the Cairo Governorate

2.8 Cluj-Napoca

Cluj-Napoca is located in the north western part of Romania, in the centre of Transylvania. It has 298.000 permanent residents and another 80.000 temporary residents, most of whom are students. Cluj is the fifth largest city in Romania and one of the most important cultural, industrial, and academic centres in the country. According to the last census in 2002, the population is 79% Romanian, 19% Hungarian, 1% Roma, 0,2% German, and 0,06% Jewish. With a projected growth rate of 0%, the amount of residents will neither grow nor decline. Romania joined the European Union on 1 January 2007.

Figure 4. Map of Cluj-Napoca

The formal Solid Waste Management activities in Cluj-Napoca are defined by national regulations and laws, harmonised with European Union legislation.
The institutions that are accountable for the solid waste management system are the Regional Environmental Protection Agency (REPA), the Environmental Protection Agency (EPA), the County Councils, and the City Council. These parties all share a significant and overlapping responsibility for a range of solid waste management activities: for developing policy and verifying compliance of contracted waste management activities, for giving out permits, and for documentation of waste collection figures.

In addition, REPA is specifically responsible for regional waste management planning, complementing EPA's responsibilities of research, co-ordination with other regional offices and compliance of environmental legislation on regional level. On a geographical smaller scale, the EPA and the County Council are specifically responsible for, verification and publication of county solid waste management plans. Also, the EPA is in charge of inspection, technical assistance and reporting, and the EPA issues landfill permits. The County Council co-ordinates and monitors the activities of Local Councils. Local Councils are accountable for the safety of sanitation local circumstances.

Private companies have the contract for implementation of solid waste management, which includes collection, transport, disposal and treatment at the landfill. The responsibilities of the private sector contractors include ensuring waste collection and treatment in accordance with legislation, and reporting to governmental institutions on quantities and types of waste collected and disposed.

2.8.1 Stakeholders

Table 11 gives an overview of the major stakeholders active in the solid waste sector in Cluj-Napoca.

Table 11. Relevant stakeholders in Cluj Napoca

Stakeholder type and sector	Stakeholders
Public sector	Municipal and county government, National environmental ministry
Service users	Households, firms, institutions
Providers	Private formal sector waste collecting companies, public sector organisations
Formal recycling sector	Junk shops, formal recycling companies
Informal recycling sector	Street pickers, door to door collectors, dump pickers

Source: original field work Green Partners, based on documents provided by the local authority and listed in the reference list of the Cluj City Report.

Table 12. Private sector responsibilities for collection in the Cluj formal waste system

Collection from	Company responsible
Households	Brantner Veres, Valmax, Rosal, Prisal
Businesses	Brantner Veres, Valmax and Prisal
Litter control, street cleaning / sweeping	Rosal
Illegal dump clean-up	Municipality, Valmax
Treatment	none, not applicable
Disposal	Municipality

Households and businesses produce an annual 184.579 tonnes of waste. Residential waste weighs 2,2 kg per household per day, while, according to documents from the municipality, waste from commercial establishments weighs 0,7 kg per employee per day.[20].

2.8.2 Process flow description

The process flow for Cluj-Napoca is shown in Figure 5. Households and other generators may treat or handle waste before collection by backyard burning, home composting, animal feeding, re-use by the waste generators themselves, and burial on own premises.

The waste in Cluj-Napoca follows a series of routes: waste generators such as households, businesses and institutions either store the waste in open containers, dump the waste illegally, or bring selected materials to a formal material collection centre.

Many of the containers are picked over by street pickers who retrieve valorisable materials, re-usable items and food scraps. The street pickers sell the food scraps to livestock breeders, and the materials to formal collection centres (junk shops. They re-use the other items in their own households. The formal collection centres in turn sell materials to the recycling businesses in the city.

Door-to-door IWCs (Itinerant waste collectors) visit households to gather materials 'as a donation.' They sell the recyclables to a collection point, the organics to feed livestock, and personally re-use items such as clothing.

The four waste collection companies take the waste directly to the Pata Rat landfill. In total, 14 waste compactor trucks, 3 auto containers, 3 skip hoist containers, and 14 other waste collection vehicles transport the waste from collection point to the final disposal site. On the Pata Rat landfill, waste pickers extract the valuable or reusable material and sell them to representatives of the recycling industries, who arrange transportation. Some recovered materials are reused by the dumpsite pickers, clothing for instance. In addition, Brantner Veres supports the ECOROM recycling pilot project by collecting source-separated paper and PET directly from household containers, and makes a financial agreement with the dump pickers to allow them access to materials.

[20] The 2.3 per household is based on approximately about 0.7 kg of waste generated per person per day and one household having 3.3 people on average. There is more generation of household waste in Cluj in effect, because there are about 80,000 students coming in the city each year that are usually not registered in the city. The municipal documents do not reflect these materials, so they are not included.

There are twenty four formal 'collection points' for depositing recyclable materials throughout the city, which are designed to accumulate materials such as paper, glass, all types of metals and plastics. Part-time employees, 24 in total, manage these collection points, which belong to the formal public agency ECOROM. ECOROM bales PET and paper by using a hydraulic baler, and sells the materials to the fourteen formal recycling companies active in Cluj-Napoca. These companies recycle plastics, metals, paper and glass. Processing done by the formal recycling industries includes baling of paper, tin, aluminium, PET and other plastics, crushing of glass, and shredding of metals.

The recycled materials are then transported to different (inter)national destinations, for example, PET flakes to China, baled paper to paper mills in other cities in Romania.

2.8.3 Formal sector

Formal waste collection activities are completely privatised, and are handled by four companies in the city: Brantner Veres, Valmax, Rosal, and Prisal. The first two companies are leaders, the former one on the household services market, and the latter on the commercial sanitation services market. Rosal company handles a small part of sanitation services in the downtown area, its main activities are litter control and street cleaning; Prisal is a small company managing a very small percentage of household waste collection and disposal. Valmax also collects waste from illegal dumping areas.

2.8.4 Informal sector

The informal sector is engaged in the recovery of materials for sale, for household use, of for feeding animals. Some informal sector families also report that they eat food (such as old bread) that they recover from waste containers or the landfill. There are no informal removal services, but within the informal valorisation sector there is a small transport service component.

In Cluj-Napoca, there are three basic types of informal waste collectors: street pickers, door-to-door collectors, and dump pickers, plus another group which works in informal valorisation on a seasonal basis. Each type of waste collector has their own distinctive characteristics.

Street pickers are the most varied and numerous types of recyclers, including people of Roma ethnicity, elderly people, and the unemployed. The 2.366 street pickers are collecting 4.600 tonnes of waste per year, out of which 140 tonnes are used for personal needs (feeding, clothing etc.). They sell the remaining 4.600 tonnes to collection points.[21]

The street pickers either work alone or in family circle. In spite of apparent diversity, there are certain characteristics that set street pickers aside from other waste collectors:

- most of them have other means of income in addition to waste picking
- they use no equipment other than a stick and handheld containers,
- they transport themselves sometimes with bicycles, and even more rarely carts
- some pick only for personal use and not to sell the collected materials.

The number of street pickers was estimated based on household focus group research and questionnaires in drop off centres.

The Roma street pickers are of all ages, and both sexes. They have low social status, generally low levels of education and marginal prospects for being otherwise employed. Roma street pickers pick consistently, and either live in the City or in villages close to the City.

The elderly street pickers are usually persons not of Roma ethnicity. They have been retired for many years and receive pensions that often do not permit any basic level of subsistence. Both men and women perform this type of activity on a continual basis mostly to gain some extra income, and rarely for

[21] The number of street pickers and the amounts of materials they collect is estimated based on a week long city-wide observation, interviews, questionnaires and head count at the drop-off centres in Cluj-Napoca. The numbers are not to be interpreted as exact (we used the exact figure to allow for calculations in the model) but allowing for a margin of error.

personal use. Non-Roma unemployed persons may include people with very low salaries of all ages and both sexes. These persons are usually involved in street picking on a temporary basis, while waiting for payments from social assistance programs or when they have no paid employment.

Door-to-door itinerant waste collectors (IWCs), 400 in total, mostly collect from houses (rather than apartments) on the outskirts of the city, and can be subdivided into two groups. The Roma collectors do this work on a permanent basis, and use horse carts to collect ferrous metals, passing by their households once a month. The non-Roma collectors use handcarts to pick up paper and food. They perform these activities on a temporary basis and most probably it is not their main source of income. Both types of itinerant collectors have regular routes and service sympathetic households who are known to give to collectors. Door-to-door collectors are collecting 70% by weight ferrous metal, 15% paper, and 15% food.

Dump pickers collect waste only from the Pata Rat municipal landfill. They recover 12.2300 tonnes annually, out of which they select 30 tonnes for personal use. An estimated 793 permanent dump pickers are active in dump picking, and are all living in the vicinity of the landfill. The number of permanent street pickers is based on a headcount that is updated annually and is carried out by the Family Aid Foundation, Cluj. Of this total, about 400 pickers have created a community which they call "Dallas". The area where they live belongs to private persons or companies, thus they are squatters and do not have any legal status there. Dallas residents are Roma people who lost their jobs after 1989 and, having limited education, could not find any new employment. Most of them hold identity cards that prove their legal residence in other parts of the country. An additional 393 permanent dump pickers are from neighbouring communities, and have identity cards showing their legal residence.

Seasonal informal recyclers. There are two other groups of people who collect waste occasionally or seasonally. The number of these people is estimated based on observation and interviews with permanent pickers and the operators of the landfill. A group 20 to 50 families of Roma people from Hargita county, elsewhere in Romania, collect metals during wintertime for about five months each year. A second group of 10 families is, what the Roma call the "Corturarii" ('the ones who live in tents'). These are nomadic groups of people who stay five weeks each year on the landfill and collect waste. They are kept apart from the other dump pickers and private sanitation workers as they are considered to be dangerous.

All groups target the same materials for recovery, and so are apt to be in conflict and competition with each other.

Table 13. Dump pickers active on the Pata Rat landfill

Permanent Dump pickers	Population	Temporary Dump Pickers	Families	Population
Community "Dallas"	400	Roma from Hargita	20 to 50	400
From neighbouring municipalities	393	Corturarii	10	40
Total	**793**		**30 to 60**	**150-600**

More than 500 of the dumpsite pickers are reported to sell the materials directly to representatives of recycling companies located at the landfill, who transport it to their places of business.

The materials which are not solid at the landfill are transported to buyers off of the landfill in horse carts owned by 25 of the dump pickers. The cart-owners charge for this service and reserve certain days of the week for transport activities. The transport capacity of one cart is up to 480 kilos of waste, and the charge to the nearest collection point is € 4,20.

One sub-group of dumpsite pickers collect waste, transfer it to another location on the landfill, process it, and then sell it to the representatives of recycling companies purchasing at the landfill.

The street pickers, door-to-door collectors and dump pickers do not dispose of any waste, as they are only removing from the landfill, or accepting from households, the materials that they can sell or use in

their own households. The same is true for the dump pickers: they sell recovered materials to recycling industries and organic waste to livestock breeders. They take a small number of items for re-use in their households. There may be small residues from this activity, but the pickers themselves did not acknowledge this.

The material loss for the informal sector can be broken down to two categories: loss as a result of personal re-use, or loss related to residues from the activities of collection and processing. Personal re-use by street pickers, door-to-door collectors and dump pickers constitutes an annual 250 tonnes of materials. For collection and processing, the losses are too small to be documented, as collection is both selective and efficient. Since virtually no waste is lost during the limited processing that is taking place, for modelling purposes, we treat 100% of the collected waste, other than that intended for re-use, as being sold to collection points or the formal recycling industry.

2.8.5 Disposal and treatment

Formal disposal takes place only at the "Pata Rat" dumpsite, which is situated at five kilometres outside the city. This is a controlled dumpsite without environmental protection: it has no liner or leachate collection system and no gas recovery. There is perimeter fencing and a weighbridge, and some of the slopes and berms have been covered with sand.

The site is in operation since 1975 and was planned to be closed as far back as 1988. The owner of the landfill is the Cluj-Napoca municipality and it is operated by Brantner Veres company. Even though the municipality has decided to close the Pata Rat dumpsite and build a new, state-of-the-art landfill, delays in siting have prevented this from happening. A recently approved plan for the process of European Union (EU) legal compliance commits to closing the landfill by 2010. The 7,5 million tonnes of waste so far deposited on this landfill is estimated to consist of approximately 95% household waste and 5% industrial waste. There is no information on the mix of recoverable and non-recoverable materials. The informal sector is credited with setting regular fires at the dumpsite.

Illegal disposal occurs in several places in the city. The quantities of waste deposited as well the number of illegal dumpsites is increasing, which means increasing clean-up costs for the municipality. Annual illegal disposal for 2006 is estimated on 10.100 tonnes, of which 3.100 tonnes are subsequently collected by either municipal workers or by private subcontractor Valmax. The municipal authority collects illegally dumped waste and brings it to the Pata Rat landfill.

Materials cross from the formal sector to the informal recycling sector when they are picked from waste containers before collection by street pickers, and at the dumpsite, where dump pickers remove materials. Burning accounts for losses at household level, from containers during the collection process, and for losses at the landfill itself.

2.8.6 Cluj-Napoca: Scenarios for change

In Cluj-Napoca, Romania, the entire waste management system will be modernised under the influence of the EU according to the *Acquis Communautaire*.[22] The expectation and formal plan for Cluj-Napoca is that solid waste management will be tendered out in the next one to three years, even though large part of the system is already privatised. There will be a new sanitary landfill, a city-wide selective collection system for glass, cardboard, paper, PET and tins and a sorting plant at the landfill. Both the subtraction and addition scenarios are based on contrasting interpretations of these planned or expected developments, which conform to EU law and practice.

2.8.7 The subtraction scenario

In this scenario key actors, especially the private waste management sector, stop allowing the informal sector to work at the margins of the formal system. The current level of activity (as represented in the baseline) is in fact illegal right now, so this does not require anything other than strict attention to the law.

[22] The legal instrument for new EU countries to agree on harmonising with existing EU laws, rules and directives.

The consequences for the overall solid waste system are as follows:

1. Informal sector door-to-door collection of metals, paper and food for reuse will stop. The metal will still be recovered, but by formal, private operators, and so will not enter the waste stream. The paper will enter the formal selective collection system. Food and textiles will no longer be recovered, and will be handled through the mixed waste collection system, thus increasing the amount of materials going to the landfill.
2. Street picking will be prohibited. Eliminating street picking will be an additional cost in the selective collection system, in terms of "garbage police." This will be reflected in increased manpower for patrolling in the city, assumed to be six paid patrollers and three cars.
3. Dumpsite picking will be prohibited, and all the current dumpsite pickers will lose their livelihoods. There will be an automated sorting plant that will separate and sort metals, paper, plastic, glass and, later on, organics for composting from an incoming mixed waste stream.
4. The remaining waste will be sent to the landfill, where it will remain to generate methane because no-one will pick it.
5. Selective collection will be introduced into the formal waste system. Assuming that the participation rate will be the same as it has been in the pilot project, 42%, and further assuming that the percentage of capture from participating people is 50%, an absolute recovery rate of 21% can be expected. Materials to be collected separately are PET; LDPE film; paper and cardboard; tins and glass.

2.8.8 The addition scenario

In this scenario, key actors, especially the private waste management sector, comply with the laws against informal recovery, but in a different way. Rather than disallowing the informal sector to work at the margins of the formal system, they incorporate the informal sector through contracts and arrangements with Roma businesses or associations. One consequence of this is that the informal sector itself disappears, and is replaced by a formal system in which the Roma work under better conditions (they are still considered "informal" for purposes of tracking socio-economic impacts). The consequences for the solid waste system are as follows:

1. Door-to-door mixed waste and selective recyclables collection will be contracted out to partially "formalised" street pickers organisations through franchise agreements with the waste company that wins the tender. Street pickers will organise themselves in one or more small businesses per district and/or collection point. The material capture rate is expected to be higher than in the subtraction scenario, due to personal contact between street pickers and neighbourhood community as well as due to the "new" recycling sector's direct economic interest to collect as much recyclable material as possible. The street pickers' organisations will work with its own small trucks, be better equipped and follow basic health and safety rules. A capture rate of 50% is assumed.
2. Sorting of materials will be done by the partially "formalised" dumpsite pickers on a special platform provided by the Sanitation Company at the landfill site. The dumpsite pickers organisation will engage in a franchise agreement with the Sanitation Company, whereby they will not be paid for labour, but have equipment, vehicles, and storage locations that allow them to aggregate materials and reliably obtain market prices. To make sure they stay in business the Sanitation Company will guarantee a certain minimum monthly payment regardless of market prices. There will be 200 people working full time in this business. Since dumpsite pickers do not work full time as of now, this will translate into an income opportunity for 400 people.

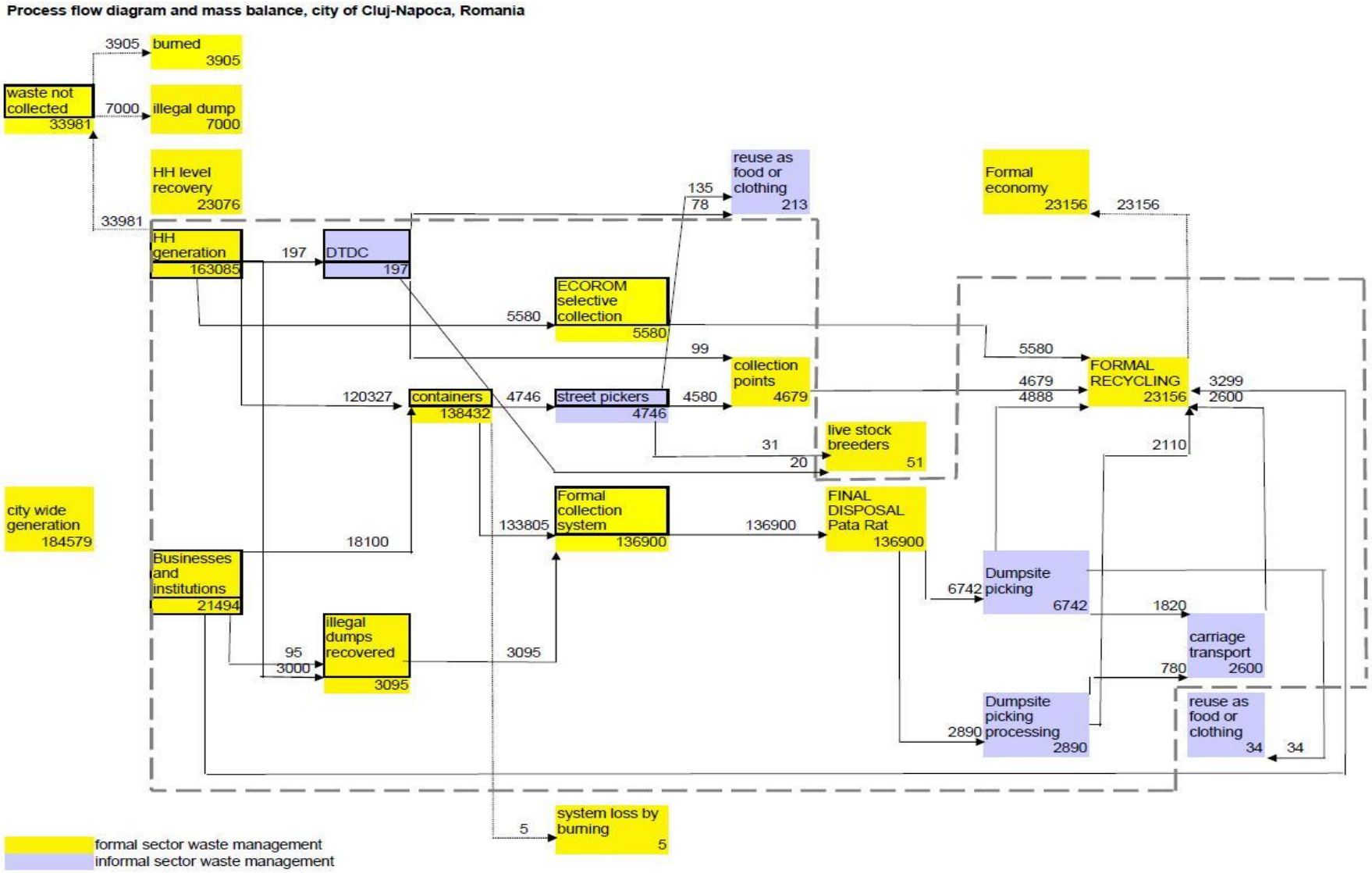


Figure 5. Process Flow Diagram for Cluj-Napoca

2.9 The Combined Cities of Lima and Callao

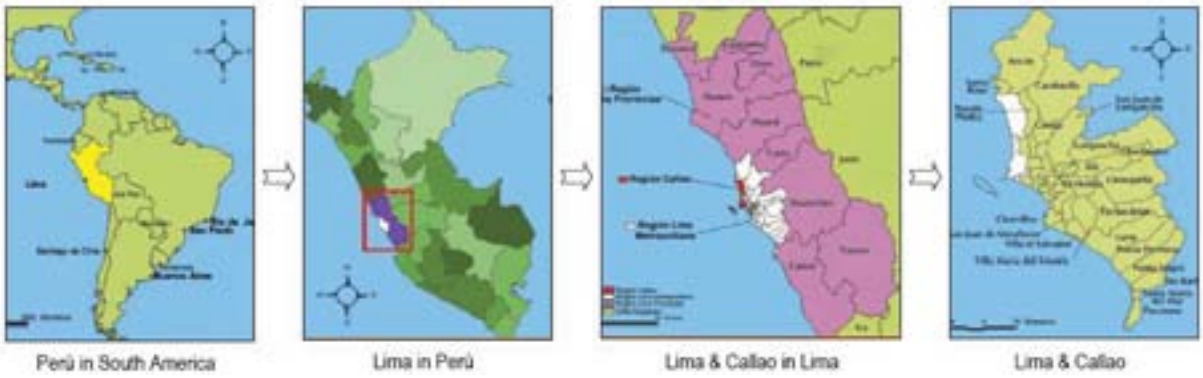


Figure 6. Maps of Lima and Callao

The combined city Lima & Callao is located on the West (Pacific) coast of Peru. Lima & Callao together are a mega-city of sea and desert at the foot of the Andes mountains, with the small city of Callao fully surrounded by the large city of Lima. It has an altitude between 0 and 154 meters, with a total area of 2.817 km2.

The Lima & Callao conurbation has a population of 7.765.151, which is 29% of total population in Peru, and consists of 50,1% women and 49,9% men.

Table 14. Number of districts and population in Lima and Callao

Province	Number of districts	Population
Lima	43	6.954.583
Callao	6	810.568
Lima & Callao	**49**	**7.765.151**

The total production of assets and services in Lima & Callao city represents nearly 50% of national production. This city represents 62% of national commerce, 68% of national manufacturing industry, 53% of national construction, 40% of governmental services and nearly 77% of financial services.

Solid waste management in Lima & Callao is regulated by municipal laws and regulations, specifically the Lima Municipality Regulation of solid wastes. The national legal framework is based on the Péru General Environmental Law and Péru Solid Waste General Law.

The Environmental Health National Directorate (DIGESA) is the main operational arm of the Ministry of Health in relation to solid waste management. This authority regulates the sanitary and health aspects of solid waste management, especially but not only in health care institutions. The Directorate also has responsibility for registering and licensing solid waste operators and recycling enterprises.

The National Environmental Council (CONAM) has the task of managing the public participation, information, and promotional aspects of solid waste. CONAM works in a national level and has regional offices.

Callao & Lima Municipalities are responsible for solid waste management from households, businesses, markets and institutions. There are 49 districts (43 in Lima and 6 in Callao); each district has its own independent waste management system.

2.9.1 Stakeholders

The solid waste sector in Lima and Callao has the following major stakeholders, shown in Table 14.

Table 15. Stakeholders identified in Lima and Callao

Type of stakeholder	Stakeholders
State institutions	Municipalities, Environmental Health National Direction, National Environmental Council
Users /clients	Households, businesses, industries, markets and institutions
Formal sector providers and operators	Formal private sector solid waste collectors, mid-level recycling processors, facility operators
Informal sector providers	Street pickers, dump pickers, itinerant waste buyers, pickers at transfer station plants, dump pickers, itinerant waste buyers, piggeries and junkshops
Formal recycling industry.	All kind of enterprises which process recyclables for use or export

The waste generation in Lima & Callao is 0,72 Kg per person per day.

2.9.2 Process flow description

The process flow for Lima is shown in Annex 3. The process starts with households, businesses, markets, institutions, and the street, which are identified as waste generators in Peruvian law. The total generation is 2.725.400 tonnes per year, after losses of 1,4%, or 37.300 tonnes per year, to the system by animal feeding and waste burning, leaves a net volume of wastes entering the system of 2.688.100 Tonnes per year. The Process Flow diagram for Lima is shown in Annex 6 in a separate folder.

68% of waste is formally collected by 49 municipalities, and 20% is recovered by informal waste pickers in streets, dumpsites, restaurants and markets. 11% of non-collected and non-recovered volume of wastes. The remaining 0,5% consists in informal collection in tricycles, selective collection systems and recycling campaigns.

At the right part of the flow diagram 68% of wastes is formally disposed in 5 sanitary landfills. 12% is going to open dumpsites. 14% of inorganic recyclables goes to junkshops for selling to recycling industry. 6% of organic wastes go to informal piggeries and a final loss of 0,3% in piggeries by waste burning.

2.9.3 Formal sector

There are three categories of formal collection in the 49 districts of Lima & Callao:

- 25 districts provide direct formal collection services with municipal equipment, tools and crew.
- 18 districts provide formal collection service by concession to private operators called "Provider enterprise of solid waste services".
- Six municipalities or districts provide formal collection with a mix of municipal and private services.

In Lima & Callao there are two main separate recycling collection programs. One is operated by a municipal enterprise in Surco. The other, in Villa El Salvador, is operated by an association of waste pickers that has been registered and organised by the municipality. Some other municipalities and districts are only in the early stages of implementing selective collection programs. The quantity of wastes collected separately by the formal sector is quite small, only 0,2% of total wastes in Lima & Callao.

Photo 1. Two types of selective collection in the Lima area

Municipal waste is collected and transported by compactor trucks, open trucks, dump trucks and tricycles to transfer stations or directly to landfills. In some occasions the wastes are also transported to uncontrolled dumpsites.

There are nine transfer stations in Lima & Callao, used by 11 of the 49 districts. One third of all wastes that reach a landfill pass through a transfer station. Only one of the transfer stations has an operating permit from the City of Lima and is in compliance with national laws.

There are five legally authorised and controlled landfills, four in Lima and one in Callao, which provide disposal without any additional form of treatment, meaning that they cannot be called sanitary landfills. Together, these five landfills have received a total of 1.830.300 tonnes for the year 2005, which is 68% of total wastes.

According to the Lima material balance, which is based on numbers for 2005, 12% of the waste is disposed in open dumpsites, also without additional treatment.

Photo 2. Kinds of vehicles used in formal collection in Lima & Callao

2.9.4 Informal sector

Recovery and valorisation of inorganic recyclables is the primary activity of the informal sector. The

inorganic recyclables go to more than 750 junkshops that pack, process, and sell the material to recycling end-users, or to cottage industries. The organic wastes are informally collected from restaurants and markets and then transported to piggeries.

Alongside its major focus on valorisation, the informal sector engages in a modest amount of informal collection service provision in areas not covered by formal collection. Informal waste collectors use tricycles to collect mixed waste in areas characterised by narrow or steep streets, poor maintenance of roads, and the like.

In Lima & Callao there are two kinds of informal recycling collection:
- Separate collection of inorganic materials for recycling, and
- Collection of organic wastes for pig feeding.

The collection and recovery of recyclables happens in streets, in municipal collection trucks, in dumpsites, in transfer stations, in landfills, and as residues from organic waste delivered to the piggeries.

Table 16. Informal collection and recovery in Lima and Callao in tonnes per year

Description	Tonnes handled per year
Informal recovery – Streets	156.600
Informal recovery – Collection	36.100
Informal recovery – Dumpsites	19.400
Informal recovery – Landfill	12.300
Informal recovery - Transfer Station	1.400
Informal recovery - Collection Organics	6.200
Informal recovery – Tricycles	5.500
Informal recovery by IWB	142.300
Informal collection of organics	176.400
Subtotal	**556.200**

It is estimated that there are 6.698 street pickers, 48% with carts and 52% on foot. There are also 149 informal collectors on tricycles, who recover recyclables from the mixed waste they collect, and account for 15% of the recyclables. There are 666 dump pickers, in dumpsites, 423 waste pickers at piggeries, and 1.856 IWBs. In addition, there are 240 waste pickers at formal landfills, as well as 32 waste pickers at the formal sector's transfer stations. There are 1.060 informal junkshop workers. Additionally, 482 informal workers collect organic scraps from restaurants and market places. In total, there are 11.183 informal sector workers in Lima.

The 482 organic waste collectors collect 176.400 tonnes of organic waste per year, about 7% of total wastes, from markets and restaurants, and sell it to informal piggeries. The informal piggeries provide employment for an additional 6.460 persons.[23]

Annually, 9.100 tonnes of organics collected as part of mixed waste are burned and lost, 14.600 tonnes per year go to one or another dumpsite, and the remaining volume of 152.700 tonnes per year goes to informal piggeries.

Primary collection, transfer and transport of recyclables operate with muscle power. 48% percent of the street pickers, 100% of informal collectors and 100% of itinerant waste buyers use tricycles to collect and transport waste. The remaining 52% of waste pickers in streets recover and transport the recyclables on foot, using bags and sacks.

[23] In this report, the persons working in piggeries are often included in the calculations of the informal waste sector. When combined, the total number of people working in the informal waste sector is 17.643. This report specifies when the persons working in piggeries are not included in the calculations.

The recyclables extracted from landfills, transfer station plants and dumpsites are transported and sold to junkshops once or twice per week in normal trucks, either by the pickers themselves, or by representatives of the formal recycling companies who are operating at the landfill.

The recovered wastes are sold to small, medium or large junkshops, which buy all the separated recyclables, compact them, and transport them to the recycling industry in medium-sized to large trucks. There is a very strong demand from overseas markets in the Pacific rim, especially for PET bottles, so a considerable quantity of materials are exported.

Of the 750 junkshops for inorganic recyclables, 47% would be considered small operations, 50% medium size and 3% as large operations. For 2005, it is estimated that all junkshops combined bought and sold a total of 386.000 tonnes per year.

2.9.5 Disposal

The residual wastes from processing or marketing recyclables end up in informal or illegal dumpsites. In some cases the municipalities collect some part of these wastes for transport to formal sector landfills. The material loss within the informal sector occurs mainly at dumpsites and piggeries, due to burning. It is estimated that 5% of wastes that reach the piggeries is burned.

2.9.6 Lima: Scenarios for change

The scenario analysis is based on two contrasting but still plausible interpretations of the recently passed General Law N° 27314 that regulates SWM. This law permits the recovery of recyclables at source exclusively in formal selective collection systems, and gives a monopoly on waste collection to some combination of formal enterprises and municipalities. It forbids scavenging at landfills in its current form. Both scenarios have been developed in consultation with the municipalities of Lima and Callao.

2.9.7 The subtraction scenario

The hypothesis is that following General Law N° 27314, recovery of recyclables is restricted to recognised formal separate collection systems. Only formal enterprises or municipalities can collect waste or recyclables. This scenario is composed of two main elements:

- First, the municipalities of Lima and Callao are requested to prevent the traditional activities of waste pickers, IWBs and informal collectors. They therefore create regulations that criminalise informal collection and recovery activities. The city is divided into three groups of municipalities with different levels of effectiveness in eradicating the informal sector activities: group 1 eliminates 60% of the activity, group 2 eliminates 30%, and group 3 is not successful in eliminating it at all.
- Second, informal recovery at landfills and in transfer stations is prohibited and 100% effective, which eliminates the hitherto tacit acceptance of dumpsite and transfer station picking. The result is the elimination of all recovery activities in two landfills and five transfer stations: 100% of all the dump pickers lose their access to the recyclables and are denied the opportunity to work in recovery activities. The operational result is that there is no longer any recovery of recyclables in landfills and transfer stations; no other systems for recovery in those places are put in place, and all of the materials arriving at the landfills are disposed.
-

2.9.8 The addition scenario

The hypothesis is that following General Law N° 27314, selective collection systems are promoted (although not explicitly required), and organised waste pickers are included as part of the formal municipal solid waste management systems. This scenario is composed of two main elements:

- First, source separation is introduced and selective collection systems are installed; this is done by waste pickers according to the Bono Verde model of Villa El Salvador. 16 municipalities in Lima and two in Callao implement modestly capitalised municipal programmes of selective collection by organised waste pickers. In this system, organised but still "informal" teams of two collectors equipped with one tricycle collect the separated recyclables from defined zones of 650 households each, with a weekly collection frequency. The teams sell the collected material directly to the larger

junkshops and the revenues are their main income.

- Second, a hypothetical small modification to General Law N° 27314 would make it legal and possible to recover recyclables in transfer stations and at landfills, under improved working, health and safety conditions. In this scenario, operators of all five landfills and nine transfer stations in Lima and Callao actively facilitate the recovery of recyclables, setting aside adequate areas for recovery activities by organised waste pickers.

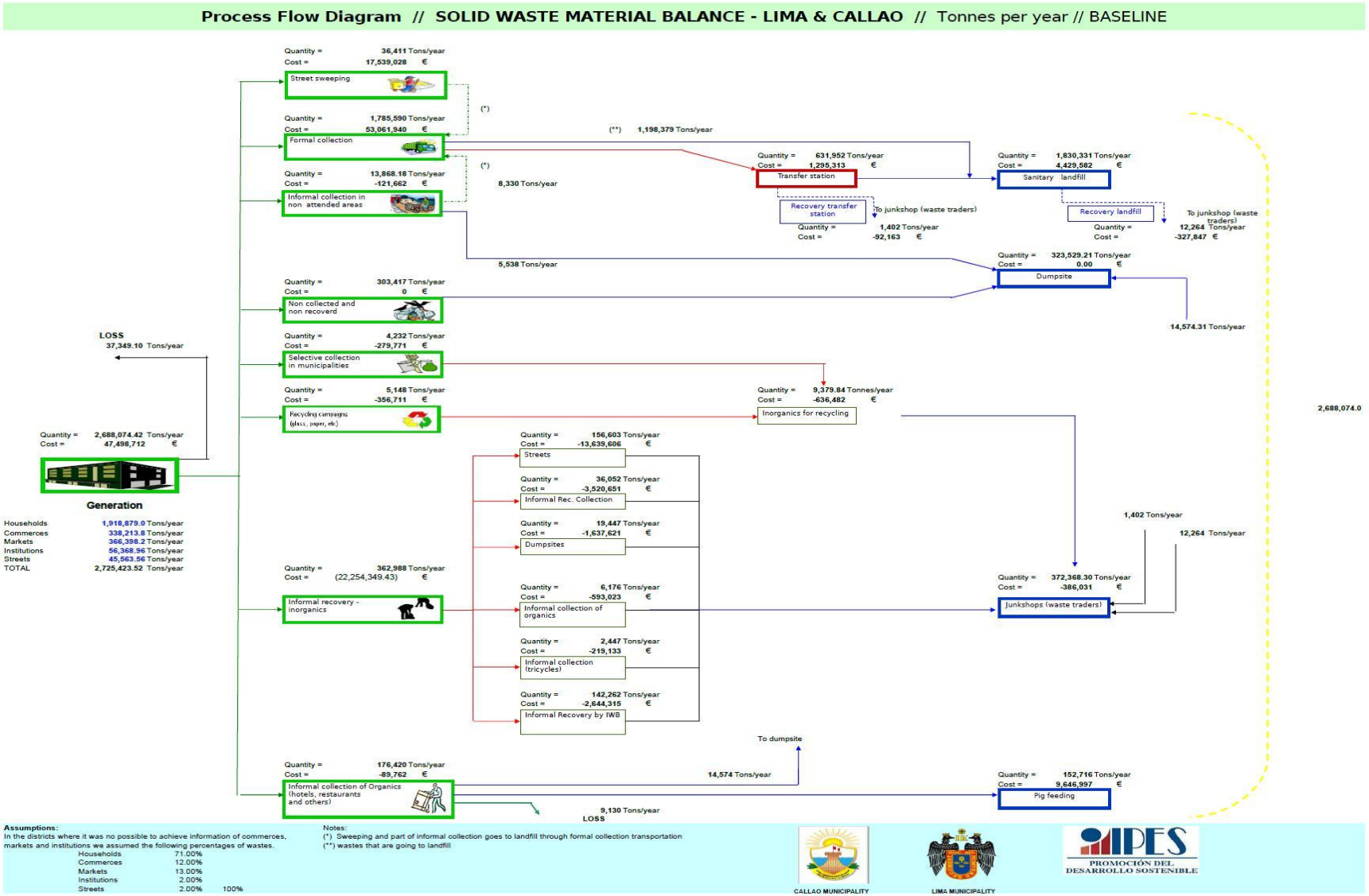


Figure 7. Process Flow Diagram for Lima and Callao

2.10 Lusaka

Figure 8. Map of Lusaka

Lusaka is located in Central Zambia (15 degrees 28 minutes south of the equator and 28 degrees 16 minutes east of the Greenwich Meridian). Located on the African plateau, Lusaka has an average attitude of nearly 1300 metres above sea level, which is slightly higher than the surrounding areas. The whole Lusaka urban area falls within the boundaries of the city of Lusaka, which has a surface area of 360 square kilometres. The city borders the central province to the north and west respectively. It also extends to the localities of Kafue, and Chongwe and Luagwa to the south and east respectively. The city includes 67 townships, but it is worth noting that, not all townships are of the same status, as some are low density townships while others are medium and high density townships.

Lusaka is flat with some isolated hilly areas. Apart from a few streams and small-made reservoirs, there is little surface water and no large water bodies. The soil is mainly composed of alluvial to clayish deposits. In areas where soil cover is present, the maximum depth of such soils range between 2-3 metres. The bedrock is characterized by the Matero Formation and the Lusaka Formation, composed of crystalline limestone and dolomite marble. The Lusaka Formation is known to contain one of the underground aquifers, which is a source of about 52 percent of the total Lusaka water requirements. The regional ground water flow pattern has a general North-West direction.

The population of Lusaka stands at 1.238.227, a total number of 252.699 households, with 83 percent of these households being in urban areas. The district is approximately 38% urbanised and has a population density averaging of 3.013,4 persons per square kilometres.

The economic importance of Lusaka is very significant, in that it provides the market for most agriculture produce as well as manufactured products from all provinces. Lusaka is actually the second largest economic centre of Zambia outside the Copperbelt and is notable for its substantial diversification in the production of goods and services.

There are a number of laws that delegate authority to the local authorities, specifically the Lusaka City Council, to effectively manage city waste services such as waste collection, transportation and disposal. Up until recently, the City of Lusaka had limited institutional and technical capacity to efficiently and effectively provide solid waste management services to the city's inhabitants.

Table 17. Solid waste legal framework in Zambia

Name of Law	Description
Local Government Act Cap 281	The Local Government Act is the principal legal framework for local government. It provides for an integrated three-tier local administration system and also defines the functions of local authorities. The statutory duties of the council / local authority are provided for in the Second Schedule of the Local Government Act and includes various aspects of the urban environment including provision of solid waste management services.
The Public Health Act – Cap 295	The Act provides for the prevention and suppression of diseases and generally to regulate all matters connected with public health in Zambia. Some of the specific provisions on sanitation and housing include section 65 which states as follows:
It shall be the duty of every Local Authority to take all lawful, necessary and reasonably practicable measures for maintaining its district at all times in clean and sanitary condition, and for preventing the occurrence therein of, or for remedying or causing to be remedied, any nuisance or condition liable to be injurious or dangerous to health, and to take proceedings at law against any person causing or responsible for the continuance of any such nuisance or condition.	
The Environmental Protection and Pollution Control Act – Cap 204	The Act provides for the protection of the environment and the control of pollution; as well as the establishment of the Environmental Council (ECZ) and prescribes the functions and powers of the Council. The ECZ has a number of powers prescribed under this Act which have to do with the protection of the environment which in this case refers to -land, water, air and other external influences and conditions which affect the development and life of all organisms including human beings. More specifically, ECZ has the mandate to establish pollution control and management standards for water, air, waste, chemicals, natural resources conservation, land use etc.
Waste Management Regulations	The Waste Management Regulations Statutory Instrument No. 71 of 1993 provides for the control of transportation of waste and management of waste disposal sites. All persons transporting waste or operating waste disposal sites including Local Authorities are required to obtain licenses and have to adhere to conditions and standards set by ECZ.

Under Danida-funded Lusaka Waste Management Project, a franchise system has been established for conventional housing areas which are low to medium density areas, and middle to high income. For the franchise system, the city has been divided into 12 service areas, called "waste management districts", each made up of a number of residential, commercial, and in some cases, industrial areas. With an eye to facilitating adequate return on private investment, the Lusaka City Council, has awarded four-year contracts to nine companies covering ten districts, and retained two districts for direct service by the WMU: the Central Business Districts and the Villa. A community waste management system has been put into place for low-income peri-urban and high density areas.

2.10.1 Stakeholders in solid waste management

Table 18. Analysis of stakeholders in Lusaka involved in solid waste management

Stakeholder	Description
Lusaka City Council	The Lusaka City Council has established a *Waste Management Unit* (WMU) as part of the DANIDA funded Lusaka Waste Management Project. The WMU presently has the responsibility of not only planning for waste management in the city, but also contracting for services, landfill management and general provision of technical advice to various actors. The WMU is equally involved in the collection and transportation of waste from the selected parts of the city.
Franchise contractors	Presently, there are nine local waste management companies who have each been assigned a waste management district, or zone. The franchise gives these companies the right and obligation to service the zone on a monopoly basis. These franchisees have the responsibility not only for providing collection services, but also for billing and revenue collection from those that have subscribed to the system. Some of the contractors are involved in recovery of waste for sale to recycling industries. The materials mainly recovered are waste paper.

Stakeholder	Description
Community Based Enterprises (CBEs)	The City of Lusaka has almost 70% of its population living in peri-urban areas and/or unplanned settlements which are not easy to access due to lack of roads. Additionally, the peri-urban areas are mainly low income areas and this includes a majority of poor people some of whom are unemployed. The status of these areas has made it difficult for the private sector to provide solid waste services, hence Lusaka City Council agreed to involve *Community Based Enterprises* to provide primary collection[24], which they accomplish using muscle power and hand-tools, moving material to communal collection points with wheelbarrows. The Lusaka City Council then provides secondary collection to move the materials to the disposal site. The CBEs can be considered as semi-formal with about thirty established to date. Although, only eight of the CBEs provide comprehensive solid waste management services for their areas.
Licensed Waste Generators	Under the Waste Management Regulations, the ECZ is mandated to license waste generators who wish to manage their own waste arising out of manufacturing and production process. The licensed waste generators collect and transport their own waste from their premises to the official dumpsite. The ECZ provides certain conditions to ensure that these licensed waste generators work within the license and do not illegally dispose of their waste. From the information available from ECZ, there are fourteen companies in the City of Lusaka who are licensed to manage their own waste.
Performance Contractors	The Lusaka City Council, in conjunction with the Ministry of Local Government and Housing has awarded performance contracts to six companies to provide street sweeping and drainage clearance services in selected parts of the city. The contractors are responsible for ensuring waste generated through the performance of their services is appropriately transported and disposed at the official Chunga dumpsite.
Recycling Industries	Recently, Lusaka has seen an increase in the number of recycling industries. Previously there was only one known waste paper recycler, *Zambezi Paper Mills*, but there is now a Zimbabwean outfit, *Flexi-Waste* that has established operations in Lusaka. Also, there is an increase in the recovery of scrap metal and a new company, *Universal Steel and Mining* which is in the process of setting up a steel plant has been actively buying and stockpiling scrap metal. There is also *Central Recyclers* involved in the recovery of non-ferrous metal. There is limited recycling of plastics although nothing is done in terms of PET or PVC materials. The recycling industries like Flexi-Waste and Zambezi Paper Mills, go out and collect their own waste paper from different clients.
Unregistered Waste Collectors	In spite of the law that requires that all transporters of waste be duly licensed by the ECZ and awarded a franchise contract through the City Council, there are a number of illegal (unregistered) waste collectors who are involved in the provision of waste collection services in the city, who can undercut the official collection price because they do not pay all the necessary fees. In most cases these collectors illegally dispose of the waste in outskirts of the city and so avoid the disposal fee charged at the dumpsite. It is estimated that there are about 20 of these companies operating in the city.
Street Pickers	High levels of unemployment and poverty in the city contribute to the growing number of waste pickers, who mainly collect waste paper and scrap metal –particularly high-value, non-ferrous metal. Waste picking is not well organised and the pickers have to walk long distances from the points where they collect the recyclable materials up to the recycling industries. In some instances, the Recycling Industries have provided support in the form of handcarts to allow for efficient collection of waste materials. It is estimated that there are about 190 street waste pickers who are known to supply their materials to the recycling industries although there could be more who pick waste but use it for various purposes.
Dumpsite pickers	Due to the lack of effective controls and management at the official dumpsite, there are a number of waste pickers involved in the recovery of waste paper, scrap metal and plastics. There are about 200 waste pickers on the dumpsite and these include women, children and men. The waste materials that are recovered are either sold directly to the recycling industries or consumed or used by the waste pickers themselves.

[24] The model for these Community Business Organisations (CBOs) franchises is the International Labour Organisation (ILO) project in Dar es Salaam, which also supported the start-up of this system in Lusaka.

2.10.2 Process flow description

The process flow diagram for Lusaka is shown in Annex 3.

In areas where there is collection service, generators have a choice of a variety of containers for storage and set-out, including plastic bags, sacks, metal or plastic bins or even used 210 litres (55-gallon) drums. Where there is no collection coverage, the majority of households and commercial outlets use refuse pits and burning to handle their waste.

One third of all covered households are served by unregistered collectors, who are paid a service fee by the clients on a private-to-private basis. They do not recover any materials, but take their waste either to Chunga or to an illegal dumpsite.

The different providers – including the unregistered ISPs (informal service providers) – use a variety of collection methods, including the use of light trucks, tipper (dump-)trucks, compactor trucks, skip lifters (roll-off trucks), carts, and wheelbarrows. There are no transfer stations or Material Recovery Facilities, with the result that waste is moved directly from the point of generation right to disposal site. In the case of peri-urban areas, collection is divided into two stages.

Informal recovery of valuable waste by the formal truck crew and staff is responsible for material cross-over to the informal sector. Usually crew members recover materials that they can either sell or re-use.

Primary collection using carts is the responsibility of the community based enterprises (CBE)s, with secondary collection provided by the Lusaka City Council. In contrast to many other cities, in Lusaka there is no recovery or extraction of waste at the communal secondary collection points in the peri-urban areas. CBEs in Lusaka are part of the formal waste management system.

Lusaka City has only one formal dumpsite – Chunga. It is currently a controlled dumpsite. An electronic weighbridge has been installed and equipment for managing the waste on site procured. Construction of a more environmentally sound, engineered landfill has started with the support of DANIDA, but is not in use at this time.

The material losses from the waste entering the system mainly occurs due to the type of collection vehicles employed. There is a requirement for open light trucks or tipper trucks to be covered with a tarpaulin or net to prevent waste flying out, but compliance with this law is weak, so quite a lot of waste is lost during transportation to the disposal site.

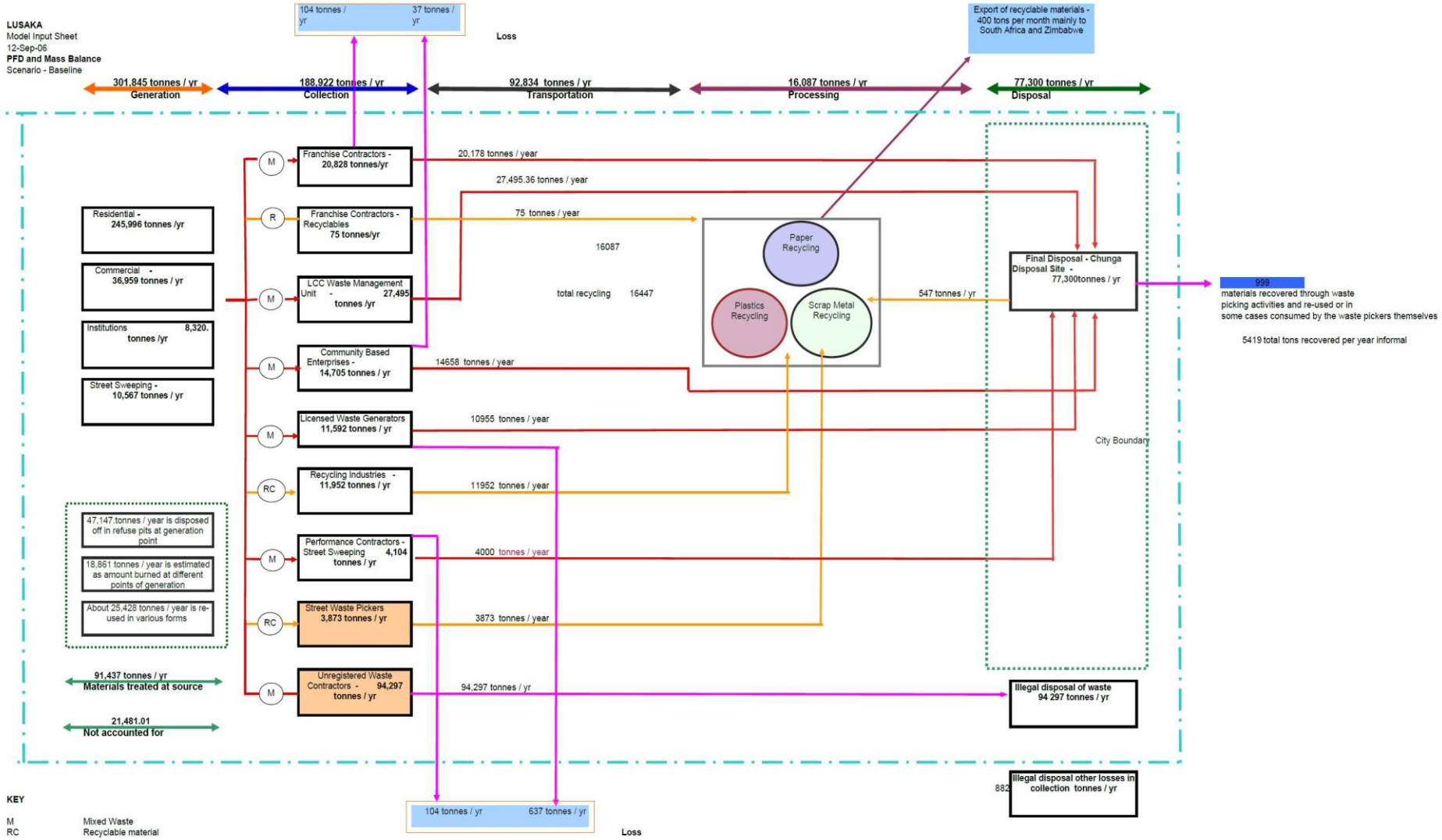


Figure 9. Process Flow Diagram for Lusaka

2.10.3 Lusaka: Scenarios for change

Lusaka City Council, with support from the Danish Government, has been implementing a project aimed at improving the way waste is managed in the city. This includes the division of the city into 12 Waste Management Districts that have been contracted out on a franchise basis to the private sector, and financing a new landfill for the city. There is an official policy decision to reduce the amount of waste that is disposed of at the new landfill site. Public education campaigns have been embarked upon to encourage residents and other waste generators to separate their waste, but this has not been accompanied by structural creation of separate collection systems, and so the recovery is predictably very low. At the same time, there are new prohibitions for household self-treatment of waste by burying and/or burning. Combined with organised separate collection, this could have the effect of more mixed waste, together with recyclables and compostables, into the franchise system. On the one hand, this would reduce losses and provide enhanced opportunities for waste recovery; on the other, it could overburden the current infrastructure and institutions and create a crisis.

While recognising the role of the informal sector, the City Council considers it strategic to focus on improving the amount of waste collected and gradually move to a stage where the residents and business outlets can be encouraged to separate waste and provide mechanisms for recycling.

2.10.4 The subtraction scenario

The hypothesis is based on the "real-life" 15 year solid waste management Strategic Plan enacted by the City Council but not yet implemented. The plan gives the Lusaka City Council and the formal private sector actors - in this case franchise contractors – a monopoly position in relation to waste and recycling collection. The first 5 year rolling Action Plan emphasizes this because the local authorities want to improve the coverage and quality of the waste management service provided.

2.10.5 The addition scenario

The hypothesis is that the Lusaka City Council recognises the role of waste pickers and provides an appropriate institutional and legal framework to allow the waste pickers to operate in a protected legal environment, with better equipment, health, and safety conditions. At the new landfill, a group of waste pickers has already been recognised and encouraged to form a cooperative that can legally conduct business at the landfill site in designated areas. The hypothesis extends this recognition to the rest of the city.

A further hypothesis is that the Lusaka City Council promotes the establishment of 'buy back' centres set up by the informal junkshop operators to buy recyclables at existing transfer points where the 15 – 20 m3 containers are currently located. The informal sector operators running the 'buy back' centres accept responsibility for container maintenance in return for the concession to buy at that point.25 The 'buy back' centres also provide space for storage of materials before these are sold to the recycling industries.

The addition scenario changes the system to include metal and paper buy-back centres, and to allow for activities of the recognised group of waste pickers at the Chunga site. In this scenario the status of the illegal or unregistered collectors is also regularised.

[25] This "integration" approach is based in part on a real, and quite successful integration experiment in Commune VI in Bamako, Mali.

2.11 Pune

Figure 10. Map of Pune

Pune, the financial capital of India, is located about 170 km South-east of Mumbai. It is the second largest city within the State of Maharastra. The city is surrounded by the Sahyadri range of hills, with two perennial rivers, the Mula and the Mutha, flowing through it. Pune experiences three distinct seasons: summer, monsoon and winter. Annual precipitation is 722 mm, with most rain falling in the monsoon period.

Pune ranks ninth in the list of 27 cities in India with a million-plus population. In 2005, the estimated population of Pune in was 3.006.036. Pune's annual growth rate is 4,14%. 62% of the total population is under the age of 30. It is estimated that about 50% of the population increase is on account of immigration. Besides being a financial centre for India, the main drivers of the economy in Pune are the automobile industry and auto ancillary, and hence the name "The Detroit of India". Pune is also the prime higher education centre, "The Oxford of the East". Potential areas for economic expansion are in the information technology, bio-technology and agro-business sectors.

In September 2000, the Ministry of Environment & Forests promulgated the *Municipal Solid Waste (Management and Handling) Rules, 2000* (the Rules). The Rules make it mandatory for urban local bodies to improve the systems of waste management, and provide legal procedures for waste collection, segregation, storage, transportation, processing and disposal. The Rules require all cities to set up suitable waste treatment and disposal facilities by December 31, 2003 or earlier, and specify standards for compost quality, health inspection, and management and closure of landfills. These deadlines were not met for Pune, at the time of writing this report.

In April 2006, the Maharashtra Government enacted *the Maharashtra Non Bio-Degradable Garbage (Control) Act* which governs the collection, transport and disposal of non- biodegradable waste in the State.

2.11.1 Stakeholders

Pune Municipal Corporation (PMC) is the statutory local government authority responsible for providing solid waste services in Pune. The PMC consists out of a General Body 146 elected, and 5 appointed members, a Standing Committee, and a Ward (village or neighbourhood) Committee. The Standing Committee is the most important group of the PMC, consisting of 16 councillors elected from among the General Body of councillors. The Standing Committee has control over finances and is subject to supervision by the state government.

The Ward Committee consists of councillors representing the electoral wards within the territorial areas of the ward committees. The main functions of the committee are to approve the cost of works for the wards and incorporate the expenses in the budget.

The Municipal Commissioner is the key figure in local self-government and is the administrative head of PMC. The Commissioner is assisted by senior officials in discharging his functions.

The Maharashtra Pollution Control Board (MPCB) is implementing various pieces of environmental legislation in the state of Maharashtra, with a focus on water, air, and solid waste legislation. The Central Public Health & Environmental Engineering Organisation (CPHEEO), Housing and Urban Development Corporation (HUDCO), National Building Construction Company (NBCC) are key stakeholders. The CPHEEO is the technical wing of the national Ministry of Urban Development, and is involved in Pune's solid waste management system. HUDCO is involved through planning of the proposed mechanical composting plant. If the plan is accepted, the NBCC will build the composting plant.

Table 19. Pune stakeholder inventory

Formal Stakeholders	Informal Stakeholders
Generators - households, commercial	KKPKP (Union of waste pickers and IWBs)
Labour contractors	ISPs
Vehicle contractors	Waste pickers
Formal sector employees - solid waste management staff	Itinerant Waste Buyers
Pune Municipal Corporation (PMC) administration	Scrap dealers - retail to wholesale
Municipal Councillors	Farmers
Airforce Station	Informal sector composting agents
Maharashtra Pollution Control Board	Residents in vicinity of landfill
Recycling enterprises	
Biogas, compost, Refuse Derived Fuel (RDF) technology providers	
NGOs	
Financial Institutions (HUDCO, NBCC)	
PMC municipal workers union	
PMC-appointed Committees for solid waste management (Apex and Steering Committee)	

Households and commercial establishments generate an annual 544.200 tonnes of waste. This breaks out to 1,5 kg per household per day, and for commercial waste to 0,5 kg per employee per day.

2.11.2 Process flow description

The Process Flow diagram for Pune is shown in Figure 13. The solid waste management system for Pune is subdivided into five stages:

1. generation
2. primary collection
3. secondary collection and transport
4. tertiary collection and transfer and,
5. disposal

Waste is generated by households or businesses. In addition, roads are also included as waste generators because the road sweepings are also deposited in the containers that are collected by the PMC.

Two activities make up primary collection. IWBs collect recyclables through door-to-door collection. Authorized Waste Pickers (AWPs), roam the streets and extract and recover both recyclables and organic waste from containers. The IWBs and AWPs bring the materials directly to scrap traders in the city. Certain commercial generators also bring recyclable materials directly to the scrap traders, and organics to

farms and piggeries.

The materials that remain uncollected in the primary collection stage are picked up in the secondary collection stage, in which trucks collect waste from households by going door-to-door, and hotel trucks pick up waste from large commercial generators.[26] Some household and commercial waste generators also deposit their waste in community containers at central drop-off points, and the municipality arranges transportation to the transfer stations. Municipally collected waste from roads also ends up at the community containers.

The transfer stations receive organic waste, inert materials (sand, dust, etc), and recyclables that were not separated and sold by the generating household or business. There is additional sorting at the transfer station, and the organic waste that is extracted there goes to piggeries, to agriculture and to the landfill. From the transfer stations, recovered recyclables end up the scrap dealers' shops, and the residue goes to the landfill. The non-recoverable materials are transported from the transfer station to disposal.

Not all recyclables that are collected by the municipality end up at the transfer station. The truckers also deliver recyclables directly to scrap retailers.

2.11.3 Formal sector

All formal collection is done by the PMC, the local authority. The PMC collects waste from households, commercial establishments and roads. There are no private companies collecting the materials that are covered by this study, but some special materials are handled in private systems. Medical waste, for example, is collected by Image India Limited. Table 20 summarises the different types of municipal waste collection in Pune.

Table 20. Pune Municipal Corporation collection

Type of waste	Collection point	Method	Tonnes Collected per day
Organic waste (daily), recyclable / non-biodegradable (weekly): households & businesses	Households: door-to-door or at gates of buildings	41 'Ghanta' trucks (who ring a bell when they are collecting)	143
Mixed waste from households / businesses	Inner city areas: door-to-door	Cycles + pushcarts supplemented by AWPs	344
Mixed waste from households / businesses	Community Containers	Skip hoist trucks replace full container	1016
Organic / Inert waste	Roads	Sweepers collect in pushcarts and deposit in the containers that are collected by skip hoist trucks	113 (as part of the mentioned 1016)

The municipality arranges formal transport of the solid waste, from waste generation to the transfer stations, and from the transfer stations to the landfill.

There are nine transfer stations in the Pune. Based on surface area of the stations, seven are considered small (to 465 square metres), one is medium (2325 sq metres) and one is large (4650 square metres). Two of the small transfer stations are not functional at the time of writing, due to local protest.

In 2005, the Pune Municipal Corporation commissioned HUDCO to prepare a detailed project report for a 500 metric tonnes per day mechanical compost plant and has also entered into a Memorandum of

[26] This refers to direct collection from households by a vehicle which is often used for secondary collection. For this reason the term 'secondary collection' is used.

Understanding with the company IL&FS-AIILSG for a 500 tonnes per day RDF plant and a 100 tonnes per day biomethanation plant, but none of these are operating, so there are no waste processing facilities.

2.11.4 Informal sector

Recycling and valorisation occur entirely in the informal private sector, up to the level of a medium junk shop. There are no public sector recycling activities at all.

The recycling sector is structured in the form of a pyramid, with the scrap collectors at the base and the end-use recycling industries perched at the apex. At the bottom are the waste-pickers who extract waste from municipal garbage bins and dumps. Marginally above them are the itinerant buyers who purchase small quantities of scrap from households. Between the scrap collectors and the end-users are various levels of traders including retailers, stockists and wholesalers, most of who are registered under the Shops and Establishments Act. The largest and most profitable are the Registered Dealers. The end-users are in a class by themselves.

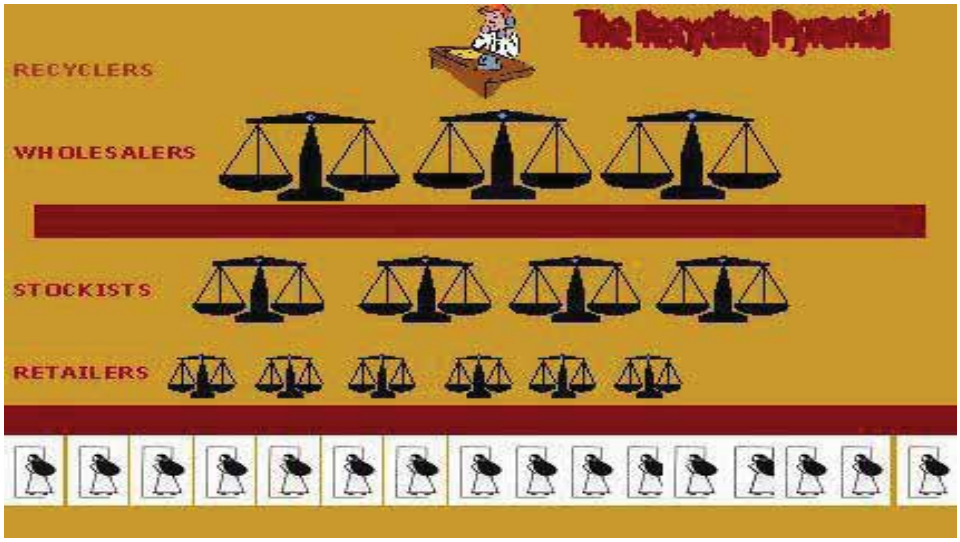


Figure 11. The Recycling Pyramid in Pune

2.11.5 Collection

Itinerant buyers purchase small quantities of scrap from households, offices, shops and other small commercial establishments. 81% per cent of them are men. They access small amounts of capital from the scrap traders who deduct the amount from their earnings at the end of the day. The pushcarts which the men use are provided by the traders for a fee. The items collected by the itinerant buyers are of relatively better value than those collected by waste pickers.

Waste pickers retrieve paper, plastic, metal and glass scrap from garbage bins or municipal waste containers, and from landfill sites where the collected garbage is transported and dumped. They establish 'territorial rights' over bins and dumping sites and frequently squabble over perceived infringement on their territory. Since 1996 waste pickers in Pune have been authorised by the Pune Municipal Corporation to collect scrap through a system of identity cards issued to them by the Kagad Kach Patra Kashtakari Panchayat (KKPKP, the Union of waste pickers).

2.11.6 Transport and transfer

The waste collected by the IWBs is transported to the scrap stores on pushcarts. AWPs transport the scrap to the scrap stores at their own cost. 2.280 pickers, or about 60% of the AWPs, carry the scrap on their heads; 1.140 hire small tempos (motorised three wheelers) and 380 use hired handcarts.

A small part of the organic wastes are directly transported to informal piggeries and to informal agricultural enterprises and/or individuals.

The residual waste from the scrap collection and processing crosses into the formal sector system when it is deposited in the municipal containers.

2.11.7 Processing

The IWBs undertake limited sorting, dismantling, and processing to make the items they have collected into marketable commodities. These activities generally take place either in the slums where they live or outside the scrap stores.

The Authorised Waste Pickers undertake sorting of paper, plastic, glass and metal scrap and sometimes washing of milk bags. They sort under trees along the roads, outside the scrap stores or outside their homes in the slums where they live. Washing of milk bags is undertaken in their homes or in small rivulets or the river. The residue after sorting is disposed in the municipal containers.

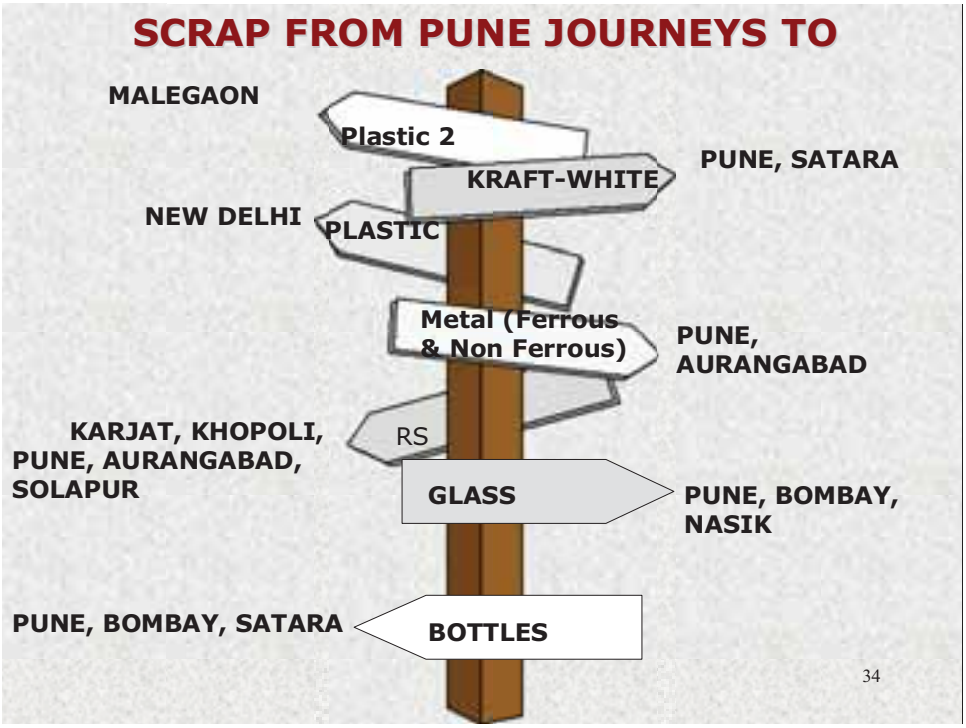


Figure 12. Destinations of recyclables from Pune recovery activities

The scrap traders sort and grade the scrap; bale and/or pack it and arrange for it to be transported to the wholesalers or the recycling units as applicable.

There are about 30 recycling industries in and around Pune but most of the scrap is sold to other urban centres in the state or other states in India.

2.11.8 Disposal and treatment

The present waste disposal site is located on 11 hectares at Urali Devachi, which is about 20 km from the city of Pune. Earlier, PMC was converting biodegradable organic waste into compost by the aerobic process at the landfill sites. Since 2002, PMC has shifted to spraying Effective Micro Organism (EM), a Japanese technology at the landfill site.

In addition to the current site, PMC has also identified seven hectares of land at Yewalewadi as a future landfill site and 48 additional hectares at Urali Devachi for a waste processing and disposal facility. Development of the new site at Urali Devachi is in the process of receiving central government funding.

The initial losses at household level are chiefly from burning, burying or dumping the bio-degradable

materials and inerts, or from moisture loss from organic waste, due to formal system delays in waste collection, exposure to heat, and evaporation. The majority of the non-bio-degradable material loss occurs at the level of the scrap dealers, also from burning or moisture loss form sitting organics, with any residuals going to community containers. There is little loss at the waste pickers' and itinerant buyers' level, since restraints on processing and storage space make them unlikely to take on materials unless they can make an immediate sale.

2.11.9 Pune: Scenarios for change

Many cities in India have privatised their waste collection, transport and disposal via contractual arrangements with national and international companies. Most municipalities are very happy with the resultant cost savings. The pressure on municipalities to privatise is therefore quite high. There is additional pressure on municipalities to design, site, and maintain sanitary landfills for the city, which is associated with a commitment to reduce the amount of waste that is collected and disposed of at these new landfill sites.

The subtraction and addition scenarios have been developed as extensions of real situations in Pune, based on an overarching set of changes mandated by the Municipal Solid Waste (Management and Handling) Rules 2000 and the recently enacted Maharashtra Non-Biodegradable Garbage (Control) Act, 2006, which include the following provisions:

1. Segregation of waste into organic and other waste
2. Organisation of door to door collection of source segregated waste
3. Recycling of recyclables
4. Restrictions at landfills allowing only non recyclables and/or inert materials to be landfilled

2.11.10 The subtraction scenario

The subtraction scenario is based on the assumption that the PMC constructs a 500 metric tonne per day RDF and electricity co-generation plant for processing mixed waste.[27] This is only feasible if plastic and paper are directed to the RDF plant and all other recycling ceases. The hypothesis is that the PMC ceases its support for separate collection of paper and plastics at the source, and this decision disrupts the recovery of these materials to some extent.

The hypothesis is that the PMC actions do not interfere with the IWBs, so their recovery activities will continue. The PMC does prevent, and in practice eliminate, all recovery activities of street and dump pickers. As a result, all of the paper and plastic will be collected by the formal municipal system and converted to RDF.

RDF is presented as a convenient option for citizens who can mix their waste and still know that something will be recovered from it. RDF is in fact convenient for the administration because mixed waste can be collected through motorised vehicles, and is based on the expectation of increased technical efficiency. The RDF generator supplements its revenue from the sale of metals and glass recovered by post-collection sorting.

The RDF plant will need a regular source and supply of garbage free of dust, grit, sand, and inerts, and some form of flow control is assumed. Contracts therefore routinely include penalty clauses on municipalities for failing to supply garbage 'of the specified composition'.

The problem with this kind of contract is that it is almost impossible for the municipalities to comply with the composition specifications. The main reason for this is that the current system of collection via containers encourages mixed streams, and also serves municipal sweepers as the correct destination for road sweepings. Consequently, the overall amount of waste collected daily reflects a high proportion of inerts and silt which will inhibit proper functioning of the RDF plant. Moreover, the current system experiences poor operational efficiencies, erratic work, and low operational norms, so that even regular delivery of garbage, irrespective of the quality, is an issue and may remain so.

[27] In the "real" situation (end 2006), PMC is in negotiations with two companies for the construction of this facility. More details about the costs of the facility are not available at this time.

These uncertainties make it probable that the RDF operator will, if allowed, seek to make a backdoor entry into household collection of garbage to ensure the required composition of garbage as its raw material, or pressurise the PMC to privatise collection. Since many employees of the PMC are legally protected and cannot be fired when their workload is taken over by a private firm[28], this will mean that the costs of doorstep collection will actually increase, and overall solid waste management costs will go up.

Door-to-door collection, which is currently performed by the informal sector, will cease. Some level of segregation will be enforced by the private company as part of their collection rights and fees. Dumpsite picking will stop. Metal and glass will be subject to automated post-collection sorting at the landfill and sold, and the paper and plastics will enter a mixed waste collection system and used in the RDF. Street picking will stop. Eliminating street picking will be an additional cost for the private company which it will recover through user fees. This will be reflected in increased manpower for patrolling in the city. The remaining waste will be sent to the landfill together with fly ash and other rejects from the RDF plant.

2.11.11 The addition scenario

The addition scenario is formulated to optimise and secure extension of the current situation, where waste pickers are to some extent regularised and integrated. The addition scenario models the effect of having the informal or traditional waste pickers associated in the KKPKP cover the whole city for separate collection of organics and recyclables. In the addition scenario, source segregation of waste at household level is enforced. Door-to-door collection of both organic and recyclable waste is undertaken by waste pickers, who later sell the recyclables. The waste pickers transport the organics and non-recyclables to a transfer point, where a municipal service collects it and transports it to a disposal site (the non-recyclables) or to a mechanical composting plant and a bio-methanation plant (organic waste).[29]

The addition scenario is based on the assumption that the PMC has entered into a memorandum of understanding (MoU) with HUDCO for setting up a mechanical composting plant for 500 metric tonnes per day, with the result that all collected organics can be composted. In this scenario, the organics would also be processed through bio-methanation for production of gas and subsequently electricity. The non-recyclables would be despatched to a sanitary landfill. No RDF plant is assumed in this scenario.

This scenario assumes that the waste pickers will cease to be 'informal workers', as their collectivisation in cooperatives will introduce some degree of 'formality' to their work. Operating norms, terms of work, and the like, will be regularised and will cease to be as flexible as they are now. As member-shareholder-owners of the cooperative, the pickers are considered as self-employed and remain informal only for the purpose of this analysis.

[28] Particularly, Class IV employees.

[29] See Annex 6, Workbooks, Pune Addition Scenario, Process Flow Diagram (PFD) for a visualisation of the process.

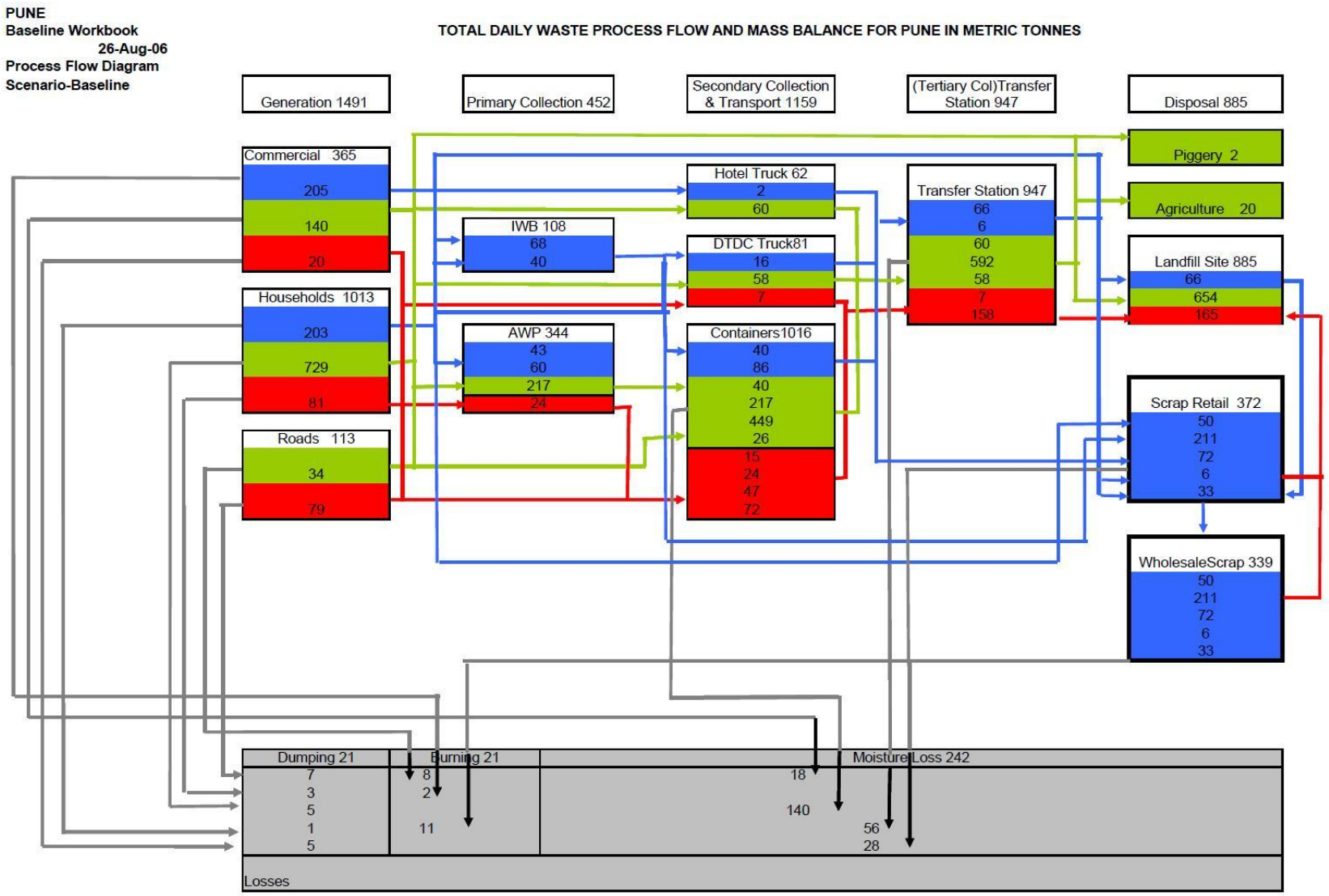


Figure 13. Process Flow Diagram for Pune

2.12 Quezon City

Quezon City, which is part of Metro Manila, is located in the island of Luzon. It is the former capital of the Philippines, and it is the biggest city of six cities and 17 municipalities in Metro Manila. Situated on the Guadalupe Plateau, the city is characterized by largely rolling terrain with alternating ridges and lowlands.

In 2000, the city registered a total population of 2.173.831, and an annual growth rate of 3%. The city's population is divided among the ethnic groups which are associated with the island of origin: Tagalog (65,4%), Ilocano (5,2%), Bicol (5%), Bisaya (4,4%) and Cebuano (3,25%). These figures show that the city had had many migrants from different parts of the country.

Quezon City belongs to a tropical monsoon climatic zone with two pronounced seasons: relatively dry season from December to April and wet season from May to November, although rainfall comes at any time during the year.

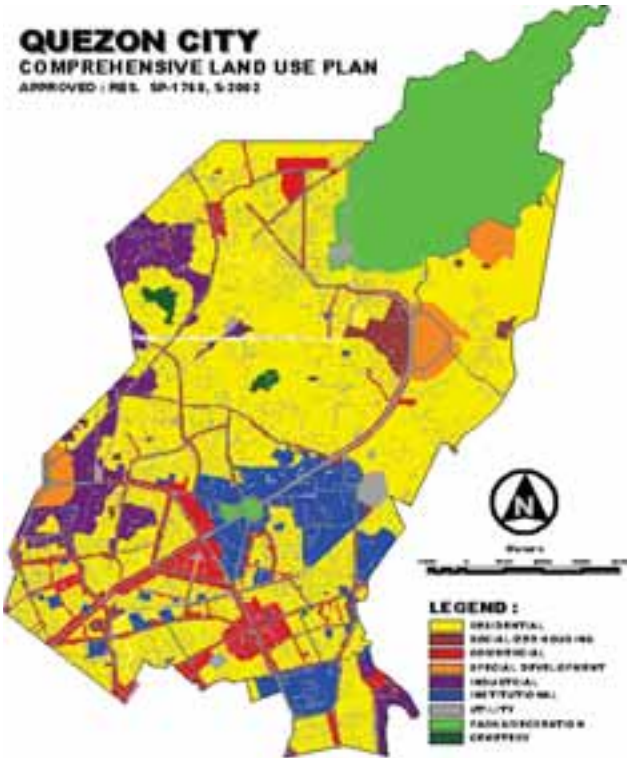


Figure 14. Map of Quezon City

The city is dominated by small and medium-scale family business establishments engaged in the distribution of finished products and the provision of basic personal services. Wholesale and retail trade makes up 47% of the business establishments.

In the Philippines, the national law commonly known as Republic Act 9003 of 2000 or the Ecological Solid Waste Management Act (The Act) provides the legal framework for the country's systematic, comprehensive and ecological solid waste management program. Among the key features of this law are:

- Creation of a Solid Waste Management Board within the city or municipalities;
- Formulation of a 10-year management plan consistent with the National Solid Waste Management Framework;
- Mandatory segregation of solid waste at source;
- Segregated collection with the *barangays* (a village or municipal subdivision, similar to a ward, with some governance functions) collecting the biodegradable and recyclable wastes and the city collecting the residual and special wastes;
- Establishment of at least one Materials Recovery Facility (MRF) in every barangay or cluster of barangays;

- Prohibition of open dumps;
- Mandated guidelines and/or criteria for the establishment of controlled dumps and sanitary landfills;
- Provision of monetary and non-monetary rewards and incentives, financial assistance, grants and the like to encourage local government units (lgus) and the general public to undertake effective solid waste management;
- 25% waste diversion requirement; and
- Filing of citizen suits against public officials and alleged violators.

In terms of local ordinances, the City has enacted several additional local laws related to solid waste management.

2.12.1 Stakeholders

- Quezon City Government is primarily responsible for the implementation and enforcement of the provisions of Republic Act 9003 within its jurisdiction. The collection of residual non-recyclable materials and special wastes is the specific responsibility of the city government. As part of its compliance with the law, the Quezon City Government created the Environmental Protection and Waste Management Department (EPWMD) to serve as the entity which develops and administers a Comprehensive Environmental Protection Program covering garbage collection and pollution control.
- Barangays (villages) are responsible for the collection, segregation, and composting or recycling of biodegradable, recyclable, compostable and reusable wastes. They are also responsible for the establishment of MRFs which process biodegradable wastes through composting and non-biodegradable waste for re-use and recycling.
- Metro Manila Development Authority (MMDA) is a government entity that performs planning, monitoring and coordinating functions over the delivery of metro-wide services particularly on waste disposal. Metro-wide services under the jurisdiction of the MMDA are those services which transcend local political boundaries or entail large expenditures such solid waste disposal and management. MMDA monitors the disposal of waste in the Payatas Controlled Facility and shares in the expenses for its operations.
- IPM Environmental Services, Inc. (IPM-ESI) is a private contractor responsible of the conversion of Payatas dumpsite into a controlled waste disposal facility. The process of conversion involved a restructuring, upgrading, and optimising the utilisation of the dumpsite to extend its lifespan and to mitigate the impact of its operations on the environment.
- City Collection Service Contractors are responsible for the Package Clean-up System of the City Government where they are paid based on the computed hauling requirements of assigned routes. This system allows the city government to determine exactly how many trucks are needed each day to collect the garbage. It also facilitates the coding of service areas, and provides a rationalised basis for scheduling collection.
- Itinerant waste buyers are persons who go from house to house and buy the recyclables from households. The junkshop dealers supply the itinerant waste buyers with pushcarts and limited capital to purchase the recyclables.
- Junkshops are buyers of recyclables from both the formal and informal sector. They, in turn, sell the recyclables to consolidators or exporters in large volumes.
- Payatas Alliance Recycling Exchange (PARE) is an organisation composed of 15 associations of waste pickers working in the Payatas Dumpsite. The organisation was formed after the collapse of the landfill in 2002, referred to as Payatas Tragedy, and was created primarily to organise the system in picking of waste in the dumpsite.

Table 21. The major stakeholders in the solid waste sector in Quezon City

Stakeholder	Stakeholders specified
Local Authority	Quezon City Local Government, Environment Protection and Waste Management Department (EPWMD), Payatas Operations Group, National Solid Waste Management Commission (NSWMC), Metro Manila Development Authority (MMDA), Barangay Solid Waste Management Committees.
Service users	Households, commercial establishments, public and private institutions
Private formal waste sector	City Collection Service Contractors, IPM Environmental Consulting Services (contractor for the disposal facility), private haulers of commercial establishments, city accredited pig slop collectors
Informal waste sector	IWBs, garbage crew scavengers ("*paleros*"), Linis Ganda Multi-Purpose Environmental Cooperative, PARE, recyclers, consolidators, junkshops
Non-Government organisations	Philippines Homeless People's Federation, Star of Hope Philippines, Vincentian Missionaries Development Foundation

2.12.2 Waste characterisation and composition

Household and commercial establishments generate about a total of 623.400 tonnes of mixed wastes per year. The total waste generation per capita is 0,7 kgs/capita/day. Biodegradable wastes comprise at least 48% of the waste generated by the household and commercial establishments, followed by paper at17% and plastics at 16%. Residual waste comprise only 13% of total waste generation. The City Government with its various programs can easily attain and even surpass the 25% waste diversion requirement of RA 9003.

2.12.3 Process flow description

The Process Flow Diagram for Quezon City is shown in Annex 3.
Based on the process flow, the households and commercial establishments generate the 623.400 tonnes of wastes each year. Households and businesses bury 1.900 tonnes of waste in backyard pits, throw 2.600 tonnes in waterways, burn 3.700 tonnes, feed 500 tonnes to animals and compost 1.400 tonnes at the source, that is, in their own yards or compounds.

With 10.100 MT of the waste treated at household and business sources, the amount that enters both the formal and informal systems is 613.200 tonnes.

2.12.4 Formal sector

The formal sector handles 489.600 tonnes (80%) of the total amount that enters the system. It diverts only about 15.600 tonnes (3%) of what it handles while disposes 455.200 tonnes (93%). About 18.200 tonnes (4%) is diverted to the informal sector through informal sector activities such as garbage crew and dumpsite scavenging. An insignificant amount (700 tonnes) is lost through the decomposition process in formal composting practices.

In general, five City-contracted haulers collect the wastes based on a cell route system, where one cell is equivalent to 16 cubic metres or one 10-wheeler truckload. The City haulers collect 412.200 tonnes of mixed waste from the collection cells and additional waste discarded by MRFs (130 tonnes) and Junkshops (1.100 tonnes).

The package collection system has proved to be more advantageous to the City Government than the previous "per trip payment scheme" and through it the City was able to (a) reduce the cost of collection, and (b) to incorporate other services in the areas of coverage. Such services include: the conduct of follow-up collections at no expense on the City, the provision of street sweepers, and the conduct of information and education campaigns.

Barangays which have trucks are allowed to collect their own wastes (16.700 tonnes) using their own staff, and are paid an incentive by the City Government. Seven barangays collect mixed waste (12.800 tonnes) and dispose them at the disposal facility. There are 18 barangays who collect segregated waste in compliance with the City's "no segregation - no collection" policy. The segregated recyclables and biodegradables (3.900 tonnes) are directed to a MRF located in the barangay for final segregation and

processing.

Commercial establishments generate a large volume of waste and thus have separate collection from that of the households. The commercial establishments hire private haulers to collect (60.400 tonnes) and dispose (48.500 tonnes) their mixed wastes at the Payatas Disposal Facility. Before dumping at Payatas Disposal Facility, most private haulers sell recyclables (7.700 tonnes) and pig slop (4.300 tonnes) materials that can be readily sorted and handled. From the sale of these materials, they generate an additional income on top of the hauling fee paid to them by the establishments.

In five barangays, City-accredited pig slop collectors collect directly from households and are able to recover 340 tonnes of pig slop annually.

MRFs are the sites of the composting and resource recovery activities of the barangays. Through the MRFs, created (at least in part) in response to the "segregation at source" policy of the City, the barangays are able to significantly reduce the amount of wastes going to the disposal facility and earn additional income for the barangay through city incentives, sales of compost and recyclables.

Annually, 18 MRFs process about 3.900 tonnes of waste annually. The biodegradable component is processed to produce 680 tonnes of compost that is eventually sold to compost end-users. 2.500 Tonnes of recyclables are sold to large junkshops. Through the process of final segregation, an amount equivalent to 130 tonnes is considered as rejects and thrown via city collection.

2.12.5 Informal sector

The informal waste system handles 123.600 tonnes or 20% of the total waste that enters the waste system. Generally, the informal sector recovers all of the wastes it handles. This includes waste initially handled by the formal sector that is recovered through informal activities such as garbage crew scavenging and organised waste picking. The informal sector does not dispose any of the waste it handles.

There are several types of informal sector actors that collect recyclables and food waste, also referred to as pig slop. IWBs are primary collectors who directly buy recyclables from households. The IWBs are able to recover 101.500 tonnes of recyclables annually. The itinerant waste buyers are usually provided with pushcarts and some capital by junkshop dealers.

Secondary collectors include garbage crew scavengers and dumpsite waste pickers. The garbage crew ("*paleros*") who collects the waste from assigned cells, separate and pick saleable waste materials enroute to Payatas disposal facility. Although there is a policy of "no picking", this is not strictly observed by the *paleros*. Each year, the *paleros* sell 7.800 tonnes of recyclables to junkshops found along the vicinity of the disposal facility.

The Payatas Alliance for Recycling Exchange (PARE) consists of 15 associations whose members are dumpsite pickers. The City recognises and provides PARE some level of support through the disposal facility contractor, IPM (i.e. setting up of trading centers). PARE follows a system in the recovery of recyclables in the dumping area. Seven associations work during the day while eight work at night. Member waste pickers are allowed to pick recyclables from the dump truck in a period of 30 minutes after dumping. About 2.000 of the waste pickers, called "*baraot"*, are informal members of PARE who sell their recyclables directly to junkshops. Specialised waste collectors of food wastes, textiles, and other specific materials are also active. The dumpsite pickers are able to recover 10.300 tonnes of recyclables and 1.200 tonnes of food waste annually before the final soil covering is done by the City Contractor.

The junkshops are the market for recyclables and also a source of information for prices, quality, minimum volumes and new demands for materials. Annually, the junkshops buy 101.500 tonnes recyclables from IWBs, 7.800 tonnes from "*paleros"*, 2.600 tonnes from MRFs, 10.300 tonnes from dumpsite waste pickers and 22.200 tonnes direct from residential and commercial sources. The junkshops then sell the recyclables in large volumes to consolidators or exporters.

The member associations of PARE act as small junkshops. They buy and process the waste materials

recovered by their member pickers. Middlemen, usually associated as large junkshops transact with the associations on the sale of recyclables.

The small junkshop dealers serve as collection points, and have direct influence over the collectors of recyclables, and serve as a link to the large junkshop dealers and end-users. The collectors are not financially able to bypass the small junkshop dealers, since the big junkshop dealers don't like to buy materials in small quantity lots. Large junkshops have storage areas and large vehicles that allow them to transport packaged or processed recyclables to reyclers/exporters. The 1.100 tonnes of material discarded by junkshops is disposed via formal city collection.

2.12.6 Disposal and treatment

There are no known illegal disposal sites in Quezon City. The City has the biggest and longest operating disposal facility in Metro Manila. Payatas occupies almost 22 hectares with two main refuse mounds: the Old Dump, 30-40 meters high covers almost 12 hectares, and the Active Dump, already 20-30 meters high, covers approximately 10 hectares. The City has contracted a private firm, IPM Environmental Services in association with Sinclair Knight Merz, Inc., to manage, rehabilitate, and convert the Payatas dumpsite into a controlled disposal facility. 466.700 tonnes of waste enters the disposal facility annually. However, the final waste that is covered with soil is only 455.200 tonnes since 11.500 tonnes of waste are recovered by dumpsite pickers.

Some wastes generated at the source (residential and commercial) are lost annually through burying, burning, feeding of animals, and the like. The only system loss in the formal sector is the 680 tonnes lost through the composting practice of MRFs.

2.12.7 Quezon City: Scenarios for change

The Philippines National Government through the National Solid Waste Management Commission has recently increased the pressure on all cities and municipalities for strict implementation of Republic Act 9003, also known as the Ecological Solid Waste Management Act of 2000. The Mayor of Quezon City has acted in response to this pressure by increasing the role of the City Government and the barangays in handling the solid waste system of the City. The key mandates of the Law are as follows:

- All households, business establishments, and other solid waste generators are required to practice segregation at source.
- The 142 barangays of Quezon City are expected to carry out the following responsibilities:
  1. Enforce the "no segregation no collection" policy.
  2. Collect segregated recyclables and compostables from the residential areas.
  3. Establish and operate a MRF to process the recyclables and compostables collected from residential sources.
- The City Government is expected to carry out the following responsibilities:
  4. Collect residual wastes from residential, main thoroughfares and commercial sources. (the City opted to engage in cost effective contracts with private contractors for solid waste collection services.)
  5. Provide a disposal facility that is legally compliant. (The City opted to engage in a contract with a private company for the over-all management of the disposal facility.)
  6. Provide incentives for barangay contractors to collect residual waste from their own barangays.
- All forms of scavenging are prohibited. This applies to street waste picking, garbage crew scavenging and dumpsite scavenging.
- Incineration of wastes is prohibited.
- Illegal dumping of wastes in streets and waterways is prohibited.

The two scenarios are based on contrasting interpretations of the law and its potential practical impacts.

2.12.8 The subtraction scenario

The hypothesis used for the subtraction scenario is that strict implementation of the Law is unfavourable for the informal sector, because it emphasises the direct role of the local government units in providing

solid waste services in their jurisdiction. As a consequence, the Law favours formal sector operations and disadvantages the informal sector.

In this scenario, households stop working with IWBs and street pickers, and give all their recyclables and compostables to the formal authorities at the Barangay level. As a consequence, the IWBs have nothing left to purchase from the households, and fewer recyclables remain in the residual waste, making it less interesting to garbage truck crews to scavenge as they do now.

As a result of fierce competition with the barangay MRFs, junkshops within the residential areas and those near the route to the dumpsite are forced to close down since neither households, nor IWBs, nor the garbage truck crew scavengers, nor the dumpsite pickers have anything to sell to them.

In his scenario, all 124 barangays in Quezon City invest in MRFs, which collect all the recyclables and compostables generated in their areas. Cost increases are expected, but higher revenues as well, since the recyclables arrive partially separated, with low contamination, and command a good price from the recycler/exporter.

All MRFs also have to invest in composting equipment, as they are also responsible for processing of biodegradables. Half of the biodegradables will be composted and the other half will be collected by livestock enterprises. Livestock farmers cannot afford to buy the pig slop from the MRF but they will collect it at no cost and pay only for transport. The MRFs are likely to accept this arrangement because demand for pig slop in a highly urbanised city like Quezon City is small. The MRFs will recover 22% of the incoming waste flow.

As no dumpsite picking is allowed, there is no recovery of any remaining recyclables and compostables that reach the dumpsite, which increases the amount disposed, requiring a substantial increase in additional soil cover and higher dumpsite operation costs. In spite of the MRFs' performance, the proportion of materials recovered from the total handled tonnage decreases.

2.12.9 The addition scenario

The addition scenario is based on a contrasting interpretation of Law. The hypothesis is that it would be too costly for the public sector to do all the resource recovery activities currently carried out by the informal sector. The City Government will therefore continue to implement segregation at source and segregated collection in barangays which already have MRFs. Private haulers are allowed to continue with collection of mixed wastes from commercial establishments.

In this scenario, the City Government is assumed to partner with the informal sector, which includes the IWBs, junkshops and the Payatas waste pickers association PARE. The City Government takes a co-operative and facilitating role, for example helping junkshops which are not registered to get business permits.

Barangays that do not have MRFs because of lack of space will designate existing junkshops either in their area or in neighbouring barangays to serve as their MRFs, through a process of accreditation. The City then charges modest annual fees to these junkshops for administration expenses. Even barangays with their own MRFs will be encouraged to link with junkshops for the sale of recyclables they have processed.

IWBs and waste pickers will be accredited by the City, but remain in the informal sector as they receive no payments from the formal system. Minimal annual fees and administration costs are charged to provide proper identification cards and authorisation to sell or to deliver to the MRFs.

The City will create an MoU for the large number of waste pickers in the Payatas dumpsite by which they become part of the central MRF located at the disposal facility. The scavenging activities of the garbage truck crews will be prohibited by the City and the contractors. In compensation of lost income, the contractors will strictly pay the minimum wages as indicated by the Labour Code.

3 Chapter 3. Economic Aspects of the Informal Sector in Recycling and Waste Management

3.1 Context for Informal Activities: The Formal Solid Waste System in the Six Cities

3.1.1 Waste removal and disposal services

The formal solid waste management system arranges and manages collection of waste from households and businesses. In most of the cities, with the exception of Pune, the formal sector is completely, or largely, privatised. In all cities, at least some households and businesses have access to formal primary waste collection and removal from the household, or collection from community containers convenient to their household. The formal sector also transports this material either to a disposal site or to a transfer point. Transfer points in the four largest cities range from stationary containers to trucks waiting at appointed places, to open dumping sites where the primary collection vehicles dump their waste on the ground, and it is picked up at some later time and placed in secondary collection containers or vehicles. While it is on the ground, it is often picked or grazed by livestock, or scavenged by dogs, so that the amount that is moved to disposal is reduced.

All cities have formal controlled disposal facilities. Lima and Cairo have disposal sites that are classified as "sanitary landfills," according to their local laws and technical standards, but it is unclear if they are managed as controlled disposal sites or sanitary landfills. All the rest of the cities have at least one formal controlled disposal facility which is recognised by the formal authorities, although the degree of management and protection of the environment differ greatly. Tipping fees are charged in some but not all cities. None of the cities have incinerators, biogas facilities, or other alternative kinds of disposal facilities, and so these do not appear in any of the cities' baseline analyses. Pune uses plans for refuse derived fuel as part of their scenario modelling; this is the only reference to energy recovery via burning in any of the cities.

In all of the cities, there is some degree of private sector participation in the formal solid waste sector, either in collection or disposal. Within this, there is variation in the institutional and financial arrangements that finance public-private partnerships in the handling, transport, recovery and disposal of materials. All cities except Pune show some contractual or franchise arrangement with formal solid waste collection and transport companies to deliver services to a portion of the residential sectors. Informal arrangements where informal sector workers provide some portion of the required services supplement formal contracts, and fill small niches. Privatisation as a separate topic is not covered in this report unless the fact of privatisation changes some aspects of a city's process flow.

Formal collection in Cairo is performed by three private international companies contracted per zone to manage all solid waste and recycling, and one zone is still managed by an Egyptian private company that sub-contracts to the Zabbaleen in a semi-formalised system. In the other privatised zones, there remains some participation of the Zabbaleen as sub-contractors but they get less income and have less control over their work.

In Cluj, door-to-door and container collection has been contracted to four private companies. The contracts include street sweeping, collection, transport, disposal and treatment at the landfill.

In Lima, formal door-to-door and street container collection by municipal employees is supplemented by concession of the service to private operators called "Provider enterprise of solid waste services" in 18 districts; six other districts have a combination of public and private service providers. In addition there are two specialised collection programs operated by waste pickers associated, registered and organised by the municipality.

In Lusaka, only 60% of the city is served with primary collection. Lusaka has franchised their operations to nine local waste management companies who have been assigned one or more collection districts where they are the sole provider. These franchise contractors provide waste collection services, and bill and collect revenues from subscribers. In the peri-urban areas, where about 70% of the city's population

live, CBOs operate in a stepped-down franchising system of micro-zones, to provide primary collection and then the public sector provides transfer, secondary collection, and transportation to the disposal site. In addition, performance contracts have been awarded to six companies to provide street sweeping and drainage clearance services in selected parts of the city.

Pune's municipal public works department provides daily collection of organics and weekly collection of dry recyclables and waste. Informal sector waste pickers have been integrated in the daily collection of recyclable and non-biodegradable waste with differing degrees of success, depending upon the degree of cooperation of the respective ward administrations. In the high density areas of the inner-city, where truck access is limited, primary collection is performed by municipal employees utilising pushcarts. In such areas, the mixed waste is carted to strategically located secondary collection containers. Finally, there are also authorised informal sector waste pickers (AWPs).

In Quezon City, the city has contracted five private haulers to service standard areas, or collection zones, called "cells" paid based on trips per day. For some barangays, incentives are paid by the municipality to have the neighbourhoods collect their own wastes. In parts of the city, this may involve pushcarts or any small collection equipment to collect household wastes door-to-door. The wastes are then transferred to the waiting municipal trucks that are stationed at the main thoroughfares.

3.1.2 Formal collection and valorisation of recyclables and organics

Formal recovery of recyclables occurs in all cities except Pune where the formal sector is not involved in recovery at all. Formal recovery of organics occurs in Cairo and Quezon City.

3.1.3 Formal sector transfer

"Transfer" in the cities refers to at least four different technical arrangements.

1. Transfer station: a place where motorised vehicles discharge collected waste into larger transport vehicles or containers, usually with compaction.
2. Transfer site or transfer point: a location, container park, depot, or even a temporary dumping site, used by smaller vehicles and hand and animal carts to deposit collected waste. The sites are often picked for recyclables, and in addition are (in theory) serviced periodically by larger vehicles that pick up the waste and transport it to final disposal.
3. Secondary collection point, community container: a usually fixed place where households and businesses who do not have door-to-door collection can bring their own waste or recyclables, or where MSE or CBO collectors can discharge their waste. The waste is then moved again, either to a transfer site, or to final disposal. The term used for this type of movement is generally "secondary collection," and in Cairo such points are called "waste pooling sites."
4. Mobile collection point: a pre-arranged location where a larger vehicle waits for smaller vehicles to arrive and dump directly into it.

Cairo, Lima and Pune all indicate that waste is taken to formal secondary collection or transfer points before it is sent for final disposal. These transfer points are also used for separation of organics and inorganics, with the organics subsequently going to composting processing points in Cairo and Lima. The inorganics are either being recovered as recyclables or being sent to sanitary landfills.

Smaller and less capital-intensive transfer points have been developed in a number of the cities. In Quezon City, pushcarts or small vehicles are serving households in densely populated areas and then discharging their loads directly to a waiting municipal vehicle, which is serving the function of secondary collection. In addition, skips or large containers, serving specific densely populated slum neighbourhoods or high-rise housing, are used in Pune, Cluj and Lusaka. Containers are also utilised in most of the cities for commercially generated materials.

In the highly populated peri-urban areas of Lusaka, and also in Cluj (and most likely in all other cities, although this was not specifically reported) there are temporary dumping sites that are periodically

"liquidated" or cleaned up by municipal collection vehicles. While there is no formal transfer, these sites perform a similar function.

3.2 The Informal Solid Waste and Valorisation Sector in the Six Cities

All cities have in fact two informal solid waste sectors, which are rather different from each other. The one that is most well known is the *informal valorisation sector*, that is, the individual, family, micro-, small- and medium enterprises that extract valuable materials from the waste system and *valorise* them. The main forms of valorisation are for own use (with or without repair), repair and sale, fabrication from waste materials, recycling, and organic waste recovery and processing for sale to the agricultural value chain.

In all of the cities, the informal sector's primary activity is valorisation, with the largest number of people working in either swine feeding or material recycling. There are many variations in the way the materials are extracted and what is done with them from city to city. Organic waste extraction and valorisation, in combination with reuse for household purposes, is common to all cities except Cluj and Lusaka, with the focus in the informal sector being on pig feeding, in contrast to formal organics recovery which normally is based on either composting or recovery of methane for energy.

While most informal livelihoods relate to valorisation activities, there is also an active and robust informal service sector focusing on collection and street sweeping, and other cleaning and removal activities, in Lusaka, Lima and Cairo; Quezon and Pune have some hybrid activities that combine services and valorisation. In Cairo, the service of mixed waste collection, and the commodities-oriented recovery activities are so closely related that they are difficult to separate.
Table 22 provides some information about the informal sector population that is involved with the extraction, collection, transport and processing of materials for recycling and reuse.

Table 22. Informal sector demographics

	Number of Informal Sector Workers	Number of City Inhabitants per Informal Sector Worker	Number Informal Sector Workers Per km2
Cairo	33.000	441	6
Cluj	3.226	118	18
Lima (1)	11.183	694	4
Lusaka	480	2.58	1.3
Pune	8.850	339	64
Quezon City	10.105	246	63
Total six cities	66.844	422*	26**

*(1) Lima figures exclude informal sector working in pig farms. * Weighted average*
*** Simple average of six cities*

3.2.1 Occupations in the informal valorisation sector[30]

In general, the informal recycling and organic waste collection sector can be divided into several main types of occupations and facilities

1. **Itinerant waste buyers (IWBs)** move along a route, and collect recyclables from households (or businesses). IWBs collect specific recyclable materials and/or organic waste or pig slops from households. In all cities but Cluj IWBs pay households for materials in cash or in barter for an accepted item or service, while in Cluj the household gives them as a "donation". IWBs carry collected materials in sacks or on their heads, or load them into pushcarts or wheelbarrows. IWBs tend to be specialised to one or two kinds of materials.

[30] This section gives a more detailed description of the informal sector in SWM in the six cities. A general presentation is included in section 4.4.

2. **Street pickers** collect materials that have already been discarded by households. In some cases street pickers extract materials from household waste set-outs, breaking bags, and/or picking up reusables or materials waiting for formal collection. Street pickers extract materials also from community containers, litter bins, skips, disorganised piles and illegal dumping places. The activities of street pickers differ quite considerably from country to country. Street pickers tend to be generalists, picking both for sale and for their own use. Street picking attracts a considerable amount of casual participation, as teen-agers, elderly and retired people, and unemployed persons move in and out of street picking depending on their immediate economic circumstances. In countries where there is a deposit on beverage containers, either because they are refillable or because of a deposit law, street pickers usually engage in salvaging cans and bottles, either exclusively or in addition to other materials.
3. **Dump and transfer station pickers**. Dump pickers work and on the landfill or dumpsite, and sort through the waste as it is disposed there. Many dump pickers also live on, or near the dump, and in some countries, dump picking is considered a family and/or seasonal activity. Many dump pickers also live on, or near the dump, and in some countries, dump picking is considered a family and/or seasonal activity. They climb in and around heaps of waste at the time they are discharged from collection vehicles, extracting the materials before someone else can. At some dumpsites this activity is limited to the parts of the day when trucks are arriving, or, in contrast, to the period after all trucks have finished dumping. Dump pickers tend to be highly specialised as to the material they extract, and how they process it, in part because the social environment on the dumpsite has a hierarchy that leads to gender specialisations. For example, men often focus on metals and do not accept that women can pick this high-value material. Frequently dump picking is both competitive and socially stratified, with thug-like "dump bosses" or "co-ordinators" that control particular materials. There is more variety among the activities and specialities of dump pickers than other types of informal sector activities.
4. **Truck and garbage crew pickers** represent a special category of formal sector employees who are structurally involved in informal sector activities. Truck pickers include both informal members of formal sector waste collection crews[31], and paid members of the formal garbage truck work crew[32]. Truck pickers inspect the waste as it is loaded onto the truck, and separate out valuable items for their own use, for trading, or for sale. In many countries, garbage crew workers are paid very low wages because it is assumed that they extract materials from what they collect and sell them for personal benefit.
5. **Junk shops:** (small, medium, and large), are usually specialised by material. They get their materials by buying from waste pickers, the public, and waste generators. In principle all junk shops have a physical premise, but buying from market stalls, and mobile trading or reverse peddling based on a vehicle, which are based on buying and selling without a physical location, are essentially the same occupation.

All cities in the study have junk shops that buy ferrous and/or non-ferrous metals, and most also have junk shops buying paper and/or cardboard. The existence of junk shops for textiles, plastics, glass and glass bottles, re-usables, and organic waste is much more variable.

Small junk shops are usually located at the dumpsite or on the road to it, and also in communities where there is a tradition of households bringing materials to sell. Small junk shops (such as the "kabaris" in North India) are often family enterprises without any additional paid labour; "facilities" include not much more than a kiosk with a scale and sometimes a small upright baler.
Medium-sized junkshops are often concentrated in one commercial district, near the centre or the market, or on the fringes of the city. Medium-sized junkshops often use day-labour for which they pay

[31] In some Latin American and Asian countries, there is a special category of garbage crew pickers who are not formal members of the garbage crews. These informal sector participants may have relatives in the garbage crew; in any case they attach themselves to a particular garbage truck and work alongside the formal employees, in a highly organised way, but without pay. Data on this kind of symbiotic relationship between formal and informal sector activities is even more sensitive, and thus more difficult to collect, than "normal" statistics on the informal sector. Some of this kind of activity may be included in the numbers in this chapter for informal sector activities, but it must said that these numbers remain only estimations.
[32] Garbage crew pickers, their primary identity being formal waste sector workers, are included in statistics for the formal waste sector and not "counted" as individuals or businesses in the informal sector, although their earnings are included in amounts earned and paid to the recycling industry.

piece- or day- rates for labour. Medium-sized junk shops generally represent a cross-over from informal to formal recycling activities, and have a business license, a baler, and one or two trucks.

- Large junk shops may also be called scrap dealers, or intermediate processors33. Large junk shops are registered businesses in the formal sector, who engage in quite substantial processing and trading activities, supplemented by brokering and export. Typical activities in large junk shops include high-grading and baling of paper, disassembly, cleaning and shredding/baling of metals, agglomerating, flaking, and pelletising of plastic, colour-sorting and crushing of glass, etc. Although they themselves are (usually, and in the study with the exception of Pune) in the formal sector, they are closely related to the informal sector in the recycling supply chain, and also because of semi-formal employment arrangements with informal sector workers and day- or piece-rate labourers. Large junk shops may also supply equipment and credit to smaller junk shops and individual pickers, and in some cases junk shops may receive these things from end-users.
- MRFs and IPCs: Materials Recovery Facilities (MRF)s and Intermediate Processing Facilities (IPCs) are 'evolved' versions of junk shops that come about in the modernisation process. They are not technically informal, but it is useful to discuss them here because there is a lot of confusion. While a junk shop buys materials, both MRFs and IPCs receive mixed recyclable and/or organic materials primarily from the public sector or contractors to the public sector. These are hybrid commodities and service facilities, and they may pay for materials, receive them without paying for them, or charge a tipping fee per ton. Both MRFs and IPCs usually have a sorting line or sorting table to classify the inputs. Both typically handle more than one type or class of materials. The main difference is that MRFs normally are recognised and often partially or completely financed by the formal public sector solid waste system, and IPCs are private firms that do the same work in the industrial value chain.

Table 23. Distribution of informal sector occupations in the six cities

	Largest group active informal waste sector	Percentage of persons of total informal waste sector in largest group	Second largest group of informal sector work	Percentage of persons of total informal waste sector in largest group	Other informal sector groups active in city	Percentage of other number of informal sector
Cairo	Informal waste collection - Zabbaleen	71%	Small-scale manufacturing	25%	IWBs, dump pickers, street pickers	4%
Cluj	Street pickers	73%	Dump pickers	27%	None	0%
Lima	Street pickers	30%	Street pickers with Tricycles	27%	Street pickers, organic waste collectors, dump pickers, etc	43%
Lusaka	Dump pickers	42%	Street pickers	40%	Unregistered collectors	18%
Pune	Authorised Waste Pickers	28%	Junkshop workers & recyclers	24%	IWBs, informal collectors, junkshop workers	48%
Quezon City	Street pickers	37%	Dump pickers	26%	IWBs, informal collectors, truck pickers, junkshop workers	37%

Source: Project baseline workbooks.

Street and dump pickers are the most numerous in all cities, but in Lima the picture is complicated by the fact that there are many sub-categories within street pickers. Table 24 shows the recovery performance of different occupations.

[33] Special names for junkshops differ by materials, and include: 'paper packers,' 'auto shredders,' 'scrap metal dealers,' 'glass cullet processors,' 'plastic re-pelletisers.'

Table 24. Informal sector collection of materials for recovery

	Total Material Recovered by the Informal Sector (t/y)	Collected by Informal service providers	Collected by iwbs	Collected by Street Collectors	Collected By Dump pickers	Other	Total
Cairo	979.400	100%	-	-	-	-	100%
Cluj	14.600	-	2%	40%	58%	-	100%
Lima	529.400	7%	27%	30%	6%	30%	100%
Lusaka	5.400	-	-	71%	29%		100%
Pune	117.900	32%	34%	-	10%	24%	100%
Quezon	141.800	-	72%	16%	8%	4%	100%

Source: Project baseline workbooks, based on secondary sources, experience, and observation in the cities.

In Cluj, Lima and Lusaka, street collectors recover significant portions of recovered material. Cluj and Lusaka document that significant amounts of the material diverted to recycling are captured at the landfills and the illegal dumpsites located around the cities, but overal recovery in these two smallest cities is low in both absolute and relative terms. Pune and Quezon City show large quantities of recovered material flowing through IWBs, which is typical of recycling in Asia, and also occurs in richer countries like Japan and Malaysia. In Cairo the most important quantities are recovered from sorting the mixed waste collected door to door: it is valorisation and service at the same time. [34]

3.2.2 Occupations in the informal service sector

Lusaka, Cairo, and Lima have, in addition to recyclers, an active **informal service sector**. Individuals and/or micro-enterprises are paid by clients or the local authority to collect waste or clean public spaces. In Lusaka the "unregistered waste collectors" handle more than 30% of the waste collected from households. The semi-formal MSE and CBO sector also performs cleansing services, but is considered here as part of the formal sector, because they are recognised by the solid waste authorities. Both Quezon City and Lima have informal collection of wastes in peri-urban settlements, and where there are high density slums, steep grades, or narrow or unpaved streets. In Pune, 1.700 authorised waste pickers with pushcarts or cycles collect wet and dry waste separately door-to-door within the high-density inner city[35]. In Quezon City, some barangays (villages, sub-municipal divisions) even provide the carts for the informal collectors.

Finally, as shown for Quezon City, Cairo, Pune and Lima, the formal sector may actually collect materials destined for formal disposal, but have within it informal sub-systems that divert valuable materials to informal sector processors, single material brokers or even cottage industries.
The most common form of informal services are:

- **Unregistered waste collectors:** These are individuals with a vehicle who make private-to-private arrangements with households, to remove their waste for a fee. Lusaka has the most significant representation of this sector, in that more than a third of all mixed waste is collected from households and businesses by unregistered, informal sector collection enterprises.
- **Other informal services:** In the study cities, other informal services include street cleaning and sweeping, waste-+-recycling collection, organic waste removal, drain clean-outs, green space maintenance, and transport of waste, recyclables, or organic waste (in the case of Cluj with horse carts).

The combined valorisation and service sector is an important source of livelihoods, as shown in Table 25. Typically the informal sectors are really large, and the formal sector relatively smaller, because the value chains for purchasing materials support more livelihoods. In Lusaka, as in other East African cities, the waste stream is relatively low-value, and supports a smaller number of informal valorisation livelihoods, a

[34] Even though these informal waste collectors are in some sense, tolerated, recognised, or even "authorized" by the municipality or a sub-district within the city, they are considered informal because of the nature of their business and the fact that they are not sponsored or paid by the formal solid waste institutions
[35] The 1700 waste pickers are reported in 2010, in a new integrated collection system.

circumstance found also in West Africa and in other cities in Sub-Saharan Africa (FOCARFE, 1994; Keita, 2003)[36].

Table 25. Livelihoods in the informal and formal waste management sector in the study cities

	Total no. Of livelihoods in informal waste sector (persons)	Total employment in the formal waste sector (persons)	Ratio of persons working in the informal waste sector to those employed in the formal waste sector	Informal sector households depending fully on income from informal waste and recycling activities
Cairo	33.000	8.834	3,7	91%
Cluj	3.226	330	9,8	31%
Lima (1)	17.643	13.777	1,3	88%
Lusaka	480	800	0,6	69%
Pune	8.850	4.545	1,9	63%
Quezon	10.105	5.591	1,8	82%
Total/avg	73.304	31.793	*2,3	**71%

*(1) Including persons working at informal pig farms. The ratio of persons working in the informal waste sector to those employed in the formal waste sector, when excluding these persons, would be 0,8. *Weighted average of six cities*
*** Simple average of five cities.*

Lusaka is the only city where there are more people employed or having livelihoods in the formal sector than in the informal. In all other cities, the informal sector provides more livelihoods: in Cairo five times as many, and in Cluj 10 times as many, although not all of these are full-time. That is why the percent depending on informal income in Cluj is so much lower than the other cities, which also brings the average down.

In Cluj many waste pickers work only 50 days a year, when there is no opportunity for work such as harvesting fruit. In Lusaka waste picking is seasonal: there is less picking in the rainy season because of other work available in agriculture, and there is more picking in school holidays by children seeking pocket money.

The rightmost column in Table 25 shows how important informal waste activities are for households with one or more persons working in the informal waste sector[37]. Cluj is left out of this analysis because more than half of the informal sector there works only seasonally or on a part-time basis in waste-related activities. The lowest rate of full dependency is found in Pune, where 37% of households have some other source of income, and the highest rate of full dependency on activities within this sector is found in Lima, with only 12% pursuing significant parallel activities in other sectors.

3.3 Costs and Effectiveness of Formal and Informal Solid Waste Management and Recycling in the Cities[38]

The process flow diagrams (PFDs) form the basis for a process step cost analysis. The "typical cost of 1" approach leads to a simplified pro-forma cost analysis for each step, which builds a system cost by aggregating steps. The pro-forma analysis includes:

- **Capital costs** are based on calculating and including both fixed (facility) and mobile (vehicle) capital

[36] The data gathered for the study suggest that the formal waste sector in Lusaka employs around 800 people, but this could not be confirmed. The confirmed figures are 390 persons working in recycling, and an additional 90 persons working as unregistered waste collectors. The 30 unregistered collection drivers earn €832 per year, the 60 members of the truck crews €475.

[37] This is a reported figure, not connected to the workbooks, and refers to the extent to which informal waste sector households depend on the income from recovery, collection and pre-processing of solid waste and recyclables.

[38] For many cities, while there are budgets and cost information for the formal solid waste system, this is the first time that formal and informal operations in recycling and in solid waste collection and disposal have been analysed in the same way as in the formal sector, and as part of an integrated analysis per city. These internationally standard calculation methods are used in the modelling even though in most cases the informal sector themselves do not know or analyse their capital or operating costs in this way.

costs. All capital costs are annualised to model depreciation and amortisation, using the straight line depreciation method, based on the reported or modelled standard lifetimes. These include costs to purchase and install equipment, and also to construct facilities when this is applicable to the local situation.

- **Operating costs** include labour; materials; fuel; electricity; other sources of power (such as muscle power or water power) for operating equipment. Where available actual costs of maintenance; and supervisory and administrative costs are used, or estimated as percent of annualised capital costs. In cases where no salaries for informal work are recorded, a shadow for the cost of labour has been introduced in the modelling, to make fairer comparisons between formal and informal operations possible.
- **Revenues** are split between **service revenues**, which are outside of the net cost calculation, and **materials revenues** in the supply chain, which are included in the net cost calculation except when the operation that pays them falls outside the spatial or other system boundary.

Looking first at Table 26, the most important information that jumps out is that informal sector activities are profitable without service revenues. Lusaka is the exception to this, where the most common informal activity in waste management is provision of collection service and service revenues are not shown in this table.

It is clear that system costs per tonne – before any revenues are calculated – are highest in Lima for the formal sector, and in Cluj for the informal sector. Such high costs raise several questions, the most obvious is whether there is a problem with over-capacity or under-performance of the system as a whole. In Cluj it may be the process of acceding to the EU and meeting EU standards that drives up the cost; in Lima it appears to be inefficiency or scale problems. High absolute costs mean also that the informal sector in Lima has a more modest net gain per tonne than any other city except Lusaka. The extremely high net benefits in Cairo relate in part to the fact that in this city, the raising of pigs is (or in 2006 was) within both the spatial and system boundary of the analysis.

Table 26. Differences in costs per tonne, net costs per tonne (with revenues for materials sales included), for formal and informal sectors

	Formal Sector			Informal Sector		
	Total cost (benefit)/ tonne €	Total net cost (benefit)/ tonne €	Difference (delta)	Total cost (benefit) /tonne €	Total net cost (benefit) tonne €	Difference (delta)
Cairo	13	5	(8)	55	(90)	(145)
Cluj	25	7	(18)	288	(108)	(396)
Lima	42	41	(0.5)	110	(8)	(118)
Lusaka	35	15	(20)	7	2	(4)
Pune	23	21	(8)	251	(46)	(297)
Quezon	31	28	(3.5)	48	(51)	(93)

Source: Project baseline workbooks. Note: parentheses indicate net revenue

Table 26 shows that informal sector activities tend to be stand-alone profitable businesses. Formal sector activities tend to be busy in the service sector and material revenues are just a fraction of their income. The exception is Lusaka and the story of Lusaka is that there is hardly any valorization business going on in that city.

The modelling methodology also makes it possible to look at costs for each individual step. In Table 27 we can see the difference between"

- Similar formal steps accross cities
- Similar informal steps accross cities
- Similar formal and informal step inside a city (paralell steps within a city)

Table 27. costs per tonne for formal and informal services and valorisation process steps in €/tonne

First column per city is for labour not including revenues from the value chain or from services, second column is for labour including value chain revenues; informal labour is shadow-priced													
Occupation	**F/I**	**Cairo**	**Cairo**	**Cluj**	**Cluj**	**Lima**	**Lima**	**Lusa**	**Lusa**	**Pune**	**Pune**	**Quez**	**Quez**
Door to door*/IWB	**I**	€ 21	(€ 15)	€ 30	€ 0	€ 118	(€ 2)			€ 96	(€ 30)	€ 19	(€ 21)
Primary collection of organics/pig slop	**I/F**					€ 19	€ 0					€ 41	€ 41
Street /container picking	**I**			€ 55	€ 0	€ 65	(€ 33)	€ 25	(€ 68)	€ 29	(€ 23)		
Transfer station/secondary collection picking	**I**					€ 57	(€ 40)						
Dump picking	**I**			€ 114	(€ 59)	€ 51	(€ 46)	€ 40	€ 0			€ 17	(€ 45)
Dump picking of organics	**I**					€ 96	(€ 2)						
Picking by garbage collection crews	**I**											€ 0	(€ 66)
Landfill informal recovery	**I**					€ 42	(€ 2)						
Post-dump carriage transport	**I**			€ 16	€ 16								
Inf. Processing for recycling, small junk shops, kiosks	**I**	€ 19	(€ 185)	€ 118	(€ 62)					€ 88	(€ 18)		
Informal sorting and trading	**I**	€ 114	(€ 27)										
Tricycle collection recyclables	**I**					€ 92	(€ 5)						
Junk shops /traders	**I**					€ 123	(€ 1)			€ 124	(€ 5)	€ 27	(€ 22)
Pig feeding	**I**	€ 5	€ 2			€ 63	€ 0						
ECOROM/formal sector selective collection, curbside	**F**			€ 21	€ 8	€ 32	(€ 66)	€ 85	€ 85				
Container collection	**F**			€ 5	€ 5								
Collection points recycling	**F**			€ 40	(€ 32)								
Recycling campaign	**F**					€ 28	(€ 69)						
Recycling processing (in Lusaka, includes co-collection)	**F**	€ 3	(€ 14)	€ 42	(€ 56)			€ 85	(€ 34)				
MRF without composting	**F**											€ 182	(€ 22)
MRF with composting	**F**											€ 56	€ 64
Supervision	**F**									€ 2	€ 2		
Primary collection	**F**	€ 8	€ 8			€ 30	€ 30	€ 15	€ 15			€ 27	€ 27
Secondary collection/ transfer/transport	**F**	€ 2	€ 2							€ 12			€ 20
Formal waste collection	**F**	€ 8	€ 8	€ 12							€ 10	€ 20	
Franchise/private primary collection	**F**				€ 12			€ 30	€ 30			€ 11	(€ 12)
CBE mixed waste collection	**F**							€ 3	€ 3				

Street sweeping	**F**					€ 482	€ 482	€ 72	€ 72				
Clean-up of illegal dumps	**F**			€ 26	€ 26								
Generator self-haul	**F**							€ 25	€ 25				
Transfer station operation	**F**					€ 2	€ 2			€ 7	€ 7		
Controlled dumpsites/landfills	**F**	€ 2	€ 2		€ 0	€ 2	€ 2	€ 2	€ 2	€ 3	€ 3	€ 6	€ 6

Source: Project baseline workbooks.

Two things immediately jump out of Table 27. The first is that cost of both transfer and disposal in all cities is low, which is consistent with the fact that none of them really have sanitary landfills. These costs are too low to make it economical to do composting on the basis of avoided costs. The highest cost for disposal is Quezon City, also the city where recovery levels are highest and policy supporting valorisation and recovery is clearest. The second is that there are some very high costs for all operations in Lima. But revenues are not included.

Nothing conclusive can be said when comparing formal and informal recycling activities accross cities, because these activities vary so much and the steps were not standardized in any way for cross comparison.

Looking within each city, we can conclude that informal selective collection steps (mainly door to door collection and street picking) are always profitable and almost always more profitable than their formal counterparts. The exception to this is Lima, where the informal selective collection, while making an absolute profit, is less profitable than its formal counterpart. Formal selective collection usually comes at a net cost per tonne, ranging from a cost of €85 per tonne in Lusaka to a cost per tonne of €8 in Cairo and Lima even including revenues from material streams.

All informal recycling and selective collection combined with informal recycling activities are profitable, while some formal selective collection actions in the cities are operating at a loss, namely in Lusaka, Cairo and Cluj. The reason for this might be that the formal and informal systems are competing for material streams and informal manage to keep their collection costs down and stay profitable at all times relying on materials revenues as shown also by the figures in Table 26.

Table 28 shows the material recovered within the formal and informal sectors. The percentage of recovery is based on the material actually entering each separate (formal and informal) materials handling systems. The picture that emerges is that in most cases, materials formally collected as mixed waste are at some point extracted from the mixed waste chain, and then they "cross over" to the informal system, where they are re-directed to recovery. The informal system is functioning as the formal system's recovery channel, so the informal system gets the "credit" for valorisation. This gives an important insight about benefits to the formal sector: it gets the environmental benefit of recovery without paying the costs of organising or implementing it.

Lusaka is again the outlier, the informal service providers make so much money collecting the waste that they don't bother to think about valorising it. In Quezon and Cluj the informal sector only handles recoverable materials, and there are no informal service providers. This explains the 100% recovery in the informal sector.

Table 28. Material recovered by the formal and informal sectors in the cities

City	Formal Sector			Informal Sector		
	Initially Handled Tonnes	Recovered Tonnes	% Recovered of total initially handled	Initially Handled Tonnes	Recovered Tonnes	% Recovered of total initially handled
Cairo	1.224.300	433.200	35%	1.224.300	979.400	80%
Cluj	145.800	8.900	6%	14.600	14.600	100%
Lima	1.839.700	9.400	1%	848.400	529.400	62%
Lusaka	90.700	12.000	13%	98.200	5.400	6%
Pune	394.200	0	0%	132.100	117.900	89%
Quezon	489.600	15.600	3%	141.800	141.800	100%

Source: Project baseline workbooks.

In most cases the recovery rate in the formal sector is low due to the fact that materials that are collected and transported by the formal sector "cross over" to the existing informal sector organizations that have historically developed to collect, separate, clean, aggregate and densify recyclable material destined for home/cottage industries or manufacturers. Lima registers movement of recyclables to 'junkshops" not only from formal transfer stations but also from municipally sponsored selective collections and recycling campaigns. Similarly, inorganic materials coming out of MRFs are directed to the informal junkshops in Quezon City. In Pune, there is no formal sector recovery of recyclables.

The material recovered by the informal sector includes both organics and inorganic recyclables as can be seen for Cairo, Lima and Quezon City, with Lima primarily sending organics to swine feeding and Cairo and Quezon City producing a formal sector composting product in addition to the informal swine operations.

Many layers of processors and brokers are active in the recycling supply chain in Quezon City, Cairo, Lima and Pune. In Cluj and Lusaka there is very little processing after initial collection, with materials being delivered directly to (formal) recycling companies, and the supply chain has fewer layers in general.

Table 29 indicates the prices that are received for different items across the cities by the informal sector, at the highest point in the supply chain. In virtually all cases, waste pickers and junk shops are receiving less than this, these are the official prices in the second quarter of 2006.

Table 29. Average prices for recyclables (€/tonne) paid by industries to wholesalers

City	Paper	OCC (old corrugated containers)	Plastic (PET)	Glass	Non ferrous metals	Ferrous metals	Organics
Cairo	€ 30	€ 34	€ 244	€ 27	€ 950	€ 54	€ 8
Cluj	€ 22	€ 22	€ 109	€ 44	€ 190	€ 150	€ 0
Lima	€ 70	€ 50	€ 250	€ 40	€ 675	€ 88	€ 12
Lusaka(2)	€ 30	€ 30	€ 30	€ 0	€ 60	€ 60	€ 0
Pune (3)	€ 68	€ 119	€ 339	€ 34	€ 778	€ 220	€ 0
Quezon (4)	€ 59	€ 21	€ 172	€ 4	€ 687	€ 120	€ 15

Source: Project baseline workbooks.1) Reported as PET and other plastics 2) Tanzania data from 2004-2005 3) Prices paid by recycling enterprises to wholesalers 4) For Pig-slop

Table 29 is interesting for a number of reasons. First, it shows how both material type and geography matters to informal valorisation. Non-ferrous metals have high per-tonne costs everywhere, but they are more valuable in Cairo, Pune, Quezon, and Lima, all large, industrial cities with a complex value chain. PET is valuable also in those cities, and again with PET, Cluj and Lusaka receive the lowest prices per ton. These four cities have the highest prices for most materials in most categories. Organics have a low or no value in all cities, as does glass.

Table 30 shows price stratification for Pune in more detail, where social and economic status and power play significant roles. For example, what a (female) waste picker receives at the landfill site in Pune differs from what a (male or female) IWB receives. This may in part be due to the greater contamination of recyclable material that is not collected door-to-door, or to the lower status, and hence lower bargaining power, of the waste picker.

Table 30. Value chain prices to waste pickers and IWBs in Pune

Material	Price/ tonne (€) to Waste picker	Price/tonne (€) to IWB
Paper	€ 17	€ 85
Cardboard	€ 68	€ 68
Ferrous metal	€ 170	€ 170
Non-ferrous metal	€ 778	€ 778
Film plastic	€ 34	€ 85
Rigid plastic	€ 170	€ 170

Source: Pune City Report.

From collection to delivery of materials to end-users, one can see an increase in price paid for materials as they move up the recycling supply chain. The following shows examples of this in the prices paid for materials in Quezon City as they move up through the informal processing infrastructure.

Table 31. Value chain prices in € per kilo in Quezon City

	Selling Price of Waste Picker/Buyer to Small Junkshops	Average % Increase	Selling Price of Small & Medium Junkshops to Large Junkshops	Average % Increase	Selling Price of Large Junkshops to Exporter
white paper	€ 88	35%	€ 119	21%	€ 144
newspaper	€ 62	27%	€ 78	24%	€ 97
mixed paper	€ 11	7%	€ 12	88%	€ 22
cardboard	€ 35	26%	€ 45	63%	€ 73
glass	€ 49	76%	€ 86	30%	€ 112
glass cullet	€ 12	65%	€ 20	11%	€ 22
tin cans	€ 40	87%	€ 75	20%	€ 90
aluminium cans	€ 746	36%	€ 1.015	3%	€ 1.045
iron	€ 112	21%	€ 136	10%	€ 149
other non-ferrous (copper)	€ 2.369	28%	€ 3.022	9%	€ 3.284
PET	€ 235	5%	€ 246	21%	€ 299
HDPE	€ 189	26%	€ 239	13%	€ 269
LDPE	€ 43	14%	€ 49	54%	€ 75
organics (for compost)	€ 15	0%	€ 15		

Source: project baseline workbooks I(1) from global sources

Value chain revenues show the relation of the informal valorisation sector to economic activity. Based on Table 31, the value added by informal activity – with little or no fossil energy – varies in Quezon city from 5% to nearly 100%. For many materials, the value added by the informal sector is more than that between formal steps in the value chain. A municipality selling into this market will be less likely to create the same amount of value.

Service revenues are not part of the net cost calculation, because unlike value chain prices, they are often

set based on political or socio-economic considerations. For example, in Dar es Salaam (not one of the study cities), the price that franchisees may charge their household clients depends on the size of their organisation and its financial reports, not on the type or frequency of service (UNIDO 2004). In Bamako, Mali (also not a study city), the City Council sets the price for house on house waste collection at what they consider to be a politically acceptable price that will not affect their re-election chances (UN-Habitat 2010).

Service revenues are also not always paid by the same parties. For example, in Cairo it is households who pay the intermediaries, who in turn pay the Zabbaleen, a similar arrangement to the private-to-private service arrangements in Lusaka with both CBEs and unregistered collectors. In contrast, in Cluj the city authorities pay the private contractors.

Table 32. Cost recovery through service revenues (excludes Lima and Pune, where there are no service revenues reported)

	Name of operation	Formal / Informal	Total cost, excl. material revenues (in €/y)	Total cost, incl. material revenues (in €/y)	Total service revenue (in €/y)	Cost recovery ?
Cairo	Formal Collection	Formal	€ 9.923.000	€ 9.923.000	€ 16.045.000	**yes**
Cluj	ECOROM selective collection	Formal	€ 115.000	€ 46.000	€ 45.000	**no**
Cluj	Formal waste collection by sanitation comp.	Formal	€ 1.670.000	€ 1.670.000	€ 4.180.000	**yes**
Cluj	Final disposal	Formal	€ 37.000	€ 37.000	€ 235.000	**yes**
Lusaka	Franchise contractors (mixed)	Formal	€ 615.000	€ 615.000	€ 1.989.000	**yes**
Lusaka	LCC / Waste Management Unit	Formal	€ 409.000	€ 409.000	€ 1.597.000	**yes**
Lusaka	Community Based Enterprises	Formal	€ 46.000	€ 46.000	€ 15.000	**no**
Lusaka	Performance Contractors (Street Sweeping)	Formal	€ 271.000	€ 271.000	€ 101.000	**no**
Lusaka	Final Disposal	Formal	€ 139.000	€ 139.000	€ 158.000	**yes**
Quezon City	Barangay collection	Formal	€ 280.000	€ 280.000	€ 142.000	**no**
Quezon City	Commercial private collection	Formal	€ 664.000	(€ 711.000)	€ 389.000	**yes**
Quezon City	Payatas landfill	Formal	€ 2.810.000	€ 2.810.000	€ 710.000	**no**
Cairo	Informal Collection & transportation	Informal	€ 25.548.000	(€ 18.705.000)	€ 4.860.000	**yes**
Cluj	dumpsite waste picked and put on carriege	Informal	€ 41.000	€ 41.000	€ 64.000	**yes**
Lusaka	Unregistered waste collectors	Informal	€ 487.000	€ 487.000	€ 15.716.000	**yes**

Neither Pune nor Lima have reported the existence of operations that levy a service fee (at least not recorded in the workbooks).There are some operations that have both service revenues and material revenues: this becomes clear when the numbers change between columns 4, 5, and 6. It is important to note that not all service revenues are the same: some apply to collection, others to transfer, disposal, or other functions.

In Cairo, informal waste collection service is marginally profitable when materials and service revenues are combined. Commercial collection has a much more comfortable profit margin. In Cluj the combination of service and materials revenues is not quite enough to cover the cost of formal sector ECOROM collection, but formal waste collection by sanitation companies has a very attractive margin, and they make even more on final disposal. Informal carriage transport of recyclables is also not a bad business to be in. Commercial private collection is also highly profitable in Quezon, while barangay collection is recovering about 50% of its costs.

In Lusaka formal disposal makes a small profit, while the unregistered waste collectors are making 300% profit, a good reason to formalise them! Other cost-covering operations in Lusaka include franchise contractors, and the LCC waste management unit; in contrast, the costs incurred by the CBEs and the performance contractors for street sweeping are not covered by the fees.

The picture that emerges here is complex, but overall it appears that private sector collection is highly profitable, so much so that it could be used to cross-subsidise the less profitable operations and create considerably more equity. Informal services are also profitable, in Lusaka very much so, and in Cairo and Quezon the materials revenues for formal collection plus valorisation make these operations attractive sources of income. Looked at it another way, they offset the costs for the service.

Informal activities have both positive and negative impacts on the formal solid waste system. The PFD methodology provides a way of seeing where those impacts are felt the most directly, and thereby making a conservative estimate of the economic impacts of informal activities on the formal solid waste system. To do this, a "default path" for solid waste has been identified and designated in each city. The total volume of materials recovered by the informal sector, also the basis for calculating the carbon footprint of informal activity, is the basis for calculating the contribution of avoided disposal costs to total economic impact. In addition, the tonnes diverted from the "default path" are considered as "avoided cost"to the municipality wherever they in fact go into the recycling system rather than the path for disposal.

Table 33. Avoided costs for collection, disposal and total avoided costs for the six cities

	Avoided costs for collection (€/y)	Avoided costs for disposal (€/y)	Total avoided costs for disposal (€/y)	Value per informal livelihood (see also table 27)
Cairo	€ 9.923.000	€ 2.092.000	€ 12.015.000	€ 364
Cluj	€ 58.800	€ 4.000	€ 62.800	€ 19
Lima	€ 14.477.200	€ 1.281.100	€ 15.758.400	€ 1.409
Lusaka	€ 1.461.700	€ 9.700	€ 1.471.500	€ 3.066
Pune	€ 1.905.200	€ 313.100	€ 2.218.300	€ 251
Quezon City	€ 3.355.600	€ 854.100	€ 4.209.600	€ 417
Total	€ 33.601.400	€ 4.591.700	€ 38.193.200	€ 571

Source: City Workbooks

Looking at the system in this way, it appears that the informal sector in Lusaka creates a benefit of more than € 3.000 per person, but in Cluj that value is only € 20. However, on average, the 73,000 informal livelihoods in the six cities provide a collective benefit of € 38 million per year, or about € 570 per informal sector worker?. In some cities this benefit is more than the informal sector persons actually earn, meaning that they create as much value for their cities as they do for themselves.

It can also be seen from these data that the highest cost is avoided to the city in those cases where informal actors intervene in collection services and in the recovery of organic waste materials for swine feeding. This can be explained by the fact that organic waste often represents a large share of waste (high tonnages to transport and to dispose) that formal sector systems cannot easily valorize profitably.

3.4 Socio-economic Impacts of Informal Activities

This section explores the main socio-economic impacts associated with the solid waste and recycling activities of the informal sector. It is useful to repeat that the kinds of impacts assessed are, in the first instance impacts to the society as a whole, with a focus on impacts felt in or in relation to the solid waste management functions of the society. However, some of the indicators also give direct insights into the lives and living conditions of the members of the informal sector themselves, and their families.

Table 34. Average earnings in the informal waste sector compared with legal minimum wage

City/ Indicator	Average reported informal waste sector earnings (€/day)	Shadow-priced wages for the informal sector (€/day)	Weighted average earnings per day from the baseline workbooks	Legal minimum wage (€/day)*	Earnings in the informal sector as percentage of minimum wage
Cairo	€ 2,0	€ 2	9,07	N/A	no min. wage
Cluj	€ 6,3	€ 6	6,3	€ 4,34	€ 1,45
Lima	€ 5,7	€ 5	5,7	€ 5,10	€ 1,11
Lusaka	€ 2,2	None	2,2	€ 2,32	€ 0,88
Pune	€ 3,3	€ 2	4,02	€ 1,40	€ 2,35
Quezon	€ 4,6	€ 3	4,75	€ 4,85	€ 0,94

Source: Project baseline workbooks; and Project socio-economic workbooks.

Average earnings in the informal waste sector are based on a weighted average of earnings in various occupations (waste pickers, itinerant waste buyers, etc.).

As presented in Table 34, average earnings in the informal waste sector in Pune, Lusaka, Lima and Cluj are 110% to 240% above the legal minimum wage. Egypt does not have any legal minimum wage; in Quezon City they are slightly below (but the legal minimum wage is reported to often not be respected by private companies).

Table 35. Average earnings in the informal waste sector compared with industry and the formal waste sector

City/Indicator	Average informal waste sector earnings (€/year)	Salaries and benefits in the formal waste sector (€/year)	Average salary of unskilled labour in industry (€/year)	Yearly reference salary at legal minimum wage
Cairo	2.721	420	600	NA
Cluj (1)	345 (1) / 2.070	2.424	1.355	1.043
Lima	1.767	2.187	960	1.530
Lusaka	586	723	612	612
Pune	1.199	1.860	548	420
Quezon City (2)	1.667	1.003	817	1.280

(1) Represents actual earnings from about 50 days of labour per year of €345, multiplied by 6 for purposes of comparison with other cities.

(2) There is some indication that formal waste collection workers in Quezon are deliberately paid less to compensate for their "side" earnings as truck pickers.

Earnings in the informal waste sector are compared with average salaries in industry and in the formal waste sector. The data suggest that the average informal sector worker earns more than formal sector workers in Cairo and Quezon City, and less in Pune, Lima, Lusaka, and Cluj. In all cities, average earnings in the informal waste sector are up to four times higher than salaries of unskilled labour in industry[39].

When interpreting this comparative analysis, it is important to consider that people working in both the formal and informal waste sector often have other sources of income. It is also important to consider that positions in the formal waste sector are usually more secure, are generally associated with a more desirable social status, and come with more access to benefits such as health insurance than work in the informal waste sector.

Within the informal sector, there are quite considerable differences in earnings between categories of occupations. Table 36 shows that there can be 100% difference in earnings (without shadow pricing) between the informal sector categories of work, using Lima as an example[40].

[39] For Cluj this is the case if daily income is considered only, because in Cluj the informal waste sector people mainly work part time and on seasonal basis.)

[40] It is important to note that the earnings in this table, in contrast to earnings discussed in city comparisons, are not shadow-

Table 36. Earnings per occupation in the informal waste sector in Lima without shadow pricing

Occupation in informal waste sector	Earnings (€/month)
Street waste picker (walking)	101,9
Street waste picker (with tricycle)	192,5
Waste picker in dumpsite	175,2
Waste picker in transfer station	205,2
Waste picker in landfill	97,3
Informal collector with tricycle	173,2
Itinerant waste buyer with tricycle	101,5
Organic waste collector (from restaurants, markets)	99,9
Worker in junkshop	127,5

Source: Project baseline workbooks.

The total income earned by the informal waste sector from in the cities under study, as shown in Table 37, ranges from €0,3 million in Lusaka to €18 million in Lima. Total income earned includes income earned by all persons in the informal sector, both from sales of recyclables and organics and from service provision. Income includes wages or piecework payments where they are paid, and other sources of income, such as rental income from renting property or a vehicle, payments related to social obligations, sales of other items besides recyclables, etc.[41]

Table 37. Informal sector income and earnings from recycling in the study cities[42]

	Total Persons Working in the Informal Waste Sector	Informal sector households depending fully on income from informal waste and recycling activities	Total Income (€/year) earned by all people in the informal sector
Cairo	33.000	91%	8.979.000
Cluj (1)	3.226	31%	1.114.000
Lima (2)	17.643	88%	18.187.000
Lusaka(3)	480	69%	281.000
Pune	8.850	63%	10.613.000
Quezon City	10.105	82%	14.396.000
For six cities	73.304		53.570.000

Source: Project socio-economic workbooks. (1) Represents earnings from between 50 days per year and full time. See Chapter 3 summary, and Cluj City Report (Annex 6), for further information. (2) 11.183 is the total number of persons in the informal sector excluding the workers in the piggeries. The income earned in Lima includes the earnings piggery workers, so they are included for calculating the income per worker. The total for six cities also includes these workers.

Gender aspects[43] considered here are focused on gender distribution of livelihoods, the simplest indicator to find. Information on strategic gender interests and practical gender needs of women and men is almost certainly interesting, but data to support such an analysis was not collected by the city partners.

In the study city cities, women and girls represent between a quarter and a half of the informal sector workers, but, with the exception of street sweepers in Lusaka, an occupation traditionally given to women, less than 5% of those working in the formal sector are women. In Lima the formal sector has no women at all.

priced. This is because (a) they are all within the informal sector, and (b) they are all within Lima.

[41] Total income earned is based on reported real income, and does not include the extrapolations used to shadow price informal operations.

[42] "Earnings in the informal sector" includes both earnings from recycling activities and from service fees for mixed or separate collection, street sweeping, and the like. "Sales to the recycling industry" covers sales made to the recycling industry, but from both informal sector and formal sources.

[43] Since the data on the informal sector are mostly based on the main livelihood earner, usually a man, numbers tend to under-represent women and girls who support male IWBs and street pickers in their families by processing and packing scrap in their households and compounds.

Within the informal sector, women are more often engaged in waste picking and valorisation-related processing, and less often in the kinds of work that require capital or equipment such as carts or baling machines. When they work in junkshops they tend to work there as piece rate employees or because it is a family business, and not so often as managers. In Lima, women compose 5% of IWBs with tricycles, 30% of waste pickers at dumpsites and 40% of the workers in swine feeding enterprises. In Quezon City women constitute 45% of waste pickers, and there 37% of all junkshops are managed by women. In Pune 92% of KKPKP members are women, which represents the percentage of women waste pickers in the city. In both West and East Africa, in service delivery, women are more likely to be working in CBOs, NGOs, and cooperatives for relatively modest wages, and men are more likely to work for private MSEs and collection firms.

Because women tend to be concentrated in lower-earning activities such as waste picking, their average income is lower. Even when they do the same kind of work, for example, itinerant waste buying, they tend to earn less and also are paid lower rates for materials by junk shops. For example in Lima, women's average earnings typically range from 45% to 90% of men's earnings in the same occupations.

In Cairo, mothers, sisters, wives and daughters and young sons of the Zabbaleen male collectors are involved in sorting the waste at their homes or yards, while one NGO, the Association for the Protection of the Environment, has set up paper and textile recycling workshops especially for women and girls (Aziz, 2004).

Lusaka has no clear data on prices, but in a survey in Tanzania in 2004 (Scheinberg 2004), men traders were offered better prices on the open market for paper and plastic, but specific women traders with a good reputation were able to negotiate favourable pricing with purchasing paper mills.

In Pune female waste pickers earn the same as men, although the men consider this is a job of last resort, and male waste pickers tend to be of advanced age, and/or disabled or physically challenged. Female itinerant waste buyers earn a fourth of men's earnings, because they operate with less capital and use baskets instead of handcarts, giving them reduced operating range and more limited buying, selling, and transport capacity.

Table 38. Gender aspects in the formal and informal waste sectors

City/Indicator	% women in the formal sector	% women in the informal sector	Average earnings of women in the informal sector
Cairo	1%	26%	4,20
Cluj	4,5%	37%	5,50
Lima	0%	24%	3,38
Lusaka	56%(1)	32%	INA
Pune	4,5%	42%	1,85
Quezon City	2%	24%	4,57
Simple Averages	**11%**	**31%**	**3,90**

Source: Project socio-economic workbooks. (1) Women working in Community-based Enterprises and as street sweepers. INA: information not available.

The distribution of resources and decision-making power between men and women is thus significantly different in the informal than in the formal solid waste sectors: women in general play a measurably larger role in informal activities, as Table 38 shows. This suggests that formalisation, while having a beneficial impact in general, may decrease livelihoods for women.

Child labour refers to the practice of children under the minimum age – usually 15 years of age – working for more than the legal number of hours a day for their age group (ILO 2004). Children work as waste pickers for a number of reasons, ranging from the wish of their waste picker parents to be able to supervise their children and keep them safe, to the difficulties they have in school for reasons of ethnicity or social disadvantage. In Romania, for example, many Roma children do not attend school as they are frequently exposed to bullying and discrimination (Stanev et al., 2004).

Child labour is a common phenomenon in the informal waste sector in the study cities, especially in dump picking and home processing. Child labour in the informal waste sector is lowest in Pune, where there have been continuous efforts by KKPKP and other social development organisations to reduce child labour (ILO 2004)[44]. Annual school enrolment drives, non-formal education classes for children, special schemes of scholarships for child waste pickers, and incentives to complete secondary education and delay age of marriage have all contributed to this.

Table 39. Child labour in the informal sector[45]

City	Percentage of child labour in waste sector	Average earnings of a child (€/day)	Child earnings as a % of adult's earnings	Total income generated by child labour in waste sector (in €/ year)
Cairo	1%	1,50	20%	270.000
Cluj	14%	INA	INA	NA
Lima	3%	1,35	24%	122.600
Lusaka	18%	1,57	77%	39.000
Pune	1%	1,00	30%	25.600
Quezon City	30%	2,94	64%	3.253.100

** Based on assuming a total family income at above amounts for two adults, two children.*
INA: information not available.

A second reason that child labour persists is that the income of children, while less than that of adults, is significant and needed for family maintenance. The total value of children's earnings per city and year, calculated by multiplying the number of children involved and their average earnings, ranges from around €25.000 in Pune, where both factors are low, to more than €3 million in Quezon City, where both factors are high. An earlier study conducted for the ILO shows similar figures, presented in Table 40 (ILO 2004).

Table 40. Impacts of child waste pickers on family income

Country	Income share of child waste picker
India (Kolkata)	Children earn 30-40% of family income.
Cambodia	Children can earn 50% of an adult's income (USD 1/day).
Egypt	Children can earn 30-50% of an adult's income (€1 /day) or provide unpaid labour, which saves the family the cost of hiring someone from outside (girls mainly).
Philippines	Children can earn more at waste picking than do neighbourhood adult factory workers working a ten-hour shift (Gunn & Ostos, 1992).
Tanzania	Younger children (6-12 years) earn 10-25%, while older children (13-16 years) can earn 50% of an adult's income.

Source: ILO, 2004

The term "transaction costs of informal status" is used to cover both conditions affecting informal efficiency, and a range of payments people working in the informal waste sector have to make to be able to continue their activities. While comparable to 'costs of doing business' in the formal sector, for the informal sector these relate primarily to the fact that informal activities are criminalised, or are illegal for other reasons, such as a junk shop being located in a residential zone where that kind of business is not allowed.

[44] The ILO study cited highlighted an absolute reduction in the number of child waste pickers from 616 in 1996 (Study of Child Waste pickers in Pune, UNICEF) to 144 in 2000.

[45] Child labour has not been studied for the formal waste sector, but this is expected to be very low, as it is officially and legally prohibited, and the prohibitions are enforced, in many countries, so it is difficult for formal companies or government institutions to ignore these regulations. One possible exception is the involvement of teen-age girls in street sweeping, but there are no studies to shed light on this.

Factors affecting efficiency are quite diverse, and include

- Full or part time: a person whose income from picking is part-time, seasonal, or occasional, can be expected to be less efficient than someone who entirely depends on picking for her income.
- Own boss or employee: the motivation for efficiency is less when working for another person, than when working for oneself. The current situation in New Delhi, India, confirms this: in the privatisation process, waste pickers have been 'hired' to pick waste at transfer points, but their labour productivity is less than the "free" pickers (Chaturvedi 2007);
- Motor or muscle power:: someone transporting waste with a truck can handle many more tonnes per year than someone using a handcart.
- Competition: if someone has to fight for materials, the quantities that he will be able to collect, process, and transport will be reduced.
- Harassment, legal barriers, and related issues: where waste pickers are harassed by police, arrested, or prohibited from taking their carts on main roads, work productivity is certainly affected in a negative way.

Transaction costs are classified in two categories:

- Payments made for bribes, for fines and payments made to generators for access to materials
- Monetised impact of arrests and incidents with the police

Table 41. Transaction costs of informal status in four cities

City	Total amount of bribes/fines/payment for access paid by informal waste workers (€/year)	Total number of arrests/incidents with the police of informal waste sector workers (incidents/year)
Cairo	21.000	40
Cluj	NA	NA
Lima	180.000	NA
Lusaka	NA	NA
Pune	18.000	25
Quezon City	54.000	29

Source: Project socio-economic workbooks. NA: no data available

Table 41 shows the bribes and other payments well as the number and cost of arrests. The value of arrests and incidents with the police has been modelled based on an assumption of three days loss of average earnings for every incident. For obvious reasons, information on these payments are very hard to find, and were completely unavailable for Cluj and Lusaka, so the information consists of estimates and triangulated inferences.

The estimated amount of bribes, fines and payments of access per year ranges from €18.000 in Pune to €180.000 in Lima. In Pune, the KKPKP waste pickers' union has protested the gross violations of human rights by the police, through public protests in various forms: sit ins, protest marches, demands for suspension of officers, written complaints to higher authorities, the press, and media publicity.

The estimated number of arrests and incidents with the police ranges from 25 to 40 per year in the study cities. Many junkshops are reported to pay bribes to avoid conflicts with the police, because the bribes cost less than the risk of lost income due to closing shop for a few days.

While virtually everyone has ideas and presumptions about the health effects of informal waste service and recycling, health impacts are difficult to document. Informal waste picking, sorting and recycling is dirty work, often done in dangerous or unhealthy circumstances[46]. In addition, many dump pickers live on the dumpsite, and in most cities, there are small junk shops located there. In addition to health impacts from breathing smoke and having contact with sharp or infected objects, there is a real danger of

[46] The most common ways of removing (picking) valuable materials (for own use, composting, or recycling) from mixed waste are: (1) scavenging from waste deposited by households for collection alongside streets, (2) climbing into dumpsters and skips on the street, (3) moving through waste at illegal dumps and community collection sites, and (4) assembling behind and around vehicles discharging waste at dumpsites

loss of life from collapsing slopes, fires, and waste slides.

Most of the limited information on occupational health available for this sector has been gathered through research among waste pickers. Information on occupational health of itinerant waste buyers, junkshops, pre-processing and recycling is even more scant than that on waste picking, and nothing conclusive can be said about it based on available data. (Ahmed et al., 2006).

Injuries and disease almost always are a cause of lost income, lower productivity, shorter life expectancies, and in some cases irreversible damage, especially to children (Gunn & Ostos, 1992). In Mexico City dumpsite waste pickers have been reported to have a life expectancy of 39 years, while that of the general population is 67 years (Medina, 2000).

An overview of a number of studies carried out on occupational health of waste pickers listed the following health impacts: (Eerd, 1996)

- More waste pickers reported past health problems than a control group.
- Waste pickers were in a worse state of malnutrition than a control group.
- Many of the waste pickers suffered from chronic backache and many complained of general weakness.
- Coughs were a chronic problem.
- Many suffered from injuries like cuts and needle stick injuries.
- Eye infections and other eye problems were extremely common.
- Many waste pickers suffered from intestinal protozoa and helminths.
- The dumps and waste bins were infested with stray dogs and rats. Bites from dogs and rats were quite common.
- Diarrhoea was extremely common among all waste pickers.
- Many of the waste pickers complained of having one or more attacks of jaundice in the past year.
- Many waste pickers suffer from skin diseases.
- Among waste pickers certain groups are more vulnerable. For example, children and women may suffer from sexual abuse and rape (Ibid., Koehs, 2006).

The sources of health problems associated with working with waste in both formal or informal activities include:

- contact with infectious materials, including faeces, blood, medical wastes, carcasses of animals, human body parts, hypodermic needles, or infected textiles and other materials from health care waste;
- eye, ear, and other injuries contact with sharp items such as rusted metals, broken glass;
- inhalation of smoke, chemical pollutants, aromatic hydrocarbons, fumes, paint, and other airborne pollutants;
- diarrhoea and other intestinal consequences of consumption of contaminated or spoiled food, parasites, helminths;
- ergonomic injuries from lifting, reaching, falling;
- skin or other infection or injury from insects, or from bites or scratches from dogs, rats, snakes, lizards, pigs, and the like;
- exposure to weather, precipitation, hot sun, in combination with dehydration, lack of drinking water, and the like;
- injuries from backing or discharging vehicles;
- burns and cuts as a consequence of processing materials for sale;
- contact with hazardous and carcinogenic materials, including materials as common as used crankcase oil, lead from automobile batteries, and paint; and
- violence associated with competition for materials and territoriality, or sexual violence.

The main indicator used in this study for occupational health is the number of serious and fatal accidents at disposal sites, in combination with health care costs. While difficult to find, available data from five of the cities is presented inTable 42; Lima is excluded as no data was available. The number of serious and fatal accidents at disposal sites varies considerably between the study cities. This information is usually not recorded, so it depends on estimates of resource persons. In a recent survey in Lima among informal waste sector participants, 39% of waste pickers, 48% of informal collectors and 17% of junkshop workers say they regularly experience accidents in their activities (Waste pickers study, PROPOLI - IPES, 2005).

Serious accidents have been monetised in other studies by calculating one accident as a loss of one month's income, while a fatal accident has been counted as loss of 25 years of income. This is a simplified method that does not account for loss of productivity after an accident nor for the immaterial loss of a human's life.

Table 42. Health indicators of the informal waste sector

City	% of inf. waste sector people who can afford healthcare	Expenditure on healthcare (in €/person/ year)	% of inf. waste sector people who have health insurance	No. of serious and fatal accidents per year
Cairo	95%	50	5%	75
Cluj	60%	200	40%	6
Lima	NA	NA	4%	NA
Lusaka	63%	32	90%	6
Pune	100%	50	50%	27
Quezon City	100%	66	23%	3

Source: Project socio-economic workbooks. Both Asian cities have 100% access assured by policy or public sector action.

New waste streams increase health risks in the sector, partly because it takes a long time for specific health risks to become obvious, but also because it takes the informal sector some time to learn how to handle materials safely, or even, what the valuable elements are that can be extracted. One current example is the rapid increase in the recycling of electronic waste (WEEE) in many low- and medium-income countries, especially in India and China. E-waste contains toxic materials like lead and mercury. Recyclers are exposed - often without knowing or understanding the dangers - to these materials when dismantling computers and other electronic equipment, but they also expose themselves to fumes related to smelting metals using fluxes like arsenic and cyanide (Spies & Wehenpohl, 2006).

Anecdotal data from interviews in the current study in Cluj and Pune, and in an earlier study in Rio Azul in Costa Rica (Labarca *et al.* 2002) suggest that the amount of time spent working as a picker on the landfill is either quite short or quite long. There is an initial period of adaptation to the health conditions, which many people do not survive, or which convinces them to exit to other types of work. If they pass this period, they do so because their constitutions are strong and they develop both physical and social resistance to problems. This, in combination with the earning potential, then creates conditions for them to continue in the work for a long time.

Informal recyclers, but especially waste pickers, are generally vulnerable to conditions ranging from ill health or poor weather. As members of cooperatives or associations, they enjoy more stability and security, certain secondary benefits, and a higher social status. For purposes of this study, secondary benefits related to organisational support refer to both tangibles like health insurance or more daily revenue, and intangibles, such as a better negotiating position, credibility, status, to identity cards or schools, or market leverage.

The way informal activities are organised has important consequences for income generation, working conditions and social status. As a general rule, organisational support allows the informal valorisation sector to price, and/or to sell them into higher levels of the recycling supply chain, with more robust margins (Wilson et al., 2005).

Organisational support to the informal sector can take many forms, including: labour unions; self-help and savings associations; marketing co-operatives; national, city, or industry recycling forums or platforms; alliances; networks, NGOs, CBOs, private businesses, women's' trading associations, and micro-finance institutions.

Collective organisations like cooperatives or associations typically provide one or more services such as:
- making available collective storage and sorting;
- enabling or facilitating collective negotiation to obtain contracts or franchises from local governments;

- selling materials in larger pre-processed quantities which fetch higher prices;
- collective purchasing or leasing of equipment for processing or transport;
- introducing and operating "safety-net" systems for the individual members, such as healthcare and life insurance, sources of credit, emergency assistance, etc.;
- facilitating access to education or operating special schools, such as is done in Egypt; and
- lobbying and advocacy.

India, the Philippines and some countries in Latin America, especially Brazil and Colombia, are known for their high levels of organisation of the informal waste sector.

In the study cities, the informal valorisation sector is best organised in Pune and Quezon City with 60% and 37% respectively of workers being reported to belong to a sector organisation. In Cluj and Lusaka, where the least attention has been paid to the relatively small informal waste sector, no organisations are reported. Quezon City junkshops and itinerant waste buyers are organised in the NGO *Linis Ganda,* while the NGO *PARE* supports and collectivises dumpsite waste pickers. Linis Ganda has been working for more than 10 years on strengthening the informal waste sector in the Philippines (Lardinois & Furedy, 1999).

In Cairo the level of organisation is surprisingly low (2,5%), given the long history of the Zabbaleen in waste management and ongoing threats to their access to materials and clients. Two NGOs, CID and APE, are active in social development and business expansion. Associations and cooperatives in the waste field are a relatively new phenomenon in Peru, unlike other Latin American countries such as Brazil and Colombia (www.cempre.org.br). Only 7% of the informal sector workers in Lima are members of an association, cooperative or other representative structure (Waste pickers study, PROPOLI - IPES, 2005).

Alongside of association membership, health insurance can function as a proxy indicator for a range of secondary benefits that are important to the informal waste sector. Access to health insurance is usually associated with membership in associations and cooperatives. This is true in Pune but not in the other cities. Table 43 shows that both access to health insurance and membership in associations varies greatly among the cities. There is more of a link between health insurance and occupational group than with association membership: in both Quezon City and Lima many junkshop owners have health insurance, while many waste pickers do not. A recent survey indicated that 4% of waste pickers, 3% of informal collectors and 16% of junkshop workers in Lima have access to health insurance (Waste pickers study, PROPOLI - IPES, 2005).

Table 43. Access to health insurance and membership in associations

City	% of inf. waste sector people who have health insurance	% of informal waste sector people who are members of an association/ cooperative
Cairo	5%	2,5%
Cluj(1)	40%	11%
Lima	4%	7%
Lusaka(2)	90%	0%
Pune	50%	60%
Quezon City	23%	37%

(1) There are not any associations as such in Cluj but the 400 residents of the community "Dallas" have created a collectivity that provides some secondary social benefits.(2) The health insurance system in Zambia is quite unusual. Poor people can go to government run clinics and hospitals where they are required to obtain a scheme of about €1 each year. This scheme allows the registered persons to access free consultation and basic drugs, although in some instances the people seeking such medical services are asked to go and buy medicines which are not available in the health centre from the Chemists and other Drugs Stores.

3.5 Environmental and carbon footprint impacts

Environmental impacts are not directly part of the economic system, and are normally treated as *environmental externalities*. Environmental externalities in an economic study are interesting mainly when they can be (1) quantified, and (2) monetised, to be translated into economic impacts. At the time of the

study research, the possibility of doing this in a consistent way across six cities on four continents was limited in terms of local economic impacts, which vary based on climatic, geographic, demographic, cultural, social, political, legal, and economic factors. Specifically, a great deal of information is necessary on the environmental performance of the industrial and commercial sector, and this goes beyond the scope of the study. As a result, the project team elected to focus on only that part of potential environmental impacts which can be monetised and compared using carbon emissions as a common benchmark. The resulting analysis of energy use, extraction impacts, and emissions can then best be described as a (partial) environmental impact and/or carbon footprint analysis.[47]

To assess the environmental impact of the solid waste informal sector, the study first uses indicators to measure the environmental impacts, and then translates the environmental impacts to CO2 equivalents[48]. This is done in order to be able to use the price for a tonne of CO2 as a way of monetising some of the environmental impacts.

The price fetched by a tonne of CO2-e reduced varies depending on the type of abatement concerned – it may be under one of the Kyoto Protocol-defined schemes: emissions trading (like the EU Emissions Trading Scheme – EU ETS), JI (Joint Implementation) and CDM (Clean Development Mechanism), depending on the identity of the buyer and seller; or it may be a voluntary transaction, not seeking certification under the Kyoto Protocol.[49] It is important to note that the use of GHGs and CO2 equivalents is a *methodological strategy* for comparing environmental impacts. It does *not* necessarily mean that, in reality, the carbon credits could actually be claimed or that real money could be made. That being said, the results suggest that one part of a future research and action agenda is attempting to operationalise the idea of carbon credits as a structural source of financing for solid waste activities in general, and the activities of the informal sector in particular.

The methodology for this translation process uses the global benchmarking potential of carbon dioxide (CO2) equivalents, and the global system of carbon trading as a pricing mechanism. Because carbon prices are set in market transactions, translating the environmental impacts into greenhouse gas (GHG) equivalents allows for a single set of measurements to compare the impacts across the six cities, in a single evaluation scheme. The method focuses on GHG emissions of CO2 and methane (CH4), as global environmental impacts, for which international markets exist. GHG emissions, presented as CO2 equivalents avoided or generated, provide a standard measurement unit for several key (positive and negative) environmental effects of waste management[50].

The three types of impacts that can be monetised in this way are:

1. Extraction impacts, that is, the impact of removing natural resources from the environment and processing them.
   - Material recovery and recycling create environmental benefits from avoiding extraction impacts, as well as impacts of processing, transport, and energy use related to post-extraction work on the materials.
   - These are offset by the local impacts of recycling
   - Negative extraction impacts are primarily global, in that the extraction does not necessarily occur in the city or even in the country of analysis, but the impacts of recycling processes are global, regional, and local.
2. Energy impacts, in terms of the environmental impacts of energy used in the collection, transport, storage, disposal, and processing of waste and recyclables. Energy impacts are global, regional, and

[47] This is a change of vocabulary from the 2006/2007 Research Report, which refers to an environmental impact analysis.

[48] Greenhouse gas emissions identified in the raw material extraction phase and the subsequent waste management steps are quantified in terms of metric tonnes of carbon dioxide equivalent (tCO2-e). This is the standard unit used in transactions of emission reduction credits earned under the conditions specified by the Kyoto Protocol of the UN Framework Convention on Climate Change (UNFCCC).

[49] Although the coming into force of the Kyoto Protocol in January 2005 provided an impetus to developing and strengthening of carbon market institutions, there is no public registry of carbon transactions, nor price-index for project-based transactions, and the details of these are mainly kept confidential (IETA 2006). Nevertheless, the review of the carbon market of 2006 by the International Emissions Trading Association (IETA) provides some indicative prices of different types of emission reduction credits, using publicly available information, as well as confidential primary data.

local, in terms of emissions for generating energy, depending on the type of energy generated, losses in transmission, and the like.

3. Emissions impacts, in terms of pollution associated with controlled and illegal disposal.

- Emissions from leachate, methane release from decomposition and CO2 release from burning are local, but have also a global component.
- Recycling processes also have emissions impacts, but without knowing precisely what is recycled, where, how, and under what conditions, these are difficult to quantify or monetise.

The values for monetising are based on the prices of Kyoto-compliance emission reduction credits, and therefore vary depending on the classification under the Kyoto Protocol of each of the countries in which the project cities are located.

Egypt, India, Peru, Philippines, and Zambia are all non-Annex I parties, which can realise GHG emission reduction through the CDM flexible mechanism of the Kyoto Protocol. According to the World Bank's review of the carbon market in 2005, the price per tCO2e yielded by signed and certified projects in this category in the first three months of 2006 was US$11,56, which is equivalent to €9,62 using the average currency exchange rate from the period 01 January 2006 to 31 March 2006 (1 US$ = €0,83189) (OANDA 2006).

Romania is an Annex I party in the special subgroup of Parties with Economies in Transition (EIT parties), and is eligible for JI-type of transactions (UNFCCC 2005). The price of JI credits (ERUs) in the first three months of 2006 was US$7,18, equivalent to €5,97 (IETA 2006, p. 26). However, as Romania is expected to join the European Union in January 2007, and hence become eligible to participate in the EU ETS, the price for tCO2e as EUAs should apply, the closing price for which is €12,45 as of 11 October 2006 (Point Carbon 2006).

A key limitation of the analysis is the unavailability of local country-specific or process-specific studies on the life cycle of the materials in the six project locations[51]. The calculation is limited to the three types of impacts, but only when they occur within the spatial and system boundary. Also, because of the difficulty of finding specific impact information, the study unfortunately does not include local impacts of pre-treating materials, such as washing and cutting, unless they are associated with reported energy consumption. So the use of GHG emissions is at best a partial indicator of environmental impact.

For this reason the carbon footprint modelling is indicative, but it also has a bias. The environmental impacts of local recycling remain outside the scope of this analysis, as the specific formal and informal recycling activities vary greatly within and across the six cities, defying a unified approach. This means that some negative environmental effects resulting especially from informal recycling activities in some cities are not included in the calculations, thus leading to an overestimation of the net benefit that the informal sector in these cases brings to society, and an underestimation of the local environmental impacts of recycling activities.

Formal and informal material recovery and recycling in the six cities are the source of positive environmental impacts, because they lead to avoidance of pollution and savings of primary raw materials and energy, through using secondary materials for the manufacture of new products[52]. For this reason the environmental and carbon footprint analysis begins with Table 44, showing which sector is responsible for the amounts recovered.

[51] The literature identified and reviewed comes almost exclusively from research done in the US, the UK, Canada, Australia and New Zealand, and the majority of these studies use data from, and focus their analysis on, these geographical regions. A review of the availability of Life Cycle Inventory (LCI) databases in the world from 2002 shows that none of the project countries had LCI databases at that time (Norris and Notten 2002).

[52] Energy recovery, that is, the use of waste material for secondary fuel, is not part of the current operations of any of the cities, and so is not mentioned further, except in relation to Pune where refuse derived fuel (RDF) is part of one scenario.

Table 44. Comparison of material recovery by formal and informal sector in the six cities in the baseline scenario (in tonnes and percent of total generated)

City	Formal sector		Informal sector	
	Tonnes	Percent of total generated	Tonnes	Percent of total generated
Cairo	433.200	13%	979.400	30%
Cluj	8.900	5%	14.600	8%
Lima	9.400	0,3%	529.400	19%
Lusaka	12.000	4%	5.400	2%
Pune	-	no recovery	117.900	22%
Quezon City	15.600	2%	141.800	23%

Generally, using virgin resources to make and use metals, paper, glass and plastic, requires more energy input, and therefore, generates more GHG emissions, than using secondary (recovered) materials, so using recycled materials creates a savings.

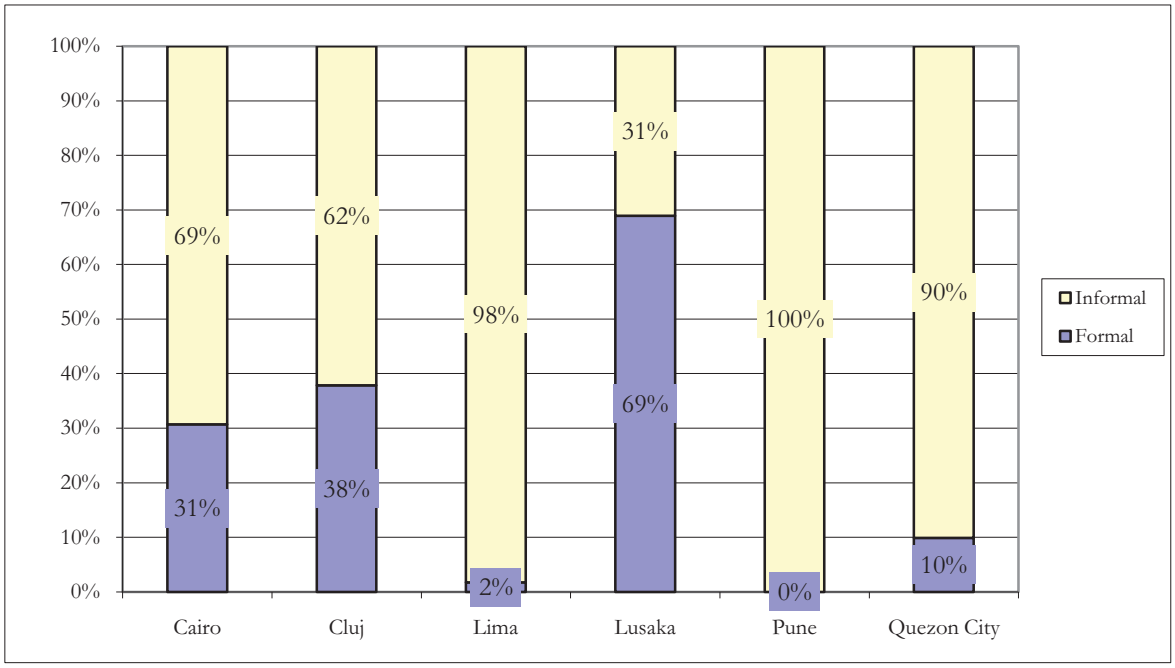


Figure 15 . Material recovery by formal and informal sectors as percent of total tonnes recovered in the baseline scenario.

In five of the six cities, but not in Lusaka, the largest share of material recovery, both in relative and in absolute terms, is done by the informal sector, and so the activities of this sector are associated with environmental benefits and a lower carbon footprint than corresponding formal activities. Figure 16 shows the benefits in carbon terms. In all cities, the informal sectors show a net carbon benefit, but Cluj shows the least and Lima the most.

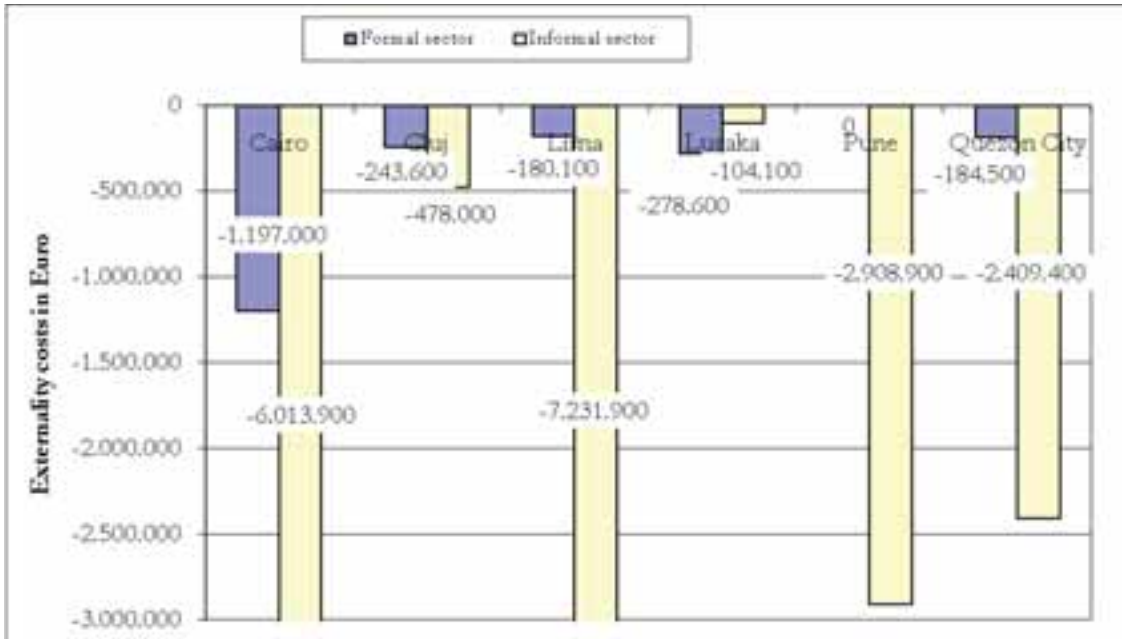


Figure 16. Environmental benefits associated with material recovery in six cities, shown as reducing the negative externality costs in Euros

3.5.1 Energy Use

The energy used by the formal and informal sectors in waste management process steps also gives rise to GHG emissions. These emissions come from two sources: fossil fuels and electricity.[53]

The GHG emissions from electricity consumption are calculated by first deriving the GHG emissions (in kg of CO2) generated for each KWh of electricity produced[54], and then multiplying this coefficient by the reported amount of electricity used in waste management processes.[55]

The informal sector in general uses less fossil fuel and electricity in its operations than the formal sector. This is an additional source of environmental benefits to society, which is able to have the use benefit that resources are recycled using little or no fossil fuel energy.

Table 45. Comparison energy use by formal and informal sector in the cities monetised using prices for carbon equivalent tonnes

	Formal sector		Informal sector		Comparison
	GHG (tonnes C02eq)	Total net cost (benefit) of GHG emissions (€/y)	GHG (tonnes C02eq)	Total net cost (benefit) of GHG emissions (€/y)	Sector generating the most benefits in terms of avoided emissions
Cairo	1.689.200	16.244.800	(28.900)	(277.500)	Informal
Cluj	103.600	1.295.300	(38.200)	(478.000)	Informal
Lima	448.500	4.313.400	(496.700)	(4.776.800)	Informal

[53] For calculating the emissions from fossil fuel use by vehicles, the quantity of fuel used (litres) is converted to its equivalent weight (kilograms) by multiplying the number of litres by the density of the fuel (0.,845 kg/l), and then multiplying by the appropriate carbon emission factor, as specified in the Revised 1996 IPCC Guidelines. For all the project cities, it is assumed that it fuel emissions come from heavy-duty diesel vehicles, , as that appears to be the most likely fuel to be used by heavy-duty vehicles involved in waste management in developing countries. The average CO2 emission factor for heavy-duty dielsel, provided by the IPCC 1996 guidelines (based on US data) is 3172.31 g/kg fuel, or after converting weight to energy, 72.098 g/MJ (IPCC 1996 Ch1ref3.pdf).

[54] Based on the average fuel mix used for electricity generation in each of the six project countries, obtained from "Carbon Monitoring for Action" (CARMA); methodology shown in Annex 3

[55] For complete detail of calculation and country-specific assumptions refer to Annex 3 Part 1.

Lusaka	25.800	247.700	57.700	554.600	Formal
Pune	210.600	2.025.000	(295.000)	(2.837.200)	Informal
Quezon City	472.800	4.546.700	(249.200)	(2.397.000)	Informal

Source: Project Carbon Footprint Workbooks. (1) Electricity use verified November 2010.

It is useful to point out that the very high values for Cluj come about because Cluj is in Europe, and there is a lot more use of electricity than in any of the other cities: compare 6 million kWh for Cluj with 2 million for the next highest one – Lima, and with 75 thousand kWh for Pune. This considerable difference in the amount of electricity used for the waste process steps translates to differentials in the environmental impact coming from electricity production.

The reason for the zero values for activities of the informal sector in Cluj and Pune is that the city partners have not reported any use of fossil energy by the informal sectors in those cities. In both of these cities the main energy user, transport, is done by muscle power – in Cluj with horse carts, in Pune with people carrying materials on their backs and on their heads.

The environmental costs of energy use (in metric tonnes of CO2 equivalent and in €) by the formal and the informal sectors are compared in Table 45. Formal sector waste management activities are typically more fossil fuel-intensive than the corresponding informal sector operations, since the formal sector uses trucks and the informal sector uses mostly animal or human muscle power for parallel operations. The reason for this is that the informal sector uses less mechanisation in their waste management and recycling operations than the formal sector, but at the same time handles and diverts more tonnes from disposal because materials are recovered for reuse, recycling, animal feeding, or composting.

3.5.2 Final Disposal and Losses

Waste disposal accounts for one of the most significant sources of anthropogenic emissions of methane, amounting to 5% to 20% (IPCC 1992 in IPCC 1996) of annual global anthropogenic CH4 produced and released into the atmosphere. Methane is a greenhouse gas with 21 to 23 times more heat trapping power than CO2 (IPCC 2001)[56]. One source of methane emissions is the disposal of solid waste to land when the degradable organic fraction of the waste is decomposed by methanogenic bacteria in anaerobic conditions. Provided the right conditions, the accumulation of mixed waste leads to the generation of the so-called 'landfill gas', consisting roughly of 50% CH4 and 50% CO2 and trace amounts of other substances (IPCC 1996, USEPA 2006b). The primary generation of CO2 is in the initial stages when decomposition of waste still occurs in the presence of oxygen. As oxygen becomes deficient, decomposition becomes anaerobic, generating CH4. The amount of these gases depends on the type of landfill site, the composition of the waste, and a range of environmental conditions, such as: climate, moisture, oxygen content, nutrient availability, degradable organic carbon (DOC), pH, the amount of methane that is oxidised instead of released to the atmosphere, etc (IPCC 1996, USEPA 2006).

The GHG emissions from final disposal sites in each city were calculated using the International Panel on Climate Change 1996 Guidelines for calculating national greenhouse gas emissions from waste management activities.[57] The GHG emissions from final disposal are distributed between the formal and the informal sector based on the reported tonnes of waste disposed in regulated landfills or other authorised disposal facilities (attributed to the formal sector) and tonnes of waste disposed in illegal dumpsites (attributed to the informal sector). Thus both formal (legal) and informal (legal and illegal) waste disposal activities are taken on board in the calculation of the GHG impacts of final waste disposal in the six cities.

[56] The carbon equivalent of emissions from methane varies depending from which year the carbon offsets are used.
[57] The Tier 1 default method suggested by the IPCC for a simplified calculation in the absence of detailed data is applied. The equation used in the calculations and its terms are explained in more detail in Annex 3 part 1.

Table 46. Contribution of formal and informal sectors in tonnes going to final disposal

	Tonnes disposed by the formal sector	Percentage disposed by the formal sector of total disposed	Tonnes disposed by the informal sector	Percentage disposed by the informal sector of total disposed	Total tonnes to disposal
Cairo	791.100	76%	244.900	24%	1.036.000
Cluj	136.900	100%	0	0%	136.900
Lima	1.830.300	85%	323.500	15%	2.153.900
Lusaka	77.300	45%	94.300	55%	171.600
Pune	322.700	100%	0	0%	322.700
Quezon City	455.200	100%	0	0%	455.200

There are clear environmental impacts of emissions from informal and /or illegal disposal. However, in carbon terms, formal disposal may also have negative impacts, based on release of methane to the environment. In standard landfill practice, methane can either be released from simple vents, or flared, in which case CO2 is released. For this reason, the carbon impact of disposal will only be avoided or minimised when the methane is either avoided, through separate management of organic waste, or recovered and used to generate energy. Figure 17 shows the greenhouse gas contribution of both formal and informal sectors in terms of tonnes going to final disposal, based on the numbers in Table 46. In Cluj, Quezon City and Pune the informal sector is not or only marginally involved in final disposal (authorised or not), while in Cairo and Lusaka the informal sector disposes more waste than the formal sector.[58]

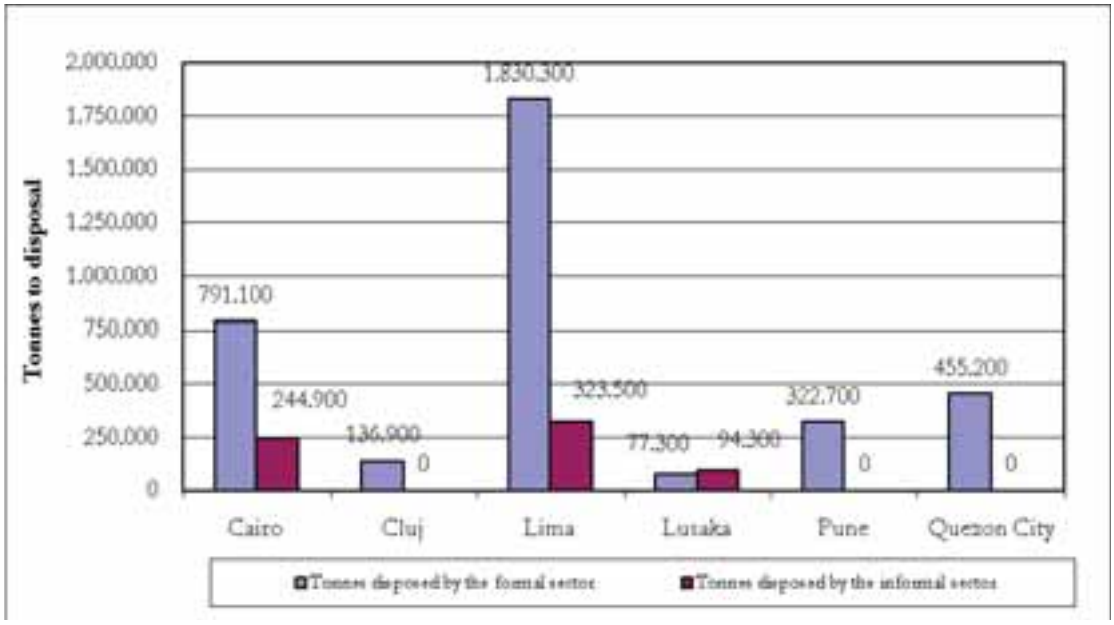


Figure 17. Contribution of formal and informal sectors in tonnes going to final disposal

The message in all three sections is consistent: even with only partial monetisation, the informal valorisation sector is delivering significant environmental benefits to their cities by valorisation. Once the recycling methodology for carbon financing is functioning, this could translate to actual financial benefits to the cities and their informal valorisation sectors.

3.5.3 Other Impacts

Negative environmental impacts that could not be quantified or monetised in the framework of this study

[58] When interpreting the resulting proportions of environmental impacts produced by both sectors, it must be taken into account that in the method used for attributing GHG emissions to final disposal, all illegal or inadequate dumping is counted towards the negative environmental effects of informal sector activities, although there is a range of actors that engage in illegal dumping in all the cities, including private individuals, small enterprises, and even formal waste management actors.

include the local nuisance impacts of the mess made by street, container, and truck pickers, the energy impacts of inefficiencies caused by dump picking, and emissions from the processes of sorting and recycling in both formal and informal parts of the industrial value chain. Examples of these non-monetised impacts include:

- emissions to air of burning pvc or other coatings off of metal, or vaporising solvents and other hydrocarbons used in the process of recycling
- emissions to water, and soil, of recycling auto parts and accumulators, and letting the fluids flow into the ground or drainage systems
- emissions to air of particulates from grinding rubber or processing paper fibre

Positive environmental benefits that could not be quantified and monetised include additional benefits of material recovery due to saved landfill space, and the avoidance of pollution to water, air, and soil, which comes with material loss from the waste management system as a result of evaporation, illegal dumping, uncontrolled burning or reuse at household level.

Both positive and negative effects are quite varied in nature and magnitude. While household reuse or organised recycling both result in saving landfill space, illegal dumping or uncontrolled burning have potentially harmful impacts on environmental and human health. They lead not only to the release of GHGs, but also to other environmental problems, including the leaching of toxic chemicals (including heavy metals) into the soil; pollution of groundwater; and emissions of highly dioxins and furans. In addition, uncollected or inadequately managed and dumped and waste can become a health hazard, as it attracts livestock and vermin, and is associated with water-borne and parasitological diseases such as dysentery, malaria, tuberculosis, cholera, jaundice, and respiratory diseases, etc (Palczynski 2002).

The choice of GHG as the standard unit indicating the degree and the positive or negative sign of the environmental impacts of formal and informal waste management systems makes it possible to compare some, but not all, of these impacts across six cities from different parts of the world, as well as between the baseline, subtraction and addition scenarios. The intention of this analysis is not to measure precise and site-specific quantities of emissions, which would require a great deal of time and resources beyond the scope of this project. Rather, the results of the environmental impact analysis are intended to reflect the general trends and help make observations about the roles and relationships between the formal and informal sectors in the six project cities.

4 Chapter 4. Policy Analysis: Modelling Subtraction and Integration of the Informal Sector

This chapter presents the results of the policy analysis and scenario modelling. In general, it answers the question: what would be the economic impact on society, and the operational and economic impact on the formal solid waste system, if the activities of the informal solid waste sector would cease or be drastically restricted? And what impact would there be if these activities would be recognised and integrated into the formal solid waste system?

The study uses a systems analysis approach. The system is defined as the current (2006-2007) situation in each of the cities, including both formal and informal waste services and valorisation. the analysis is designed to produce new information on costs and benefits of informal activities, as they relate to operations, carbon footprint, and socio-economic conditions in the cities. This current situation analysis is referred to as *the baseline*.

To serve the goals of policy analysis, the team used the baseline scenario as the platform for modelling and evaluating the results of two different types of policies. The potential impacts of future decisions- and policy-making are explored through modelling two scenarios, one in which the informal sector disappears and therefore stops its waste and valorisation activities, and the other where the formal authorities recognise the informal sector and work together with it on optimising the system and professionalising the informal workers. These are referred to respectively as *the subtraction scenario* and *the addition scenario.*

The *subtraction scenario*, represents one possible and plausible interpretation of a newly enacted law, a newly endorsed plan, or other planned modernisation activity in which the activities of the informal sector are severely reduced, via laws that forbid or criminalise especially valorisation, or claim a monopoly for the local authorities or their agents, that denies access to materials. In this scenario, informal valorisation activity declines, and the city bears the positive and negative consequences of having to handle all the materials going through informal channels.

The *addition scenario* is an alternative, but equally possible and plausible interpretation of a newly enacted law, a newly endorsed plan, or other development, in which the policy environment expands its focus on recognising, including, and working with the informal sector, with the largest focus on valorisation. In this scenario the role of the informal sector increases, but does not necessarily become formalised.

4.1 Economic and operational impacts

The total waste tonnages handled remain unchanged in most scenarios. Exceptions are Pune and Lima, which handle 7% and 19% more waste in their addition scenarios, and Quezon, where 1% more is being handled in the subtraction scenario.

From a materials recovery point of view, Cairo leads the group with a recovery rate of 43% of the total tonnage handled, which would be increased to 58% in the addition scenario. Four cities, Cairo, Cluj, Pune and Quezon would see increased recovery rates in their subtraction scenarios. In the addition scenarios, recovery would remain the same in Lima, and improve or increase in all other cities. An interesting side note to the addition scenarios is that there is room for more recovery in all cities, but this room is highest in Cluj and Lusaka where the current levels of informal sector activity are low.

Disposal rates drop dramatically in Pune in both the subtraction and addition scenarios, supported by more investment and technology. In Cluj, disposal drops in the subtraction scenario, and drops more in the addition scenario. Lima, Lusaka, and Quezon show no change in disposal in the addition scenario. Losses generally remain the same, except in Lusaka where they drop in the addition scenario, presumably because the unregistered collectors valorise more waste.

Policies that facilitate stronger integration of the informal sector can be expected to result in an increase in the rate of material recovery. Such an increase would be modest in some cities, and dramatic in others, but in all events, disposal rates can be predicted to drop, allowing for modest savings in investments for

transport to landfills, landfill space and landfill operation.[59]

Table 47. Recovered, disposed and lost proportions of the total tonnages handled (%)

	Baseline			Subtraction			Addition		
Scenario	**Recovered**	**Disposed**	**Lost**	**Recovered**	**Disposed**	**Lost**	**Recovered**	**Disposed**	**Lost**
Cairo	43%	32%	35%	35%	40%	35%	58%	17%	35%
Cluj	13%	74%	18%	27%	55%	18%	30%	51%	18%
Lima	20%	79%	2%	14%	84%	2%	20%	78%	2%
Lusaka	6%	57%	38%	4%	58%	38%	20%	57%	24%
Pune	22%	59%	19%	79%	11%	10%	71%	11%	18%
Quezon	25%	73%	2%	20%	76%	4%	25%	73%	2%

Note: The percents may not add to 100% for several reasons. First, they may not exactly add to totals because of rounding operations. Secondly, some tonnages are disposed are then recovered, these tonnages are processed twice and therefore counted twice.

Moving on to costs, Table 48 shows that integrating the informal sector in an addition scenario would lower overall costs in three cities: Cairo, Cluj, and Quezon. In Lima, costs would stay the same. The subtraction scenario also reduces costs and/or increases benefits in the same three cities. In the other two cities, both scenarios increase costs substantially, with the subtraction scenario increasing them more for Pune. This is related to technologically more complex treatment technologies in recovery (incineration and composting/digestion) foreseen in the subtraction and addition scenarios.

Table 48. Total costs, total costs per capita and tonnes recovered for the three scenarios

City	Baseline			Subtraction			Addition		
	Total cost incl material revenue	**Cost per capita**	**Tonnes recovered per year**	**Total cost incl material revenue**	**Cost per capita**	**Tonnes recovered per year**	**Total cost incl material revenue**	**Cost per capita**	**Tonnes recovered per year**
Cairo	(€ 103.963.000)	(€ 13)	1.413.000	(€ 110.001.000)	(€ 14)	1.128.362	(€ 209.990.000)	(€ 27)	1.902.000
Cluj	€ 494.000	€ 1	23.000	(€ 849.000)	(€ 2)	49.000	(€ 13.714.000)	(€ 36)	56.000
Lima	€ 68.786.000	€ 9	539.000	€ 75.270.000	€ 10	376.000	€ 67.815.000	€ 9	549.000
Lusaka	€ 1.168.000	€ 1	17.000	€ 12.761.000	€ 10	12.000	€ 12.904.000	€ 10	60.000
Pune	€ 2.081.000	€ 1	118.000	€ 4.611.000	€ 2	428.000	€ 3.023.000	€ 1	386.000
Quezon	€ 7.292.000	€ 3	157.000	€ 5.161.000	€ 2	126.000	(€ 3.113.000)	(€ 1)	157.000

The cost comparison in Table 48 does not yet include the monetised carbon benefits. The cost impacts in these cities are therefore quite dependent on how much the recovery itself costs. But while recovery is highest in the addition scenario in all except the Asian cities Pune and Quezon, this does not always translate to cost benefits.

In conclusion, the modelling exercise clearly indicates that a stronger integration of the informal sector in the cities' solid waste system has the potential to not only increase the informal sector revenues, but also to reduce the formal sector costs and the total solid waste system costs in a city.

4.2 Carbon impacts related to extraction, energy use, and disposal

Informal activities use less fossil energy than formal ones, and so their impact on carbon use in services and recovery is lower. Looking back to Table 45, above, this becomes quite clear.

In every case except Lusaka, where the the informal sector is involved in motorised collection service, the energy use and carbon impacts of informal activities are less than those of the formal sector. In Cairo where the informal sector also uses trucks, the impacts are less but still significant. In all other cities, where informal activities run on human or animal muscle traction, the informal activities create a net GHG benefit.

[59] Reduction of tonnages going to landfill may increase specific disposal costs for remaining waste, but net disposal cost savings can still be expected.

When the informal sector is excluded from solid waste management activities, there is a significant drop in total material recovered in Lima, Lusaka and Quezon City, as shown in Figure 16. Integration of the informal sector in waste management activities leads to considerable increase in the quantity of recovered material in relation to the current situation in five cities, and no change in Lima, as shown in Figure 18.

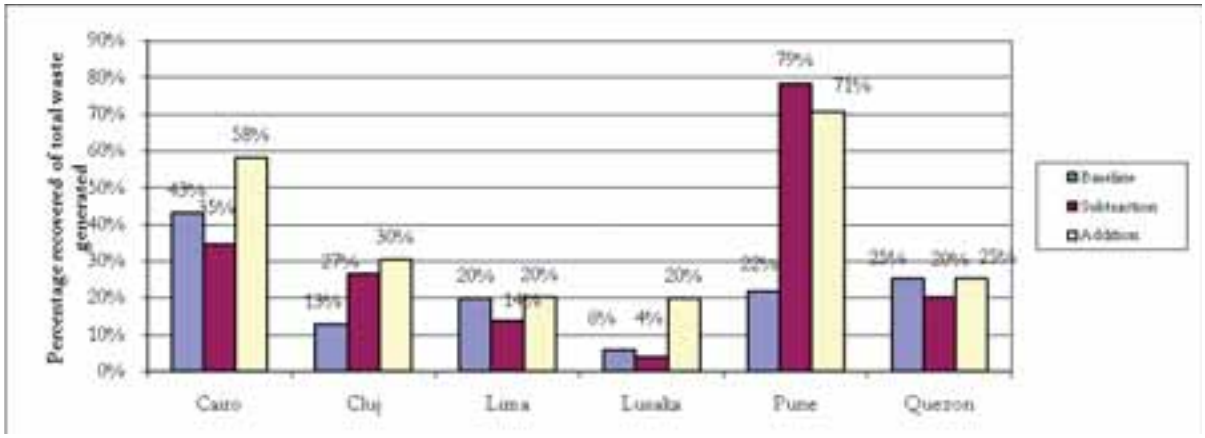


Figure 18. Comparison of total material recovery across all scenarios[60]

In the current situation the informal sector recovers more material than the formal sector, thus contributing more environmental benefits. The informal sector also works more efficiently and less energy-intensively. The analysis of the alternative futures modelled in the subtraction and integration scenarios supports the case for integration of the informal sector, as it results in increases of the quantity of recovered material in five of the six cities. However, the nature of that integration also influences the results.

While increased material recovery brings environmental benefits because of avoided GHG emissions from virgin material production, it also has a negative environmental impact coming from the use of electricity and fossil fuels in the process steps related to recovery, which includes collection, transfer, transportation, sorting, and recycling.

The integration of the informal sector in solid waste management activities, therefore, leads to more material recovery at lower environmental cost, as shown in Figure 18 and Figure 19.[61]

[60] Here and in Table 17, there are some minor inconsistencies because percentages not always add up to 100% (in the case of Cairo it adds up to 110%).

[61] The process steps are highly specific for each city, therefore, the environmental costs from energy use in all process steps are presented together, as disaggregating by process step would make comparison across. cities and sectors highly convoluted, as there is not a one-to-one correspondence of process steps either between the formal and informal sector within one city, nor across different cities.

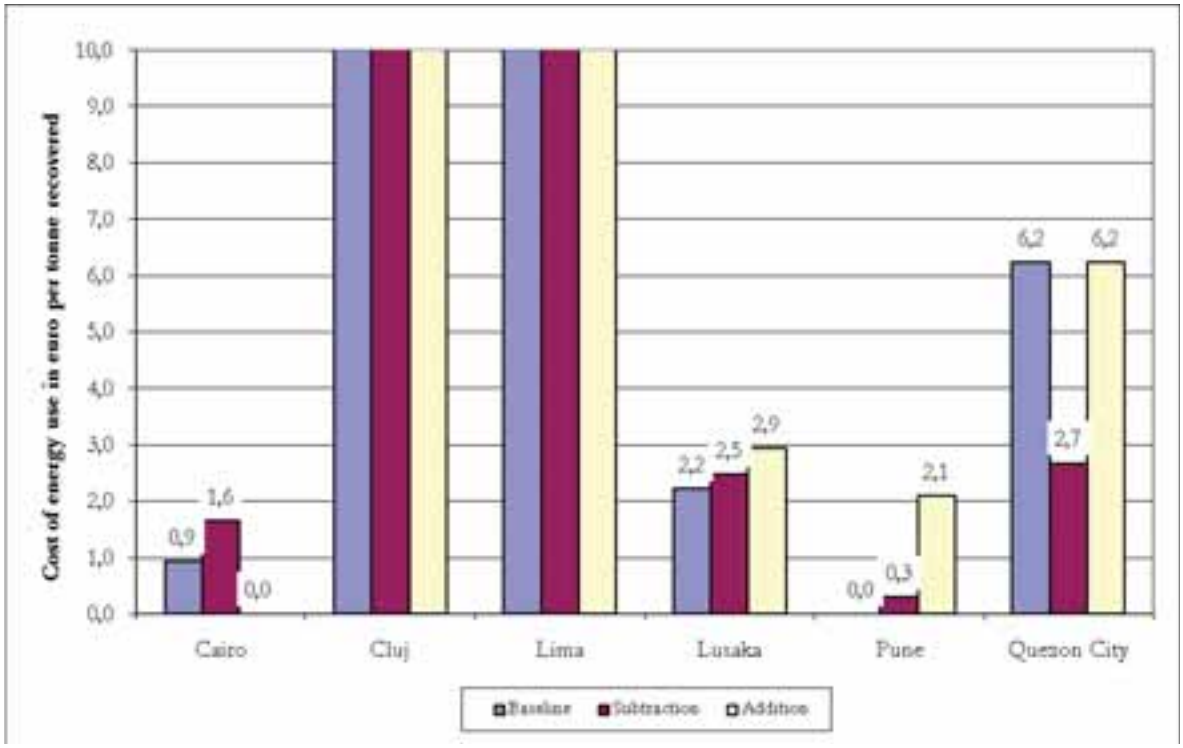


Figure 19. Comparison of total environmental costs of energy use in waste management in all scenarios in six cities in € per tonne of material recovered (1)

(1) The units for the values in this figure are euro/tonne for the environmental costs of energy use by the formal and informal sectors combined. At a cost of above €54, the costs for Cluj and Lima are "off the chart".

In most cities, the total formal and informal sector combined environmental costs in terms of energy use in the process steps are highest in the subtraction scenario, regardless of whether material recovery increases in the subtraction scenario come about due to mechanical processing by the formal sector, or decreases due to ceased activities of the informal sector. Figure 17 shows that the reason for this is that while material recovery and recycling do lead to environmental benefits due to avoided extraction effects, they also result in negative environmental effects due to energy use and related GHG emissions in the process steps involved.

Figure 20 demonstrates what happens ito the balance between recovery, disposal, and losses in the two hypotetical scenarions. In the subtraction scenario the quantity of waste going for final disposal increases with respect to the baseline in most cities, but not in Pune or Cluj, where it decreases due to significant capital investments in diverting waste from dumpsites. In the case of informal sector integration, in all six cities the fraction of waste going to final disposal is less than – or in the case of Pune equal to – the amounts disposed in the current situation or in the subtraction scenario.

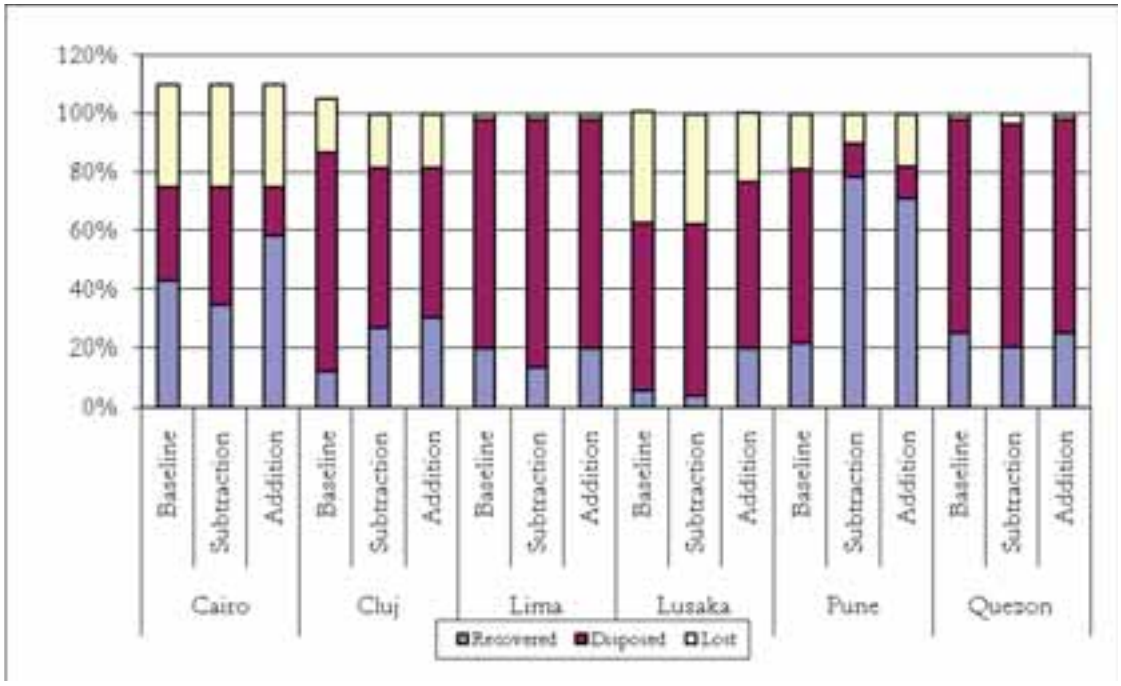


Figure 20. Destination of materials as percent of total waste handled

In addition to materials disposed either legally or illegally, there is also disposal occurring through the losses shown in the PFDs. In terms of environmental impacts, losses are important because they create emissions to air, water, and soil.[62] Losses are also a key indicator for the state of modernisation of the solid waste system and also its risks to waste pickers and the solid waste informal sector in general.

Losses occur when there is an imperfect match between the management of solid waste and the generation of the waste. In the process of modernisation, the formal authorities and their agents work to bring more and more waste under the formal management schemes. Figure 20, which shows the losses, also suggests that the most modernised of the six cities are Lima and Quezon City. This corresponds with other observations from the study: costs in these cities are in general higher than in the others, and there is the beginning of a formal recycling infrastructure. Both of these cities have taken important steps towards integration of the informal sector in formal waste management systems, and so there is not an extreme difference between the impacts in the baseline and those in the addition scenario.

When in the subtraction scenarios, the informal sector is excluded from solid waste management activities, less material is recovered and therefore more material goes to final disposal. Negative environmental impacts are highest in the subtraction scenarios, and benefits highest in the addition scenarios.

4.3 Socio-Economic Impacts Under the Hypothetical Conditions

In this section the results of the scenario modelling are presented to answer the questions: (1) what would happen if the informal sector would lose its access to the waste stream and related livelihood activities, and (2) what would be the change in socio-economic impacts to society if there were an integration of informal sector activities into formal solid waste operations and the solid waste management system?

The current real situation provides more livelihoods in the informal waste sector than in the formal waste sector in all cities except Lusaka. This situation shifts in the subtraction scenario, which models the drastic reduction of the informal sector and re-direction of the waste to the formal sector. In the addition scenario, the informal sector grows but the difference with the baseline is in many cases not very significant, and in Cluj's addition scenario there are fewer but more stable jobs.

[62] The difficulties in analysing these impacts mean that the losses are not included in the calculation of environmental impacts.

Limiting informal sector activities affects women disproportionately, as they tend to be involved in lower-status activities such as waste picking, and these are the first to be eliminated. But a more important reason for the disproportionate gender impacts of a subtraction scenario has to do with the fact that the informal sector has a higher proportion of women than the formal sector. Because much lower percentages of women work in the formal waste sector, formalisation means a high risk that (some or all) women will lose their jobs. So there is a risk that projects intended to improve conditions of the informal waste sector have adverse effects on the status and livelihoods of women, increase their workload, or lead to losing their access or being squeezed out by men, who choose the work when it involves higher incomes (Scheinberg et al., 1999). A small industries program intended to improve the livelihoods of the Zabbaleen in Cairo turned out to have negative effects on many women. The project involved the introduction of mechanised waste collection equipment, which increased the amount of waste the women had to sort so that they had to keep their children at home to help with sorting. Women had not been consulted in this upgrading program (Abdel Motaal, 1997).

The informal waste sector in Lusaka partly sells to the domestic recycling industry, but also exports 400 tonnes per month, mainly to South Africa and Zimbabwe. In other cities the informal sector is also connected to the global recycling industry through supply and sales chains. So the impacts of a restriction as modelled in the subtraction scenario create trans-boundary negative economic consequences.

In all cities under study, integrating and legitimising the informal sector can be expected to boost sales to the formal recycling industry, with the largest increase being 14-fold in Lusaka. This is because Lusaka has the smallest and least mature recycling sector, when both informal and formal sector are considered.

5 Chapter 5. Conclusions and recommendations

5.1 Conclusions

5.1.1 Economic and performance characteristics of the informal valorisation and service sectors

1. All six cities have a large and active informal valorisation sector, and a smaller informal service sector. The six cities together have a population of almost 23 million, with approximately 73,000 informal sector workers who valorise more than 3 million tonnes per year.

2. The informal waste and recycling sector in the cities is comprised of two distinct sub-sectors,
   - an informal service sector, consisting of individuals and micro enterprise informal service providers (ISPs) earning fees for removal of waste, excreta, litter, and, more broadly considered, 'dirt'.
   - An informal valorisation sector, consisting of individuals, co-operatives, and family and micro-enterprises which functions as an extractive resource industry. The main activity of this sector is identifying and removing valuable materials from the waste stream and the commons where waste accumulates, and valorising (extracting value added from) it.

3. Both the informal service sector and the informal valorisation sector, are private sector micro, small, or medium-sized enterprises. Working with the informal sector is thus a sub-activity in a private sector participation (PSP) or public-private partnership policy or strategy for cities.

4. The informal sector saves the formal authorities a great deal of money, in total €39 million in the six cities. Most of this is avoided collection costs, €14 million per year in Lima, €12 million in Cairo, and € 3.4 million in Quezon city. The average savings in avoided costs per worker is €571, which in many cities is more than that same worker earns in a year.

5. Informal valorisation businesses only extract, process, and sell those materials which have a high intrinsic value and on which they can make a profit. All informal valorisation activities along the entire value chain are profitable. The informal sector in the six cities together makes a net profit of about 130 million Euro. The large profit is able to sustain or add valuable income to sustaining about 73,000 informal sector workers.

6. By engaging in the valorisation activities, the informal sector creates environmental benefits for the municipal authorities, helping them to reach recycling targets. In all cities except Lusaka, where the informal sector is very small, the informal sector is responsible for diverting more materials from disposal than the informal sector.

7. While both formal and informal material recovery and recycling in the six cities are the source of positive environmental impacts, because they lead to avoidance of pollution and savings of primary raw materials and energy, through using secondary materials for the manufacture of new products, the informal sector is the source of more of these impacts.

8. By engaging in valorisation activities, the informal sector creates social benefits and indirect economic benefits for the municipality. Had there not been this potential source of income for this mostly unskilled, marginalized group of people that are informal sector workers, authorities would likely need to provide social assistance to them

9. Average earnings in the informal valorisation sector in Pune, Lima and Cluj, and in the informal service sector in Lusaka, are 110% to 240% above the legal minimum wage. Egypt does not have any legal minimum wage; in Quezon City they are slightly below (but the legal minimum wage is reported to often not be respected by private companies).

10. Formal selective collection ('recycling') programmes often handle materials which are not profitable,

because they are working to avoid the environmental consequences and the costs of disposal, and they get their "profit" from this benefit.

11. Informal valorisers and service providers have unpleasant and dangerous working conditions, but these are compensated by earnings which usually exceed minimum wage. The autonomy and relative freedom of the activity is sometimes also attractive.

12. Informal enterprises by definition are unregistered, which makes them vulnerable to competition and to exploitation. For this reason many of them would prefer to be recognised as formal businesses, including being willing to pay taxes, but they do not know how to make this happen.

13. The viability of informal businesses depends on their ability to identify unoccupied niches in the waste and materials chain in the city. For example, ISPs identify and exploit niches for collection in areas which are not served. They find and extract materials from disposal facilities and waste generators that are not already part of a materials cycle, and complete that cycle.

5.1.2 Technical and performance aspects of the informal sector in solid waste and valorisation in the cities

14. There are several main forms of valorisation in the informal private recycling sector, which were found in different combinations in the cities:
    - Personal or commercial reuse: Using materials for household maintenance, including as food for persons or animals, or as household, agricultural, or business inputs. Second hand shops and flea markets are examples of this.
    - Reuse with repair: Repairing items and materials and marketing them to others. This activity was identified but not examined in detail during the research for the study.
    - Recycling: collecting separately and/or identifying, sorting, processing, aggregating, storing and trading materials into the global industrial value chain,
    - Organics valorisation: collecting separately or sorting and processing kitchen, garden, restaurant, industrial and agricultural plant and animal wastes and paper, and marketing it to the local agricultural value chain as animal feed, compost, or other growth media.

15. Most forms of informal service provision relate to removing waste from households and businesses and dumping or burning it

16. There are a number of distinct informal occupations and earnings profiles, with more occupations in the valorisation and recovery sector than in services. Moreover, there are key and recognisable differences between the informal service sector and the valorisation occupations.

Service occupations tend to be paid as waged or piecework labour.

- Informal service providers are more likely to be recognised and supported by the formal solid waste authorities.
- Informal service providers (ISPs), like their formal counterparts, work for a service fee based on removal. Sometimes they also valorise some part of what they remove.
- Informal service providers see themselves as part of the waste management system, and are likely to accept or even seek integration with it.

Valorisation occupations are usually treated like other resource extraction industries and are paid by the kilo or by the item. These businesses focus on extracting materials based on what is profitable, not what is good for the environment.

- The positive externalities of informal valorisation are not considered in municipal decision-making.
- Informal valorisers, unlike their formal counterparts, are paid in trading transactions, generally by the tonne or by the kilo. They do not get a service fee.
- Informal valorisation businesses are seldom recognised or valued by the solid waste authorities, and are often blamed for stealing materials.
- Informal valorisation businesses don't necessarily see themselves as part of the waste system, but as belonging to the industrial or agricultural value chain. They are more likely to resist

integration with the formal sector.

17. Materials recycled by the informal valorisation sector are sold directly into the industrial value chain, together with those recycled by formal institutions.

18. Many more tonnes come into the value chain via informal channels in the cities, than via formal channels, recycling programmes, and other initiatives with an environmental motivation. But materials coming from informal and formal sources end up in the same value chain, and at a certain point become indistinguishable.

19. Informal organics recovery tends to supply animal feeding operations, while formal organics recovery tends to supply composting. Both are in the agricultural value chain, but serve different 'markets'. So these tonnes end up in different places.

5.1.3 Socio-economic characteristics of the informal service and valorisation sectors

20. In five cities, the informal sector provides more livelihoods than the formal sector: in Cairo five times as many, and in Cluj 10 times as many, although not all of these are full-time. That is why the percent depending on informal income in Cluj is so much lower than the other cities, which also brings the average down. Lusaka is the only city where there are more people employed or having livelihoods in the formal sector than in the informal.

21. The earning potential for individuals and/or families involved in full-time informal valorisation generally exceeds minimum wage, and almost always exceeds other individual or family livelihood options.

22. The role of informal recovery in family income and maintenance varies. Certain occupations are full-time family or individual enterprises, others are part-time, often seasonal alternatives to economic activities in agriculture or industry.

23. More women earn livelihoods in the informal waste and valorisation sectors than in similar formal occupations. In all cities, more women are involved in informal valorisation than in the formal recycling sector. No women are involved in formal collection, and few or no women are involved in informal service provision in any cities, except in street sweeping, a traditionally female occupation. Women in the valorisation sector tend to be involved at the level of family-owned junk shops or as traders of materials, or as initiators of community-based enterprises.

24. Working in informal waste services or valorisation is physical work performed under poor conditions with primarily muscle energy. These activities can compete with formal sector parallel operations because they have few or no explicit energy or labour costs, and family labour supplements the labour of the main earner.

25. Owners and workers in these businesses are subject to work-related illnesses and injuries. They seldom protect themselves, and usually do not have access to health care or hygiene – such as washing facilities, protective equipment, or health services. There is room for improvement of conditions and access to health and safety conditions, but it may affect the profitability of the enterprises.

26. Valorisation activities have two main sources of benefit for local authorities. The first is the avoided cost benefit is significant: by avoiding collection and disposal, informal workers create as much or more value for their local authorities per year as they earn themselves. The second is the carbon footprint benefit, because informal valorisation keeps materials out of disposal and has extraction, energy, and emissions benefits.

5.1.4 Carbon footprint and carbon impacts

27. The carbon benefit of recovery activities comes from avoiding disposal, using less energy, and preventing extraction of raw materials. These benefits are significant, but their monetary significance depends strongly on the capital/labour ratio and on the financial organisation of the recovery activities themselves. It is not possible to say, for example, that there is always a net carbon benefit in all cities from existing activities, nor that integrating the informal sector will produce direct or indirect financial or carbon benefits.

28. Both formal and informal recovery result in improving the carbon footprint of waste management, and therefore on reducing decomposition and methane formation in landfills. But in low- and middle-income cities, most recovery operations are completely or partially informal, so that informal valorisation is the source of many more avoided carbon emissions.

29. Informal recovery scores considerably better than formal recovery in terms of reduced fossil energy use. This is because many informal activities rely on human or animal muscle traction, rather than on motorised transport. While this is significant, there are some questions as to whether it is sustainable.

5.1.5 Comparing formal and informal systems

30. Formal recovery systems in low- and middle-income countries handle small numbers of materials at relatively high costs per ton. This is partly due to the fact that their economy of scale is small, and partly because the formal authorities are not experienced in valorisation and so are not able to market the materials to their advantage.

31. Workers in informal recycling, in particular, have a high degree of specific knowledge about identifying materials and marketing them. This is one of the main reasons for integrating them into formal recovery initiatives, because this is something they can bring to the local authorities.

32. Informal valorisation business lack organisational and general business knowledge, and are often socially disadvantaged groups with poor ability to make horizontal linkages or to organise a change in their situation. This organisational capacity is one of the main forms of support that they need from intermediaries, NGOs, unions, or the municipal authorities.

33. The fact that the sector is informal does not mean that it is unorganised. The informal valorisation sector is actually the base of the industrial value chain, and is organised to feed that value chain.

5.1.6 Impacts of the modernisation process on informal activities in valorisation and services

34. Prior to modernisation of the solid waste system, informal valorisation activities have little official relation to the solid waste system in a city, and are not seen as either benefiting nor harming it.

35. In contrast, informal removal activities, for example one-man trucks that collect in unserved areas, are seen and understood to be a part of the solid waste system and a supplement or competition to the formal waste management system.

36. Globalised standards for landfilling and waste collection push city authorities in low- and middle-income countries to build sanitary landfills, often with donor funds. This was the situation in Lusaka at the time of the study. Operating sanitary landfills, however, is beyond the financial capabilities of most cities, and so they look wherever they can for additional sources of income.

37. This financial pressure, together with globalised ideas about proper urban cleansing, push cities in low- and middle-income countries to organise recycling, mostly for the revenues they think it will earn. This often puts the cities in direct competition with informal recycling enterprises.

38. In this situation, cities can choose to work with the informal sector, the case in Lima and Quezon city, or to compete with the sector by criminalising its activity, persecuting its members, interrupting

its access, and duplicating its activities through subsidising or organising waste collection (micro-)privatisation and 'recycling programmes'. This last was happening in Cluj, Lusaka, and Cairo at the time of the study. Pune was in a kind of middle situation, where the intervention of KKPKP was facilitating co-operation rather than conflict.

39. These parallel activities are often introduced as privatisation initiatives which offer concessions or monopolies to private companies, in exchange for their ability to finance capital investment in new technologies, and professionalise operations. These formal private companies are more or less forced to occupy the niches of the informal sector, creating conflicts and either destroying livelihoods, or squeezing informals and reducing their earnings. This describes the situation in Cairo and Cluj at the time of the study, and the plans of Pune were also leading in this direction.

40. Especially in relation to recycling and composting, these newly created 'parallel' activities are expensive, inefficient, and recover rather small amounts of materials. All of the cities showed more tonnes recovered through informal channels than through new or upcoming formal ones.

41. Formalising the informal removal service activities – alone or in combination with a valorisation component -- is easier, faster, and more likely to succeed than formalising the valorisation activities, in part because the structure of informal service businesses is quite comparable to that of formal collection businesses and municipal cleansing services. Elements of the policy landscape in Lusaka, Lima, and Quezon demonstrate this.

42. The passage of a solid waste law that defines the policy landscape of modernisation sets the boundary conditions that determine whether the relationship between informals and cities will be one of co-operation or conflict. Quezon City is the clearest example of a solid waste law that promotes integration, Cluj the clearest example of a policy and legal environment that criminalises and prohibits it. Lima. Lusaka, and Pune have new laws that could push the situation in either direction, and in Cairo the privatisation initiative – based in national rather than local law and policy – creates a different kind of conflict between informal and formal private enterprises.

5.2 General Recommendations for policy and practice

The information from the six cities offers us many ideas about how to improve performance and equitability of waste management policies, to optimise both the performance of the system and the returns to the informal sector entrepreneurs. Certain occupations are full-time family or individual enterprises, others are part-time, often seasonal alternatives to economic activities in agriculture or industry. It is clear that those working in informal recycling, in particular, have a high degree of specific knowledge about identifying materials and marketing them. They have much less general business knowledge, and are often socially disadvantaged groups. Because the role of informal recovery in family income and maintenance varies, interventions or policy changes need to be highly specific.
The recommendations are divided into recommendations for policy at city level, recommendations for practice and implementation, and recommendations for improvement and application of the action research methodologies used in this study.

5.2.1 General recommendations for local authorities

Investigate and track the performance and impact of the existing informal valorisation and service sectors: Understanding the sector is only possible if there is data. It is important to include the economic and technical performance of these sectors – together with their socio-economic profile – in annual reports, reviews, and as the baseline for planning. Once the amount of valorisation that is happening is recorded, it is easier to track whether the modernisation process actually results in increased levels of valorisation, or merely a shift of the tonnes from the informal to the formal and at what cost.

If it ain't broke, don't fix it: This English proverb highlights that it is better to build on what is working, than abandon or destroy it in favour of something unknown that might or might not work. This is directly related to both informal service provision and informal valorisation. Both are key activities which improve the environmental and economic performance of the city's waste sector. Well-founded changes

or plans are improved when they take these activities into account.

DO fix what doesn't work: Not every aspect of the informal sector is ideal, and problems need to be recognised, and confronted. The highest on the list are: the health and safety conditions; the transaction costs in terms of harassment, bribery, and the effects of criminalisation; the involvement of children; the lack of available shelter, hygiene, and social and health protections; and, perhaps the most critical, the lack of occupational recognition. These problems must be fixed, or improved, but informals themselves are key actors in this process. Often, it requires facilitation, leadership, inter-agency co-operation and an inter-disciplinary team to find solutions. And above it all, there is a need for political will to improve the situation in a win-win way.

Build structures that link the formal and the informal: It is essential for local authorities to create structural relationships between the solid waste system and the formal and informal valorisation sector. Prior to modernisation of the solid waste system, informal valorisation activities have little official relation to the solid waste system in a city, and are not seen as either benefiting or harming it. In OECD countries that went through modernisation 20 years ago, the practical way of doing this was to appoint a "recycling coordinator" whose job was to be the liaison with the informal and formal private recycling sector on the one hand, and to improve the municipality's understanding of the value chains, and critical technical and logistic issues.

Use existing activities and structures in removal service as models for linking informal and formal sectors in recycling. The structures in which they work provide models of good practice for new relationships between formal and informal sector. These kinds of models much valuable as the basis for valorisation activities.

Affordable technologies are the most practical and sustainable: The study shows that expensive technologies create backward institutional and systemic linkages that drive out the informal sector in order to pay for themselves. It is therefore key to moderate technical ambitions for new disposal and processing technology, so as to keep them affordable in the short- and middle- term. It is the influence of globalised standards for landfilling and waste collection, and globalised ideas about proper urban cleansing, that push cities to eliminate informal valorisation. With less pressure to recover rapidly increasing costs, there is more time for "slow modernisation" that works with the informal sector.

Assess and include your local resources and take them with you into the future: explicitly include the informal sector in new policies and regulations because it represents a set of local resources in waste management. Inclusive policies and rules create the boundary conditions that facilitate a relationship of co-operation and mutual respect and understanding between informals and cities. Along with this, reporting and planning requirements that focus on analysing and counting existing activities have the effect of institutionalising the benefits of avoided disposal, and setting the stage for new initiatives that improve the environment and the economy still further.

5.3 Specific Policies and Policy Recommendations

5.3.1 Improving waste collection practice

Light Regulation: Create a portfolio of low-threshold formalisation measures, which combine regulation with facilitation of improvements, and documentation of results. Light regulation can provide the city with key data and points of influence, without requiring things that informals may not have, like a street address or an identity card or a bank account. Light regulation is about making things possible, not prohibiting them. It involves creating instruments, policies, or institutional contact points that are able to work with informals to modify or improve their activities. By "light regulation" we mean highly targeted but minimalist intervention that specifically addresses what needs fixing, without changing the structure or functioning of traditional rights and practices.

Some Examples of light regulation:
(a) The "Dar es Salaam model" of zonal micro-privatisation of Informal Service Providers (ISP)s through a light tendering process is an effective strategy that allows a city to supplement and broaden the municipal collection service and protect public health, while keeping it affordable for the lower-income and peri-urban areas and informal settlements, areas which frequently receive low or no municipal services.
(b) The "Linis Ganda" model, which authorises an NGO or union to issue identity cards for its members that give them access to areas which have high generation of valuable recyclables.
(c) "The Lusaka model." Allow documented informal sector entrepreneurs, such as the unregistered collectors in Lusaka, to dispose of their residues (or collected wastes) in formal skips or controlled disposal facilities, and so they can stop illegal dumping of the collected wastes, a source of environmental problems.
(d) Treat informal services as a system, not as fragmented individual activities, and strengthen horizontal linkages and communication. For example, in some cities there is a need to normalise and lightly regulate the tariffs and agreements between households and collection enterprises to increase payment rates and avoid rent-seeking behaviour. Micro-franchising and the use of micro-credit is one strategy for doing this, as most ISPs make a healthy profit and can afford to borrow money for better equipment.
(e) The "Swatch model" creates instruments that reduce improve working conditions and reduce transaction costs for individual informal entrepreneurs, while improving overall quality. This Pune approach involves creating micro collection + recycling zones for pairs of informals. In Pune, the city provides health insurance, and the union has designed a wet-dry source separation protocol. The system is based in a minimal form of mini-contract, and a standard for calculating service tariffs. There is standard model for wet-dry collection. Service fees are paid directly by the households to a service provider whom they know personally, and the service provider also has the right to valorise both the dry recyclables and the organic waste.
(f) "Lima model" also combines service and valorisation by providing tricycles or push-carts for larger informal groups in middle-class areas, are variations on this theme. In Lima, uniforms, gloves, and transport equipment are provided, and the informals have the rights to the materials.
(g) The "Quezon model" is a model of organised acceptance of informal activities, and comes out in two ways. First, truck pickers are formal workers who are authorised to pick and valorise materials. In return for this right, they accept a sub-minimum wage salary which lowers city and Barangay (village) budgets for solid waste. In a similar way, informal junk shops can receive an authorisation to function as materials recovery facilities (MRFs). This semi-formal status channels formal recovery activities to the private recycling business, and both the city and the junk shop benefit.
(h) The "Columbia model," developed in Latin America, is applicable to the situation in Cairo, where large formal enterprises, as part of a tendering procedure, agree to make transparent agreements with existing informals – or cooperatives or unions that represent them -- for services or niches which the larger companies cannot or do not wish to provide themselves
(i) the "Batangas Bay Model," where a small donor-funded project supported informal waste pickers and junk shops to form a selling co-operative, to be able to enter the supply chain at a higher and more favourable level.

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5.3.2 Optimising municipal recycling and increasing valorisation in low- and middle-income countries

Measure it, manage it: Making a baseline assessment is the most important recommendation for improvement of policy and practice. Unlike ISPs, informal valorisation businesses are usually doing something that the municipality does not understand and is not obvious to the untrained eye. Seeing, understanding, and measuring informal valorisation activities is important because provides a basis on which to build recycling activities and meet national or international recovery goals. If the baseline shows convincingly (and not merely by assuming) that there is no recovery happening, there is full scope for municipal innovation. Thorough market and value chain research is also advisable to avoid collecting recyclables for which there is no market.

Chose interventions carefully: Once the valorization is measured, there will be one of two scenarios.
Scenario 1, where there are robust levels of recovery already occurring, the supply chain is working. If it is the case, the resource recovery goals may already be met, and just need to be documented. In this situation, municipal (or NGO) activities to 'set up' recycling are likely to disturb existing supply relationships. Either the supply relationships will 'win' and the municipal programme will be ineffective, or the municipal programme will 'win' and many poor people will lose their livelihoods. Thus municipal competition is a 'lose-lose' proposition.

Scenario 2, where a careful investigation finds little or no informal valorisation activity, the supply chain is weak or missing, or there are geographic or demographic reasons for no valorisation. (This is typical of

small or regional cities, which lack access to a shipping, rail, or road transportation system). In this scenario, contacts and consultation with informal entrepreneurs can result in legitimising and building on existing efforts or supporting informals to diversify their business models. This is a 'win-win' policy approach to increasing recycling. The municipality – often in combination with NGOs, can organise sourcing, horizontal linkages, and certain kinds of social and political protections that the informal sector cannot usually manage on their own. With some organisational help, recovery rates can rise and the working conditions of the informal sector can improve.

The importance of a baseline
In this, making a baseline assessment is the most important recommendation for improvement of policy and practice. A baseline needs to analyse stakeholders and the physical system first, via the movement of materials. It should also consider economic, social, technical, institutional, financial, and environmental aspects of what is currently happening. This gives reliable points of entry for designing an improvement strategy, making a plan, and implementing it.
In the cities, the baseline shows us that there is a scenario 1 situation in Cluj, in the EcoRom collection which competes with the informals and in Cairo, where an international privatisation makes traditional collection and valorisation activities illegal, but still depends on the informal entrepreneurs to 'rescue' inefficiencies in the formal system.
The baseline also shows that there is little or no valorisation in Lusaka, where the recycling operation is among the most expensive in any of the cities; here some facilitation could be helpful.
The baselines for the cities have been a key factor in understanding the relationships between different parts of the system: formal and informal, private and public, valorisation and service. But above all they have shown that all parts are part of one system, and that interventions designed for one specific part usually affect all other parts as well.

5.3.3 Improving the carbon footprint of waste management and recycling

Waste and carbon emissions are closely related, and improved waste management can reduce a municipality's carbon emissions. This can be done not only by large technologies and upgrading infrastructure, but in many other ways, specific to the city.

Reduce fossil energy use: Net fossil energy can be reduced by more efficient use of fuel or electricity, for example, designing sorting systems to make better use of gravity, or doing a time and motion study to optimise collection efficiency.

Furthermore, informal recovery scores considerably better than formal recovery in terms of low or no fossil energy use. This is because many informal activities rely on human or animal muscle traction, rather than on motorised transport. While this is significant, there are some questions as to whether it is sustainable. Supporting the design and procurement of low-energy and small-scale collection, transfer, processing and disposal systems is a helpful input.

Use the comparative carbon advantage of the informal sector: This study makes it clear that the informal valorisation sector is more active and more effective than the formal one. In low- and middle-income cities, most recovery operations are completely or partially informal, and many more tonnes pass through the informal valorisation systems than are counted in formal recovery statistics. This makes the informal sector a source of considerably smaller carbon footprint, even though informal and formal recovery have the same impact per tonne on reducing the carbon footprint or resource management and on reducing decomposition and methane formation in landfills.

Combine the comparatively high experience and competence of informal recyclers with support in areas where they are weak: Because of their long dependence on the industrial value chain, informal entrepreneurs are experienced with valorisation, and can relatively easily learn to divert and process whatever material is not already claimed and valorised. In contrast, a lifetime of social exclusion and generally low levels of formal education mean that informals can use support in relation to commercialisation, to communicative and social skills, and to the analytic aspects of valorisation. For example, many informal entrepreneurs need support in order to organise new market relationships or longer-distance logistics, or to improve the

efficiency and scale of collection and processing systems.

Facilitating improved informal access to valorise materials, or and legitimising informal activities, increases recovery and valorisation effectiveness, which in turn decreases the need for raw material extraction, reduces emissions of carbon and supports the environment by raising the amount of materials that are recovered. The integration of the informal entrepreneurs into municipal waste management raises the level of recovery and improves livelihoods.

Enable scaling up existing organic waste handling: In low- and middle-income countries, there is usually substantial re-directing of organic waste to animal feeding, composting, or land-spreading and other uses. This reduces the generation of methane, which has a direct impact on reducing methane formation and eliminating greenhouse emissions. New plans for diversion and/or valorisation need to take existing claims and practices into account. That being said, special attention should be paid to open markets, food and beverage producers, and agricultural, silvacultural and horticultural businesses not only as generators of organics, but as potential users of valorised organic waste as well. Here again, the involvement of formal authorities in facilitating increased "market development" for compost and animal feed is a win-win situation.

Develop Carbon Financing Projects: Carbon financing is already a reality for co-financing the first of the three carbon footprint reductions strategies: limiting fossil energy use, and avoiding methane formation, can already earn emissions reductions credits. There is also hope for carbon financing to reduce extraction impacts, but the only methodology, for plastics recycling, is still in development. Only one recycling methodology exists: for plastics recycling, but no credits have yet been issued.

Carbon financing could thus become an instrument supporting integration of the informal valorisation sector, but only if municipal and national authorities, and multi-lateral institutions, invest in developing it further.

5.4 Reflections on Methodologies and Strategies to Support Policy

The action research in the cities, combined with the synergies of working with local experts in six cities on five continents, has proved to be a powerful way of exploring the informal sector, which by definition is under-documented and difficult to analyse. Basing a systems analysis on materials balances, process flows, and system modelling, while it has been used in solid waste technology assessments, has never to our knowledge been applied to situations in the South relating to the informal sector. It allows for considerable depth, but it does not solve all problems. Some of the specific lessons learned are discussed below.

- Modelling based on process flows and materials balances is accessible to solid waste or other sectoral specialists with a moderate level of excel competence. Without exception, all six city partner organisations were able to follow the guidance document, create materials balances and process flows, and use these as the basis for cost modelling using the Microsoft Excel software. The project management team then performed the impacts analysis calculations, for reasons of time and budget. This methodology has proven to be accessible and successful. Still, it can be further developed and simplified to be suitable for rapid and broad dissemination, and to reduce the amount of time necessary to model a city.
- Splitting the solid waste system into a formal and an informal sector represents a methodological necessity in order to answer the research question about the informal sector "disappearing", but it creates some specific analytic problems. In the addition or integration scenario, the first approach of several of the cities was to move the informal sector people to the formal sector when their work and materials moved there or became recognised. While this is intuitively correct, it creates a methodological dilemma, because the socio-economic analysis focuses only or primarily on the informal sector. So moving the people makes them disappear from the analysis altogether. To solve the methodological problem, the backstopping team gave new guidance to the cities to "keep" the (previous) informal sector as informal in their analysis.
- Even more interesting is to reflect on the nature of "integration" of the informal sector. In most of

the cities, "integration" does not mean absorption. The types of integration proposed by the city teams generally involve something other than giving informal sector actors a regular job. "Integration" means something like creating a special status and some kind of collective arrangements for organising and financing the work of informal sector enterprises, families, and individuals. This could be, for example, a co-operative, an NGO, a project, a person or group with a liaison function, or a private company created by some members of the sector. The central idea, as expressed by the city partner from Cluj, is that the formal sector doesn't want to be responsible for the performance of "people like" the ones in the informal sector. This is only one of the many cases in which a methodological dilemma led directly to a substantive insight: what started out as a discussion about how to keep "integrated" informal sector workers from disappearing from the analysis became a set of substantive insights on the nature of integration.

- There is a methodological gap in relation to analysing the collective environmental impacts of micro and small recycling operations, particularly those that are based entirely on manual labour.
- In the current study, it would have been useful to be able to take the materials balance a step further out, and, since it is possible to derive reasonably accurate estimates of the composition of material inputs to the micro and small (or larger) recycling operations, to calculate their environmental footprint and integrate this information into the environmental impact analysis. This would have most likely have reduced the positive impact environmental impacts of increased recovery, but would probably not have had enough of an effect to change the sign of the impacts[63].

[63] The 1988 Tellus Packaging Study (Stockholm Environmental Institute 1988) makes a strong case, based on comprehensive, Life Cycle Analysis-based investigation of a number of different types of packages, the order of magnitude of extraction impacts is – in almost all cases -- significantly higher than that of impacts associated with the processes of waste materials handling and recyclable collection and processing. Moreover, the local impacts of local solid waste management and recycling activities and are not transferable in global terms. Follow up work on Advanced Disposal fees done for California (USA) Integrated Waste Management Board (CIWMB) built upon the packaging study work to look at a tax mechanism to incorporate some of these externalities at the State level. However, this initiative, and a parallel one in Florida (USA) both failed due to issues of import from outside of the particular state. In other words, the extraction and production impacts may not necessarily be realised within the same community, region or even country; this has also been a key barrier to including local impacts in the present study. By looking only those pollutant externalities that impact global systems, such as extraction and energy effects, and GHG and Ozone depleting chemicals and to a lesser degree ocean pollution, it is possible to think about the global context for the associated costs and benefits.

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 agrees to use. Wherever possible these are drawn from standard English-language use in the UK and in the USA.

Term	Other Terms or Abbreviations Used	Working Definition	Source Of Definition
Activities at source	prevention, reuse, backyard burning, source reduction	in this study this are waste management activities of households and household-related personnel such as burning, burying, feeding waste to animals, segregation, reuse for own consumption	project team (PT)
Addition scenario	integration scenario	the hypothetical model of what would happen to a city's waste management system if there was a commitment to "integration."	PT
Addition workbook, addition scenario		the excel workbook based on the enhancement or integration of informal activity in the formal solid waste system, as represented in the process flow and materials balance of hypothetical changes in waste + valorisation system in place in 2006 in each of the cities	PT
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	PT
Avoided costs		the costs associated with formal obligations of the public authority to manage wastes, that are made unnecessary by informal valorisation activity. These are modelled as reducing the number of materials that flow through the main or default waste management path.	PT
Baseline, baseline workbook		the excel workbook based on the process flow (PFD) and materials balance (MB) of the waste + valorisation system in place in 2006 in each of the cities	PT
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	PT
Capital cost	investment cost, capital, purchase cost	the amount it costs to purchase new equipment, facilities, space, buildings, etc	PT
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	PT
Cbo	community-based organisation grassroot organisation	a group organised to provide a solid waste function or service in a community, often fully or partially staffed by volunteers	PT
Characterisation study **Waste audit**	composition study	describing the components of a particular waste stream, results in a list of materials and their percentage occurrence	PT
Coefficient	ratio, parameter	a mathematical relationship that describes part of the waste system, such as kg per waste picker per day	PT
Collection coverage	coverage, effectiveness	the percent of the total (household and commercial) waste generating points that have regular waste collection or removal	PT
Collection efficiency	efficiency, collection coefficient	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	PT
Commercial waste	business waste, shop waste, small quantity generator waste	waste which comes from shops, services, and other generators which are neither residential nor industrial. sometimes includes institutional or public sector waste.	PT

Community	barrio, barangay district	a grouping within a city, it may be as small as a group of neighbours or as large as a sub-municipal division which may or may not have formal governance functions	PT
Composition	characterisation physical composition	see characterisation	PT
Composting	treatment, organic waste management	the aerobic decomposition of materials from living organisms under controlled conditions and in the presence of oxygen	PT
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.	PT
Controlled landfill	sanitary landfill	an engineered method of disposing of solid wastes on land, in which the waste is compacted and covered every day. a controlled landfill is not sealed from below and does not have leachate collection system. Specifically having controlled access at the point of entry, and usually, a weigh-bridge	PT
Co-operative	co-op, buyers association, sellers association	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.	PT, Rivas, Price And Lardinois 1998.
Cost per ton, cost per input ton		the cost for a process step, or for a whole subsystem, divided by the number of tonnes that enter that step. Note that for many steps, input tonnes are not equivalent to output tonnes.	PT
Costs, net costs		pro-forma modelling of typical costs for a PFD step. When the step models valorisation, both purchase and sale of materials are included in the calculation. Revenues for services paid by one party to another party are not included.	PT
Coverage	collection rate	see collection coverage	
Depot	deposit, drop-off, community collection point, community container	a container, site, or facility designed to receive waste materials and/or separated recyclables directly from the generator.	PT
Disposal	discharge, dumping, throwing away	discharge of waste in a place designed to be its permanent resting place	PT
Disposal site	dumpsite, dump, depot	the site where solid wastes are deposited on land without precautions regarding human health or environment.	PT
Disposal-illegal	wild dump, illegal dump	disposal of waste at a site different from one officially designated by the municipal authorities	PT
Disposal-legal	controlled dump-site, landfill	disposal of waste at a site designated by the municipal authorities	PT
Dry waste	recyclables, packaging inorganic waste	what is left when organics are separated at source. alternatively, a way of describing a fraction that is to be further sorted into its components	PT
Dump picker	scavenger, waste picker	woman, man, child or family who extracts recyclable materials from disposal sites, often living on or near them.	Adapted from Koeberlin, 2003
Dumpster	container, skip	a vessel to contain waste, usually larger than 1 m3 and used for more than one household	PT
Effectiveness	coverage	see coverage	PT
Efficiency	collection efficiency	see efficiency	PT
Environmental costs. Carbon		costs of emissions, energy use, and extraction of raw materials, if they can be expressed in terms of tonnes of	PT

footprint		CO2 equivalent	
Extrapolate	estimate, model	apply coefficients or ratios from one area or set of data to another	PT
Ferrous metals	iron, steel	metals which contain iron and which react to a magnet and are subject to rusting	Tchoba-noglous Et Al., 1993, PT
Formal sector	official, government	in the study, used to mean the official solid waste authorities and the activities they sponsor and operate. See above, Annex 1.	PT
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 and/or recognised by the formal local authorities or their agents., usually through contracts, licenses or concessions	PT
Generator	waste producer, household	the source of the waste, that is, the first point it becomes waste	PT
Household container	garbage can, waste can, waste bin, dustbin, bin	the vessel used by a household or commercial generator to store and set out the waste materials, usually made of metal, plastic, rubber, or a basket	PT
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	PT
Incineration	burning, combustion	controlled process by which solid, liquid or gaseous combustible wastes are burned and changed into gases.	Tchobano glous Et Al., 1993
Inert material	fines dust sand and gracelgravel	the fraction of solid waste which does not burn and also does not decompose: ash, dust, gravel, grit, etc.	PT, (Koeberlei n, 2003).
Informal sector	waste pickers, rag pickers, scavengers, junkshops	individuals or businesses who are involved in waste activities but are not recognised by the formal solid waste authorities, or who operate in violation of or in competition with formal authorities.	PT
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.	PT
Input	data, assumptions	the quantitative values that are the basis for modelling	PT
Integration (see special section below)	addition	Furedy has made a list of interpretations of the term integration. Although it is probably not complete, it is quite concise. She refers to integration as:	Furedy, 1999
Itinerant waste buyer	iwb	woman, man, child, family or enterprise that purchases source separated waste materials from households, shops or institutions, usually focusing on one specific material or type of materials	adapted from Koeberlin, 2003, PT
Jumpers	crew, collectors	helpers in the collection vehicle that segregate recyclables during collection	PT
Labour costs		costs paid for labour or as a fee which is a proxy for labour. Where there are informal process steps that do not show a labour cost, the labour costs have been shadow priced. See section on shadow pricing, below.	PT
Landfill	dump, dumpsite relleno sanitario	"the engineered deposit of waste onto and into land"…	Skitt 1992
Mass balance	process flow diagram, materials flow diagram, chain analysis	a visual schematic representation of the movement of materials through the entire waste system or only the formal or informal waste system, which indicates the weight of each fraction at each stage	PT
MRF	materials recovery	an industrial facility of moderate scale that is	PT

materials Recovery Facility	facility, intermediate processing centre (ipc), intermediate processing facility (ipf)) recycling processing centre	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, color, etc.	
MSE	micro and small enterprise. micro-enterprise, junkshops, materials recovery facility	the smallest businesses, smaller than SMEs, usually having less than 10 workers	Arroyo, Rivas and Lardinois, PT
Municipality	local government authority, mayor's house, mayoralty, city, town, village	a unit of local government with its own level of governance, responsibility, and representation	PT
Net cost, net benefit	cost, benefit, profit margin	the positive or negative value of something after all costs or benefits have been calculated	PT
Net income	net revenue	the positive or negative amount earned by an individual or business after all costs have been paid out	PT
Non-ferrous metals	coloured metals semi-precious metals aluminium, copper, bronze, lead	metals that do not contain iron and are not magnetic for example copper, aluminium, brass, bronze., silver, nickel	PT
O&M cost	operating and maintenance cost, operating cost	costs associated with ongoing operations, such as energy, supplies, labour, rents, etc.	PT
Opportunity cost		the imputed or estimated loss associated with making a choice for *a* and not choosing *b*	PT
Organic waste	bio-waste, green waste, wet waste, organics, putrescibles, compostables, food waste	the decomposable fraction of domestic and commercial wastes, includes kitchen and garden wastes, sometimes includes animal products	PT
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	PT
Output	results, answers, coefficients	the quantitative values that are the results of a modelling exercise	PT
Pig slops	swill, organic waste	Food wastes collected from the households and commercial sectors which are either sold or used as food for pigs	PT
Pre-processing	sorting, screening, sieving, compaction, densification, size reduction, washing, drying	preparing waste materials for subsequent processing without adding significant value to them	adapted from Koeberlin, 2003
Primary collection	pre-collection, house-to-house collection	organised collection of domestic waste from households, taken to a small transfer station	PT
Process flow diagram	pdf, materials flow, chain analysis	a visual schematic representation of the movement of materials through the entire waste system, which DOES NOT indicate the weight of each fraction at each stage	PT
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	PT
Recovery rate	capture rate	a percent relationship between the amount of recoverable materials that reach recycling,	PT

		composting or energy recovery and the total amount generated	
Recyclables	recoverables	for purposes of the study, 14 types of materials which have a value to the users and may also have a price.	PT
Recyclers	scavengers, waste pickers, mrfs, junkshops	Entrepreneurs involved in recycling	
Recycling		processing and transformation of waste materials to be used for products that may or may not be similar to the original	adapted from Tchobanoglous Et Al., 1993
Recycling or composting market	end-user industry, buyer, dealer, broker	a 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.	PT
Replacement (capital) cost	value, insurance value	the amount it would cost to purchase a replacement for a piece of equipment or a vehicle; in this study this is not necessarily the cost of a new one, but the cost of replacement in the way that replacement is most likely, such as purchasing second-hand or rebuilding	PT
Residual waste	rest-waste, rest-fraction, residue, rejected	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	adapted from Koeberlein, 2003 And PT
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.	Tchobanoglous Et Al., 1993
Reuse	second hand use	use of waste materials or discarded products in the same form without significant transformation	adapted from Koeberlin, 2003
Sample	sub-set	a representative part of a whole that allows conclusions to be made about the whole by investigating only a small part	PT
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 is collected, and there is gate control and a weigh-bridge	Skitt, PT
Sanitation	solid waste, urban cleansing	in the "french sense" used to refer to urban environmental activities including solid waste management.	PT
Scenario		a projection of a hypothetical future situation for the solid waste system of each city	PT
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.	PT
Separate collection	segregated collection, collection of recyclables, organics collection, selective collection	collection of different types of materials at a different time, in a different container or vehicle, or in another way so as to maintain the separation and maximise the recovery.	PT
Separation at source	segregation at source	actions taken by a household to keep certain materials separate from others	PT
Shadow price	proxy price, hedonic price, contingent valuation	a reasonable estimate for the price of something based on extrapolating the price for something similar	PT

SME	small and medium-sized business, small business	businesses usually having between 11 and 50 employees or workers	PT
Socio-economic costs		costs associated with impacts to individuals or family units	PT
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.	Tchonabo glous Et Al., 1993, PT
Sorting	classification, high-grading, selection	separating mixed materials into single-material components, mechanically or manually. In some cases classifying a mixed single-material stream into specific grades or types of that material	PT
Source	generator, origin	the point at which a material is defined as waste and discarded. usually either a house or a business	PT
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	Tchobano glous Et Al., 1993 and PT
Street picker	street scavenger, waste picker	woman, man, child or family who removes recyclable materials from dumpsters, streets and public places	adapted from Koeberlin, 2003
Subtraction		the hypothetical model of what would happen to a city's waste management system if the informal sector disappeared or was denied access to the waste stream or prohibited from their current activities.	PT
Subtraction workbook, subtraction scenario		the excel workbook based on the removal or reduction of informal activity, as represented in the process flow and materials balance of hypothetical changes in waste + valorisation system in place in 2006 in each of the cities	PT
Tipping fee	dump fee, tip fee	the amount that is charged for disposing of waste at a facility, usually per ton, per cubic metre, or per vehicle	PT
Transfer	transit, collection point, depot	the movement of wastes from their first point of dumping to final disposal; it usually includes some very basic processing: compaction, pre-sorting or size reduction.	PT
Transfer station	transit point	a place where waste from collection vehicles is assembled before being transported to disposal sites or treatment stations.	Skitt
Treatment	decontamination, processing, composting	manual or mechanical operations to make discarded or disposed materials or mixed waste less dangerous or to improve the physical characteristics so it is easier to incinerate or landfill. In some locations also used to mean conserving value added.	PT
Valorisation	recycling, recovery, conserving value added	recovery of materials separated from or extracted from the waste stream because of their retained value. Valorisation involves commercial transactions, recovery can also be without payment as long as there is some transaction that recognises the value of what is traded	PT
Waste audit	waste assessment, walk-through	a visit to a factory, office, or institution for the purpose of inventorying and analysing the ways in which waste is generated, handled, managed, and removed.	PT
Waste dealer	junkshop owner, scrap trader, consolidator, owner of a godown, waste buyer	Individual or business purchasing materials for recycling or composting, storing them, upgrading or processing them, and then reselling the por who trades in recyclables and uses a dedicated storage place	PT
Waste pickers	scavenger, rag picker	Person who salvages recyclable materials from streets, public places or disposal sites	adapted from Koeberlin,

			2003
Weigh bridge	scale, wheel scale, truck balance	a facility for weighing trucks and producing weight slips	PT
Wet waste	organic waste, green waste, organics	Used both for the physically wet part of the waste stream and to describe compostable waste separated at source from dry or recyclable waste	PT

Integration, cont'd

- Recognizing the dignity of pickers as people and their need for work; tolerating their activities and reducing official harassment of them;
- Giving social assistance to picker families; educating picker children so they can do other work;
- Allowing pickers access to windrow compost facilities, in order to reduce the amounts of non-organics in the waste;
- Employing pickers at recovery facilities, including those at dump sites, to work on conveyer belts;
- Legalizing picking; requiring the registration of pickers; subjecting them to regulations and laws;
- Allowing, encouraging or organizing co-operatives or small enterprises of former pickers; allowing these to negotiate access to wastes either for waste trading, or a combination of primary waste collection services and waste trading;
- Providing job security and special protection to waste pickers; intervening in prices for recyclables to guarantee a basic living wage for pickers.

Annex 2. Annotated Bibliography And References

Ahmed, S.A. and Ali, S.M. (2004) *Partnerships in Solid Waste Management in developing countries – linking theories to realities*, article in Habitat International, Vol. 28, Issue 3, pp. 467-480

Abstract
In the light of three theories (two sociological, one economic), this paper analyses the possibilities for public/private partnership using the example of SWM as a sub-sector. The paper concludes that partnerships will not be effective and sustainable unless proper incentives for both sectors are built into the design.

Ali, S.M. (2004*) Single service – double benefit: The Sweepers of Karachi*, article published in *Small Enterprise Development: An International Journal*, Vol. 15, Issue 2, pp. 43-48

Abstract
In this paper it is stated that the poor in Karachi get double benefits when waste is collected by street sweepers: as service recipients and as service providers. This article proposes how such work could be recognized by and integrated into the future strategies of public–private partnerships. Perspective: socio-economic.

Ali, S.M. (1999), *The Informal Sector: What is it worth?*, article published in Waterlines, Vol. 17, Issue 3, pp. 10-11

Abstract
Just how important are informal recycling and primary collection activities - not only for improved solid waste management, but also for social development in the South?

Ali, S.M. (1996), *Integration of the official and private informal practices in solid waste management*, Loughborough University, Loughborough

Abstract
This publication intends to examine the potential of private informal practices in solid waste management through a multiple case study approach. Constraints, attitudes, relationships, and dependencies in the context of integration are studied. The author recommends that future model designs should incorporate the private informal sector.

Ali, S.M. (1994), *Integration of formal and informal activities in solid waste management, A case study of Karachi Administration Women Welfare Society (KAWWS)*, Karachi, WEDC Loughborough University of Technology, Loughborough

Abstract
This case study aims at understanding the role of the informal private activities in the solid waste management system, and to see how they can be integrated within the formal system to benefit it. The study has identified three dominant activities: separation of recyclable components from waste by households, selling it to Itinerant Waste Buyers; separation of recyclable materials from waste on streets and transfer points by street- and dump-pickers; and collection of waste from the houses by private and municipal sweepers against a regular payment from households.

Ali, S.M. and Ali, I. (1993), *Solid waste recycling through informal sector in developing countries*, Institute of Environmental Engineering and Research, *Journal Of Resource Management And Technology*, vol. 21, no. 2, June

Abstract
The separation, processing and recycling practices of solid waste management through informal sector have been investigated through field surveys, interviews and testing. It has been found that a large-scale reuse and recycling practices of solid waste are in operation in Karachi mostly through disorganized and unknown informal sector. This sector is playing a vital role in the reduction of solid waste quantities, in providing employment, in production of cheap raw

materials, conserving energy and indirectly preserving ecological systems. It is recommended that there is now a great need to recognize, support and strengthen this sector to manage unmanageable problem of solid waste management in developing countries. Perspective: socio-economic

Arroyo, J., Rivas, F. and Lardinois, I. (eds.) (1998), *Solid waste management in Latin America - the case of small and micro-enterprises and cooperatives*, WASTE, Gouda

Aziz, H. (2004), *Improving the livelihood of child waste pickers: experiences with the 'zabbaleen' in Cairo, Egypt*, An evaluative field study for WASTE, Gouda

Abstract
This report describes the outcome of the evaluative field study on child labour and scavenging in Egypt. It is part of a Thematic Evaluation on child labour and scavenging commissioned by the ILO/IPEC. The purpose of this Thematic Evaluation is to provide guidance to the ILO, especially the collaborating departments and constituents, on how best to address the exploitation of children in this sector. The Thematic Evaluation will identify and then critically assess what has been learned about scavenging and about various approaches to addressing the problem of child labour in relation to scavenging.

Baldisimo, J.M. and Lohani, B.N. (1988), *Waste picking of municipal solid waste in Bangkok, Jakarta and Manila*, Environmental Sanitation Information Center, Asian Institute of Technology. Environmental Sanitation Reviews

Barkhof, M. (2004), *Reducing child labour in waste picking: an evaluative report on two cases in Thailand*. Field study for ILO 2004b

Abstract
This study will show that community involvement through a holistic child centered approach towards disadvantaged children, including scavenging children, turns out to be an effective means of addressing child labour in general and therefore also in scavenging. Community interventions include helping children enrolling into schools at young age, getting birth rights registered, provide recreational activities and setting up day care centers.

Baud, I.S.A. and Post, J. (2002), *Between market and partnerships: Urban Solid Waste Management and contributions to sustainable development*, in GBER Vol. 3 No.1 pp. 46-65

Abstract
In this paper the two cities Nairobi, Kenya and Hyderabad, India are analyzed on whether the of public sector – civil society partnerships and market-led provision contribute to sustainable development. Sustainable development is conceptualized in economic, social and environmental components. Results show that strong variations in the strength of local government lead to contrasting results in the ways markets and partnerships function.

Baud, I., Huysman, M., Schenk, H. (1995), *Solid Waste Management in Urban Areas: The Case of Three Indian Cities*, University of Amsterdam, Amsterdam

Abstract
In this paper the results of a study on the linkages between municipal, formal and informal private solid waste management are explored for three Indian cities. The linkages between municipalities and community based organisations turn out to be more extensively developed than those with non-governmental organisations working with waste pickers and with formal private recycling enterprises.

Baud, I., Huysman, M., Schenk, H. (1994), *New approaches to urban solid waste management: Linkages between formal and informal systems of source separation, collection and recycling in Indian cities*, University of Amsterdam, Amsterdam

Abstract

The aim of this study is to provide an overview on solid waste management in an integrated fashion, incorporating the views of different groups of actors involved. The study looks at solid waste management activities in three cities in India: Bangalore, Hyderabad and Madras. Linkages between municipal government, CBOs, NGOs, small- and large-scale economic activities such as source separation, collection and recycling are examined. The authors advocate a better recognition of the informal sector engaged in solid waste management.

Bauman, Z. (2004), *Wasted Lives: Modernity and its Outcasts*, Polity Press, Cambridge, UK.

Abstract

In this book, Bauman sheds light on 'human waste', a term which he uses to refer to migrants, asylum seekers and outcasts, in our contemporary modernized society. He sees the growth of this group of people as the inevitable outcome of modernization. In addressing issues around 'human waste' he finds new interesting features of human relationships.

Beede, D.N. and Bloom, D.E. (1995), *Economics of the Generation and Management of Municipal Solid Waste*, World Bank, Cambridge

Abstract

This paper provides an economic view on Municipal Solid Waste Management in low-income countries. The authors claim that the costs of MSWM are likely to grow faster than the pace of urbanization in some cases, causing severe environmental issues. Perspective: economic

Bernstein, J. (2004), *Toolkit: social assessment and public participation in municipal solid waste management.* Urban Environment Thematic Group, World Bank

Abstract

This toolkit provides guidance to central, municipal, and private sector agencies in conducting a Social Assessment and ensuring appropriate levels of public participation in the planning and implementation of a Municipal Solid Waste Management investment. The emphasis in the toolkit is on both developing countries and transitional economies. The guidance is directed at project managers responsible for ensuring quality in the design and implementation of solid waste management investments. The toolkit also is intended to provide guidance to social scientists and public participation professionals responsible for carrying out social analysis and/or public participation activities in Municipal Solid Waste Management.

Berthier, H.C. (2003), *Garbage, Work and Society*, article published in Resource, Conservation and Recycling, Vol. 39. Issue 3, pp. 193-210

Abstract

This paper sheds light on the process in which solid waste is being managed and the problems around solid waste management in Mexico (City) over a period of twenty years.

Beukering, P.J.H. van et al (1998) *External Economic Benefits and Costs in Water and Solid Waste Investments: Methodology, Guidelines and Case Studies*, Report Vrije Universiteit Amsterdam, Amsterdam

Abstract

The economic implications of external effects are seldom reflected in the prices used to assess the costs and benefits of projects. As a result, a need arises for a standard, transparent and easy to apply methodology for monetary valuation of externalities and their inclusion in conventional project appraisal. The scope of the applied methodologies to assess external effects includes the full life-cycle of materials, projects and processes under investigation. This so-called impact pathway approach combines aspects of economic valuation and life-cycle assessment. This approach is especially applicable in environmentally sensitive sectors such as wastewater and solid waste. The main objective of this study is to provide external environmental benefits and costs in a form suitable for use in a routine economic appraisal analysis.

Beukering, P.J.H. van, Schoon, E. and Mani, A. (1996), *The Informal Sector and Waste Paper Recovery in Bombay*, CREED Working Paper Series No. 5

Abstract
This paper examines the possibilities for increasing waste recovery in the South. Based on field surveys in the informal recovery sector and the literature on formal waste collection, a simulation model for the solid waste flows in Bombay is developed. Extrapolations of four effects are provided for the period to 2010: formal and informal employment, environmental impact, public expenditure and income distribution. Results demonstrate that policy makers in developing country cities should be reluctant to introduce a Western style waste collection system. Promoting informal recovery does seem to be a cost effective and an environmentally optimal policy measure, although this does result in adverse consequences for income distribution.

Beukering, P.J.H. van (1994), *An Economic Analysis of different types of formal and informal entrepreneurs, recovering urban solid waste in Bangalore (India)*, article published in Resource, recovery and recycling, Vol. 12, Issue 3-4, pp. 229-

Abstract
This paper focuses on the recycling sector in Bangalore, India. Topics that are examined are market structure, the scale of operation, employment effects, constraints, and recent developments. Van Beukering claims that the recycling industries prospects are growing, but should pay close attention to quality of the output.

Beukering, P.J.H. van (1993), *The recycling sector in Bangalore*, Vrije Universiteit, Amsterdam

Bhargava, V. and Chaturvedi, B. (2006), *60 Kilos*, Vishal, Dehli (film)

Abstract
This short film examines the operations of waste-pickers in New Delhi, India. It elaborates on the process of waste recycling through the informal sector as well as the impact of socially constructed biases on the operations of this sector.

Chaturvedi, Bharati (1994), *A tale of trash: A survey of the materials, people and economics involved in the recycling trade in Delhi*, World Wide Fund for Nature India, New Delhi

Chaturvedi, Bharati (1998), *Public Waste Private Enterprise: An enquiry into the issue of integrating ragpickers into formal Solid Waste Management systems*, Heinrich Boel Stiftung, Berlin

Abstract
This study examines the issue of ragpickers and the informal sector in Solid Waste Management in India. It draws upon numerous case studies and policy, as well as the author's own experience, to suggest that formally incorporating this sector will lead up to a more efficient and economic system of Solid Waste Management. In this context, it considers the kind of spaces that must be created by various players at different levels.

Chaturvedi, Bharati (2008), "Privatisation of Solid Waste Collection and Transportation in Delhi : The Impact on the Informal Recycling Sector." Paper prepared as partial fulfilment of course on Urban Issues in Developing Countries, School for Advanced International Studies, Johns Hopkins University. Washington DC, December 2006.

Abstract
This author explores the impact of modernisation and privatisation on the informal sector in Dehi. Chintan-Environmental, the author's institutional home, participated in this study in several ways.

Chaturvedi, Bharati (2009), "Cooling Agents : The Impact on the Informal Recycling Sector on Carbon Emissions." Chintan-Environmental, Delhi, India.

Abstract

This is an extensive and also rather polemical exploration of the relationship between informal recycling and the carbon footprint of waste management. Has elements both of advocacy and research. Chintan-environmental participated in the current study as editors, and also by providing their economic consultant, Dr. Yamini Gupt, to work with the study as principal economist.

Chintan (2005), *Informal - Formal: Creating Opportunities for the Informal Waste Recycling Sector in Asia*, Chintan Environmental Research and Action Group, New Delhi

Abstract

In this paper Chintan examines the development of the informal recycling sector in three countries: India, The Philippines and Cambodia. Chintan argues that an Extended Producer Responsibility (EPR) system needs to be implemented to effectively merge the informal sector with the formal waste regime.

Chintan (2004), *Space for Waste: Planning for the Informal Recycling Sector*, Chintan Environmental Research and Action Group, New Dehli

Abstract

The overall objective of this report is to inform policy makers in Dehli, India about the importance of the activities of the informal recycling sector in that city. The report offers suggestions on how to incorporate the informal sector in urban planning. By providing detailed information about the activities of the informal recycling sector, and by emphasizing the benefits that can be attained through partnerships, Chintan encourages policy makers to acknowledge the informal stakeholders and to actualize this recognition in municipal policies.

CID (2001), *The informal solid waste sector in Egypt: prospects for formalization*, IIE/Ford Foundation

Del Campo, A.T. and Kerkhof, F. (1995), Marco Legal y Reglementario del Sector Informal: Naturaleza, Effectos y Necesidad de Reforma, Fondo Hondureno de Inversion Social, Tegucigalpa

Dhanalakshmi, R. and Shoba, I (1999), *Solid Waste Management in Madras City – 1994: a case study*, Pudhuvazhvup Pathippagam, Chennai

Dias, S.M. (2000), *Integrating waste pickers for sustainable recycling*, paper presented during the Collaborative Working Group conference in Manila, Philippines (18-21 September 2000).

Abstract

This paper described developments in waste collection and recycling that are taking place in Belo Horizonte City, in the south-east region of Brazil, where the Municipal Administration has integrated the waste pickers, as part of the separate collection scheme being implemented in the city. Other actors in the success story include NGOs and a university.

Eerd, M. van (1996), *Gender related labour market fragmentation in the informal recycling sector: A study in Bangalore, India*, Universiteit van Amsterdam, Amsterdam

Abstract

This study focuses on the informal recycling sector in Bangalore, and on gender issues specifically. Which combination of factors lead people to this kind of jobs? Which channels are used to get a job in this sector, or to recruit people? Are women and children more casually employed than men?

Eerd, M. van (1996), *The occupational health aspects of waste collection and recycling: a survey of the literature*, UWEP Working Document 4, Part I. WASTE, Gouda, The Netherlands

Abstract

The aim of this report is to give an overview on occupational health aspects in waste management. Analysis is done through literature research and through a survey on the topic of

health and waste.

Fahmi, W.S. (2005), *The impact of privatization of solid waste management on the Zabaleen garbage collectors of Cairo:* in Environment and Urbanization, Vol. 17, pp. 155-170

Abstract
This paper investigates the recently launched privatization of local solid waste management in Cairo, focusing on its adverse effects on the economy and on the urban settlement system of the Zabaleen garbage collectors' communities. The findings of a study on the situation emphasize the significance of poverty alleviation initiatives in restructuring solid waste collection and developing the recycling industry, and the development of new channels for cooperation and partnership between the garbage collectors' association (Gammiya), grassroots organizations, local authorities and multinational waste management companies. In order to promote sustainable livelihoods and better opportunities for the urban poor, the study emphasizes the need among the low-income Zabaleen to draw on the sustainable flow of local resources, while seeking new means of supporting land acquisition and its development for improved housing standards, basic services and environmental quality.

FACET (2004), *Child labour in waste picking*: *Country field study Tanzania, Dar Es Salaam*

Abstract
The purpose of this evaluation is to provide guidance to the ILO on how best to address the exploitation of children in this sector, providing lessons learnt and potential good practices. The Thematic Evaluation critically assesses what has been learnt about scavenging and the various approaches to addressing the problem of child labour in relation to scavenging.

Furedy, C. (1997), *Reflections on some dilemmas concerning waste pickers and waste recovery*, Source Book for UWEP Policy Meeting 1997. Revised April 1999, WASTE, Gouda

Furedy, C. (1997), *Social conditions in solid waste management in Asian cities: Developing International Comparisons*, article published in Journal of Public Health, Vol. 27, Issue 2

Abstract
This paper comments on trends in local action for municipal solid waste management (MSWM) to better understand the emerging socio-economic movement for an integrated approach to municipal solid waste problems. The aims are to suggest some of the main factors that can be used to understand the goals, strategies and progress of individuals and groups entering this field of socio-environmental action, to note the handicaps they face in influencing waste policies and practices, and to make recommendations for furthering international communication on this subject.

Furedy, C. (1992), *Garbage: exploring non-conventional options in Asian cities*, article in Environment and Urbanization, Vol. 4, Issue 2, pp. 42-61

Abstract
This paper describes some small-scale, community based waste management projects in Bangalore, Manila, Madras, Jakarta and Katmandu. The main objective is to assess the potential of the small-scale projects to change conventional waste management systems. Two case studies are used as illustration. Perspective: socio-economic-environmental.

Furedy, C. (1990), *Social aspects of waste recovery in Asian cities*, Environmental Sanitation Reviews. No. 30. Bangkok: Environmental Sanitation Information Centre, article in Journal of Public Health, Vol. 27, Issue 2

Gerlagh, R. et al. (1999), *Integrated Modelling of Solid Waste in India*, CREED Working Paper No. 26, Vrije Universiteit, IIED, Amsterdam

Abstract
In this working paper, Gerlagh et al propose a new paradigm of Solid Waste Management, which

extends scope the technical model to cope with social and environmental problems. Through a multi-disciplinary approach, the authors look at range of activities, issues and processes such as the types of waste generated, the number of stakeholders and economic activities involved, and the various economic, social and environmental effects of SWM. To evaluate the effectiveness of different SWM alternatives, a linear programming model has been developed. The main objective of the model is to minimize overall system costs and to identify low cost alternatives to manage household, institutional and industrial waste. The model is applied to the Indian city Bangalore.

Gilhuis, H. (1988), *Waste pickers, between self-employment and wage work: the waste recycling business in Curitiba, Brazil*, Urban Research Working Papers no. 15, Free University, Amsterdam

Gunn, S. & Z. Ostos (1992), *Dilemmas in tackling child labour: the case of waste picker children in the Philippines*, International Labour Review, vol. 131, 1992, no. 6

Abstract
This article focuses on the case of scavenger children in the Philippines. It reviews various policy and programmatic dilemmas encountered in addressing the problem of child labour and waste picking; the intention of the authors is to give an example of an approach for dealing with the case.

GTZ/CWG (2007). Economic Aspects of the Informal Sector in Solid Waste. Unpublished draft research report prepared by WASTE, Skat, and city partners. Principal authors Anne Scheinberg, Michael Simpson, Justine Anschütz, and Dr. Yamini Gupt. Contributing writers: Jonathan Hecke, Poornima Chickarmane, Laxmi Narayan, Bharati Chaturvedi, Lizette Cardenas, Oscar Espinoza, Rueben Lifuka, Berti Shaker, Laila Iskandar, Reka Soos, Ciprian Popovici, and Noemi Stanev. German Technical Co-operation, Eschborn, Germany. Available from www.waste.nl and www.gtz.de.

Abstract
This predecessor to the current study is available on a CD-Rom. The cost calculations were not shadow-priced and there are some other methodological differences, and the Cairo data was for the whole metropolitan area, not only the Cairo Governorate.

Haan, H.C., Coad, A. and Lardinois, I. (1998), *Municipal solid waste management: Involving micro- and small enterprises: Guidelines for municipal managers*, International Training Centre of the ILO, SKAT, WASTE, Turin

Abstract
This book is concerned with how MSEs (Micro- and Small Enterprises) can work in a partnership with municipalities to improve the coverage and standards of waste collection and disposal. The authors claim that compared to conventional contractors, MSEs bring the additional advantage that their appropriate technologies allow them to provide low-cost services, especially for those areas where large scale operations are either too expensive or use inappropriate equipment. Various examples are used to illustrate this statement. The target group of this book are all groups who are dealing with waste issues.

Hoekstra, I. (1998), *Informal micro entrepreneurs and the recycling of waste metal in Nairobi: A case study of the metalworkers in Kamukunji and the context in which they work*, WASTE, Gouda

Abstract
This report describers the informal waste and metal recyclers in Nairobi, Kenya. It covers private large- and small -scale recyclers and attitudes of the population of Nairobi related to waste problems. Hoekstra also examines the social characteristics of the small-scale recycling actors.

Huysman, M. and Baud, I. (1991), *Solid Waste Recovery, Re-Use and Recycling: Formal and Informal Aspects of Production and Employment in Indian Cities*, University of Amsterdam, Amsterdam

IJgosse, Jeroen, J. Anschütz, & A. Scheinberg (2004), *Putting Integrated Sustainable Waste Management into practice: using the ISWM Assessment Methodology as applied in the UWEP Plus Programme (2001-2003)*, WASTE, Gouda

Abstract
In this working document, WASTE aims at putting the concept of Integrated Sustainable Waste Management (ISWM) into practice. It provides a step-by-step methodology for all stakeholders that are involved in waste management activities.

ILO (1998), *The Future of Urban Employment*, ILO, Geneva

Abstract
This book focuses on urban employment, and on what cities can do to create jobs at the local level. The underlying thesis is that creating and protecting employment can be the determining factor in easing, if not resolving, the multidimensional crisis faced by many cities worldwide. The book highlights the new challenges for urban employment, including the impact of technological change on job creation, employment structures and the location of industries and services; and the growth of informal forms of work.

ILO (2001), *Local Employment in the informal economy, for staff in local governments and partnership organizations, ILO Publications*, Geneva

Abstract
With this guide, the ILO aims at addressing the need for job creation by showing how municipal governments can improve the local economy. The training mainly deals with the informal sector because this is the sector where most people are working in most cities in Asia. The ILO promotes cooperation between organisations active in the local economy, community-based organisations, business associations, employers' organisations. .

ILO (2004), *Addressing the Exploitation of Children in Scavenging: a Thematic Evaluation of Action on Child Labour. A global synthesis report for the ILO,* ILO/IPEC, Geneva, Switzerland

Abstract
This report is part of a series of thematic evaluations that ILO/IPEC, often in collaboration with other
ILO departments, are carrying out as part of building the knowledge base on action against child labour, particular on the type of action that works and why. The intention is for the outcome of this report to be used for further development of programming guidelines, strategies and models of intervention, particular on how child labour can be an integral issue in small scale mining programmes and projects.

ILO/IPEC. (2003), *Child ragpickers in Nepal: Time-Bound Program baseline survey, 2002-2003*, ILO/IPEC and Tribhuvan University, Katmandu

Abstract
The primary objective of this Baseline Survey is to collect nation-wide data on child ragpickers in Nepal such that the size of the affected population would be known. Through a sample survey, the authors present percentages and figures on the social characteristics of the child waste pickers: working hours, school attendance, living areas, formal rights, etc.

ILO/IPEC. (2004), *Evaluación Temática de la Segregación y Trabajo Infantil en la Gestión de Residuos Sólidos Urbanos en América Latina y el Caribe*, Reporte Finale. IPES, Peru. Price, J. and C. Castro

Johannessen, L.M. & G. Boyer (1999), *Observations of solid waste landfills in developing countries: Africa, Asia and Latin America*, Working Paper Series no.3. The World Bank, Washington D.C

Abstract
The report documents observations from visits in 1997-98 to landfills in the Africa, East Asia and Pacific, and Latin America and Caribbean regions. Specifically, it identifies emerging features, practices, and necessary improvements in the final disposal of solid waste. Also discussed are trends in the regulatory area, private sector involvement, tipping fees, and the impact of waste pickers on sanitary landfills. Finally, the report identifies crossregional observations, and offers recommendations for improvements in World Bank projects that have solid waste components.

Klundert, A. van de, and Lardinois, I. (1995), *Community and private (formal and informal) sector involvement in municipal solid waste management in developing countries*, Background paper for the UMP workshop in Ittingen, 10-12 April 1995, WASTE, Gouda,

Abstract
This report looks back on approaches that aimed to tackle waste management problems in cities in developing countries. It intends to highlight lessons learned and identify critical gaps to be addressed. Using a framework of different actors and dimensions, the paper seeks to explore intersectoral partnerships as a means to achieving sustainable solid waste management (SSWM) systems.

Lapid, D.G. and Soncuya, R.T. (1991), *A case study of a privately-initiated solid waste collection management in San Juan, metro Manila*, Centre for Advanced Philippine Studies (CAPS), Manila

Abstract
This case study provides an overview of the privately initiated solid waste section in San Juan, Metro Manila. The study identifies actors (junkshops, collectors), relationships between actors, and material flow systems.

Lardinois, I. and Furedy, C. (1999), *Source Separation of Household Waste Materials: Analysis of Case Studies from Pakistan, the Philippines, India, Brazil, Argentina and the Netherlands*, WASTE, Gouda

Abstract
The objectives of this study are to document and analyse existing separation at the source experiences and disseminate lessons learned. Field studies in several countries examined the roles of formal and informal stakeholders, types of materials separated, organisational logistics and social interaction between households and those who collect materials.

Lardinois, I. and Klundert, A van de, (1994), *Informal resource recovery: The pros and cons*, WASTE, Gouda

Abstract
In this paper, the authors look at the positive and negative sides of informal recovery. Positives effects are: employment generation, saving natural resources, saving foreign currency, reducing the volume of waste and costs (for collection), improvement of living conditions and producing cheap products. Negative impacts are: bad working conditions, environmental pollution during recycling processes, glutted markets of particular products that can be easily made from recycled materials. Proposed improvements include upgrading of working conditions, create more awareness, improve quality, product diversification. Separation at the source could support this sector with better access to materials. Governmental institutions should recognize and integrate the informal sector in the formal waste management system.

Medina, M (2005) *Serving the unserved –in formal refuse collection in Mexico*, in Waste Management and Research, the journal of international solid waste and public cleansing Association, Vol. 23, Issue 5, pp. 390-397

Abstract
Formal Mexican collection schemes take care of less than 75% of the waste generated. Medina argues that for a small fee, informal refuse collectors can fill in the gap left by official collectors to provide the poorer areas with appropriate waste collection. Remarkable is that the informal refuse collectors studied earn 3- 5 times minimum wage.

Medina, M. (2000), *Informal recycling and collection of solid wastes in developing countries: issues and opportunities*, UNU/IAS Working Paper No. 24. The United Nations University/Institute of Advanced Studies, Tokyo

Abstract

This paper proposes a typology of public policies towards scavengers; argues that scavenging activities should be supported; analyzes recent experiences on the formation of scavengers' cooperatives as a means to promote grassroots development in their communities; examines the use of appropriate technology; and suggest ways in which scavengers and informal waste collectors could be incorporated into formal waste management programs.

Medina, M. (2000), *Scavengers cooperatives in Asia and Latin-America*, article published by El Colegio de la Frontera Norte, Tijuana

Abstract

This paper argues that, when scavenging is supported – ending that exploitation and discrimination– it represents a perfect illustration of sustainable development that can be achieved in the Third World: jobs are created, poverty is reduced, raw material costs for industry are lowered (while improving competitiveness), resources are conserved, pollution is reduced, and the environment is protected. The paper also proposes a typology of public policies toward scavengers and analyzes recent experience on the formation of scavenger cooperatives. It also examines the use of appropriate waste management technology, and suggests ways in which scavengers could be incorporated into formal waste management programs.

Medina, M. (2002), *Globalization, Development, and Municipal Solid Waste Management in Third World Cities*, article published by El Colegio de la Frontera Norte, Tijuana

Abstract

In this paper, Medina argues that conventional approaches to deal with waste in cities in low-income countries often fail. He proposes an alternative approach: incorporate informal sector through public-private partnerships, scavenger cooperatives and micro-enterprises.

Motaal, D.A. (1996), *Reconstructing development: women of the Muqattam Zabbalin settlement*, Cairo Papers in Social Science Vol 19, No 4, pages 59–110, The American University in Cairo

Nas, P.J.M. and Jaffe, R. (2004), *Informal waste management: Shifting the focus from problem to potential*, *Environment, Development and Sustainability 6*: 337–353, Kluwer Academic Publishers,

Abstract

This article discusses the poorly assessed topic of informal waste management systems, in which there appears to be a high level of heterogeneity throughout the world. The article considers the ways scavengers function within the broader context of waste management; they show a wide range of locally formed and adapted activities and social systems. Examples from different cultures are included: the United States, Jamaica, Brazil, Egypt and Indonesia. The authors advocate comparative research and find a contextual, holistic approach to be the most appropriate. Using such an approach, they isolate the important factors that characterize these systems: technical, socio-cultural, socio-political and organizational aspects are elaborated. Experiments in intervention have been undertaken at various levels, from varying ideological and theoretical backgrounds. Academic analyses have ranged from neo-Marxist political economy models to neo-liberal development approaches. As expressed in the title the authors conclude that informal waste management systems are unjustifiably considered problematic whereas they often reveal great development potential.

Pearce, D. and Turner, R.K. (1994), *Economics and Solid Waste Management in the Developing World*. CSERGE Working Paper WM 95-05. Centre for Social and Economic Research on the Global Environment: London

Abstract
This paper sets out a basic economic model for the analysis of alternative waste management options and system configurations. The potential role for economic incentive instruments within an integrated waste policy is also assessed.

Pfammatter, R. and Schertenleib, R. (1996), *Non-governmental refuse collection in low-income urban areas, lessons learned from selected schemes in Asia, Africa and Latin America*, Duebendorf, Switzerland

Abstract
Inadequate waste collection coverage is one of the most important problem areas in cities growing rapidly. As a result, refuse is indiscriminately dumped on roads, into open drains, rivers and surrounding areas. This paper discusses different approaches from Asia, Africa and Latin America to set up a collection system appropriate for its economic standing.

Poulsen O.M. *et al* (1995), *Sorting and recycling of domestic waste. Review of occupational health problems and their possible causes*, in The science of the Total Environment Vol. 168 pp. 33-56

Abstract
This report focuses on the topic of health issues in 'modern' waste management processes. The report aims to provide data for better regulatory guidelines for the waste industry such as incineration plants and landfills. Several specific health issues are addressed.

Price, J. and C. Castro (2004), *Evaluación Temática de la Segregación y Trabajo Infantil en la Gestión de Residuos Sólidos Urbanos en América Latina y el Caribe*. Final report for the ILO, prepared by IPES, Peru

Porter, C. R. (2002), *The economics of waste*, Resources for the Future (RFF) Press, Washington, DC

Abstract
The economics of waste is a book on the waste situation in the United States of America. Application of economic theory is the central focus of the book. The book covers a range of topics, broken into three main parts focusing on: (1) solid waste creation, collection, and disposal; (2) recycling; and (3) hazardous wastes.

Rapten, K. L. (1998), *Community Participation in Municipal Solid Waste Management in Developing Countries, The Role of the Informal Sector*, UNDP, Washington

Rosario, A. (2004), *Reduction of child labour in the waste picking sector, India: review and findings of an evaluative field study in Bangalore and Kolkata*, publication unknown

Abstract
The central theme of the research is to ascertain the situation of waste picking children, the impact of programmes aimed at their welfare, and to look at the main approaches and interventions adopted to reduce child labour in the waste-picking sector.

Rosario A. (1998), *Waste Management and the Non-formal Sector*, Information Sheet, Waste Wise Asia Pacific, Bangalore

Abstract
Two page information sheet on waste management and informal sector. Key issues are identified.

Rouse, J. (2004), *Absorbing informal sector operators into improved urban services*, article published in *Small Enterprise Development: an International Journal*, Vol. 15, Issue 3, pp. 11-19

Abstract
In this article, Jonathan Rouse states that urban development for growing, modern cities may have adverse effects on the informal sector. Three case studies (Bangladesh, India and Ethiopia) are used to reflect the challenges faced by the informal transport, energy and waste sector. It is stated that the informal sectors are characterized by a high vulnerability, low wages and high competition for limited markets. The case of Ethiopia is used to show that the needs of the

informal sector can be accounted for. The article aims at policy makers.

Scheinberg, A. (2003a), "The Proof of the Pudding: Urban Recycling in North America as a Process of Ecological Modernisation," Environmental Politics, v. 12, No. 4, Winter 2003, pp 49-75.

Abstract
A historical-sociological exploration of the relationship between the ecological modernisation of waste management and the development of municipal recycling.

Scheinberg, Anne and Arnold van de Klundert (2005): ISWM Case Study: Developing the Dar es Salaam – UNIDO Recycling Processing Centre. UN Industrial Development Organisation (UNIDO), Vienna, Austria.

Abstract
A case exploration of donor-financed modernisation of the recycling sector in a city where the solid waste modernisation process was not fully operational. Explores the relationships of service-based MSEs and CBOs to recycling.

Scheinberg, Anne, and Justine Anschütz (2007), "Slim pickin"s: Supporting waste pickers in the ecological modernisation of urban waste management systems". International Journal of Technology Management and Sustainable Development, Volume 5, number 3, pp 257-270.

Abstract
Develops the ideas about informal integration based on professionalisation of informal recycling, as an alternative to welfare-, rights- or other approaches to eliminating child labour in scavenging.

Scheinberg, Anne, Dr. Aleksandra Mitrovic, and Valentin Post (2007), Assessment Report: Needs of Roma Collectors and Other Stakeholders in the PEP SE Region for Training, Technical Assistance, and Financial Services and Recommendations for Programmatic Response. Prepared for the Recycling Linkages Private Enterprise Programme South East Europe (PEP SE) of the International Finance Corporation, Skopje, Macedonia.

Abstract
A case analysis of the informal recycling sector in South Serbia, a middle-income country just entering a period of rapid moderisation. Synthesizes experience in 11 small cities in South Serbia.

Scheinberg, A. and A.P.J. Mol (2010), "Multiple modernities; transitional Bulgaria and the ecological modernisation of solid waste management,." Environment and Planning C 28, 1, pp. 18-36.

Abstract
Describes and analyses 12 waste, recycling, and informal sector integration projects in the pre-accesion period in Bulgaria. Most projects took place either in South-East Bulgaria or in Varna, on the Black Sea coast.

Scheinberg, Anne, David C. Wilson, and Ljiljana Rodic (2010); prepared with a team of 35 international solid waste and recycling specialists. Solid Waste in the World's Cities. UN-Habitat's Third Global Report on Water and Sanitation in the World's Cities, 2010. by Earthscan Publications, Newcastle-on-Tyne, UK
The book uses David Wilson's development drivers approach to supplement the Integrated Sustainable Waste Management (ISWM) framework for analysing waste management in cities.

Abstract
The three principal authors, together with an international solid waste and recycling specialists, profiled waste management and valorisation in 20 cities in high- middle- anad low-income countries, with an emphasis on informal activities and their productivity. The book is based on a kind of cross-analysis of the three drivers with three governance featurs, inclusivity, financial sustainability, and sound institutions and pro-active policies.

Scheinberg, A. (2001) *Financial and Economic Issues in Integrated Sustainable Waste Management: tools for decision-makers*, part of Set of Five Tools for Decision-makers - Experiences from the Urban Waste Expertise Programme (1995 - 2001), WASTE, Gouda

Abstract
This document with tools is designed to help decision-makers use financial and economic instruments to make responsible and informed decisions about Integrated Sustainable Waste Management (ISWM). It provides answers a range of financial questions that urban planners involved in solid waste management might have. The document also gives an overview of informal solid waste management activities.

Scheinberg, A., Klundert, A. van de and Rudin, V. (2000), *MSEs in Urban Environmental Improvement: Panacea, Strategy, or Transition Stage*, Occasional Paper, WASTE, Gouda

Abstract
This paper aims to create better understanding of incorporating Micro- and Small Enterprises (MSEs) in formal environmental (waste) management: structures in which cooperation takes place, and finding the questions that remain unanswered. The authos acknowledge the challenge of up-scaling succesful relatively small efforts, often community and NGO based. The activities of the MSEs are claimed to be very important if governments want to downsize the public sector.

Scheinberg, A., Muller M. and Tasheva E. (1999), *Gender and Waste, Integrating gender into community waste management: project management insights and tips from an email conference, 9-13 May 1998*. UWEP Working document no.12, WASTE, Gouda

Abstract
This paper looks at the connection gender-waste, whether or not the two terms are truly related topics. It looks at questions such as: Might women and men have different perceptions of waste management in their communities? How are their roles and tasks in household and community related to waste activities? What opportunities do women and men have to be engaged in small waste enterprises? How have gender differences affected the sustainability and effectiveness of waste management? And what strategies and methods can be applied to enhance the contribution of both women and men?

Snel, M. (1999), *Integration of the formal and informal sector – waste disposal in Hyderabad, India*, in: Waterlines, Vol. 17, pp. 27-29

Abstract
Could integration provide a solution to waste management problems in the South? This case study highlights some of the potential benefits - and problems - with such a scheme.

Spaargaren, Gert, Peter Oosterveer, Joost van Buuren, and Arthur P.J Mol (2005): "Mixed Modernities: towards viable environmental infrastructure development in East Africa." Position paper, Environmental Policy Department, Wageningen University and Research Centre, The Netherlands

Abstract
The paper applies the principles of ecologicial modernisation theory, and particularly the sustantive claims that modernisation produces modernised mixtures in solid waste and sanitation in Africa. In doing so, the paper lays the basis for some of the ways of thinking about informal integration, as well as framing the analysis of a process flow diagram as a way of identifying parallel operations between formal and informal sectors.

Srinivas, C.V. (1996), *The role of informal sector in urban waste management - some issues*, journal article, 5.6.1 96 RO

Abstract
This paper aims to analyse the role of Urban Informal Sector in urban waste management in India. The existing UIS mechanism of source reduction and recycling at various levels, advantages for their preservation is identified. The problems associated with and policy

interventions/measures required at local government level in making UIS more effective are identified.

Stanev, N., Veraart R. and Popovici C. (2004), *Thematic Evaluation On Projects Related to Addressing the Issue of Child Labour in Waste picking: Cluj–Napoca and Baia Mare, Romania,* Green Partners, Cluj-Napoca, Romania.

Abstract
The purpose of this Thematic Evaluation is to present information and an analysis of child labor in scavenging and approaches to address this problem in the cities Baia Mare and Cluj-Napoca in Romania. It presents an evaluation of these projects and defines success and non-success factors.

Svadlenak-Gomez, K. (1999), *From scavengers to eco-aides: The environmental and social opportunities of working with informal sector recyclers*, The City University of New York
New York

Abstract
Based on studies recycling in four countries (Egypt, the Philippines, Indonesia and Colombia), the author claims that there's evidence of the potential for linking formal and informal sector waste collection and recycling systems. Two most promising aspects are composting and separation at the source by households. Svadlenak-Gomez continues by saying that supporting the informal sector will not provide a permanent and complete solution for municipal waste management problems, it can provide an interim solution.

Taylor, D.C. (1999), *Mobilizing resources to collect municipal solid waste: illustrative East Asian case studies*, in Waste Management and Research, Vol. 17, Issue 4, pp. 263

Abstract
Experience in several East Asian countries of collecting and disposing of municipal solid waste (MSW) through the mobilization of locally available resources is discussed. These resources are represented by various stakeholders in MSW management, namely, the public sector, the formal private sector, the informal private sector and community and non governmental organizations. Attention is given to the nature of MSW, the nature and role of each major MSW stakeholder, the constraints to the development of partnerships among MSW stakeholders, illustrative case studies of MSW resource mobilization in East Asia and lessons learned from these experiences. Among the lessons learned are the critical importance of: (1) a service oriented collaboration between public MSW authorities and other MSW community resource stakeholders; (2) the involvement of all MSW stakeholders in MSW decision making; (3) the selection of affordable and sustainable MSW management technologies; and (4) the identification and recovery of MSW investment, collection and disposal costs.

Trettin, L. (1996), *A cooperative for rag pickers*, article published in Farm Digest. September 1996

Volpi, E. (1996), *Community organization and development among the zabbalin of Muqattam,* Cairo Papers in Social Science, Vol. 19, no. 4. The American University in Cairo Press

Wilson, D.C., Velis, C., Cheesman, C. (2005), *Role of informal sector recycling in waste management in developing countries*, Department of Civil and Environmental Engineering, Centre for Environmental Control and Waste Management, Imperial College, London

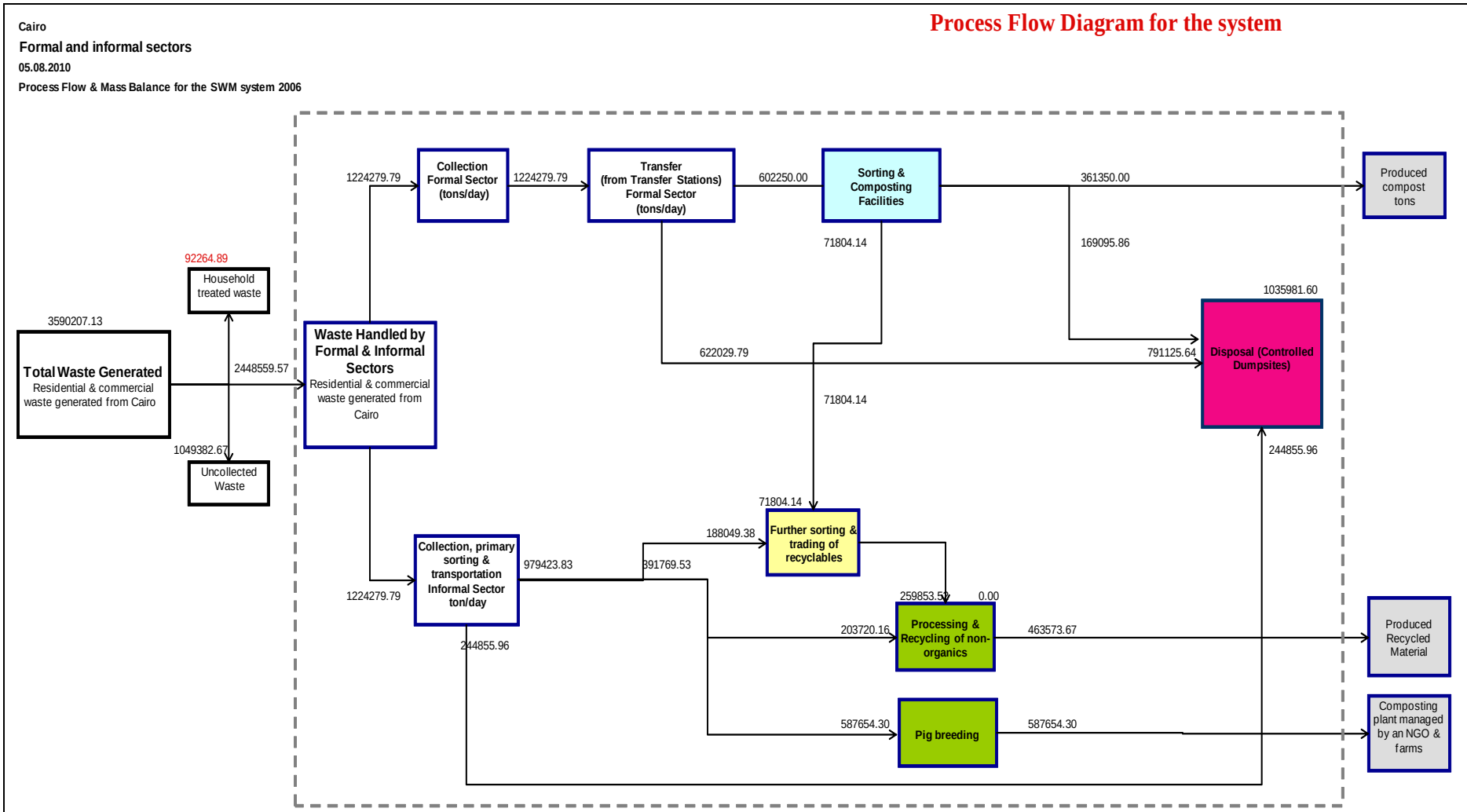
Abstract
Many thousands of people in developing country cities depend on recycling materials from waste for their livelihoods. With the focus of the Millennium Development Goals on poverty reduction, and of waste strategies on improving recycling rates, one of the major challenges in solid waste management in developing countries is how best to work with this informal sector to improve their livelihoods, working conditions and efficiency in recycling. The general characteristics of informal recycling are reviewed, highlighting both positive and negative aspects. Despite the health and social problems associated with informal recycling, it provides significant economic benefits that need to be retained. Experience shows that it can be highly

counterproductive to establish new formal waste recycling systems without taking into account informal systems that already exist. The preferred option is to integrate the informal sector into waste management planning, building on their practices and experience, while working to improve efficiency and the living and working conditions of those involved. Issues associated with integrating informal recycling into the formal waste management sector are discussed.

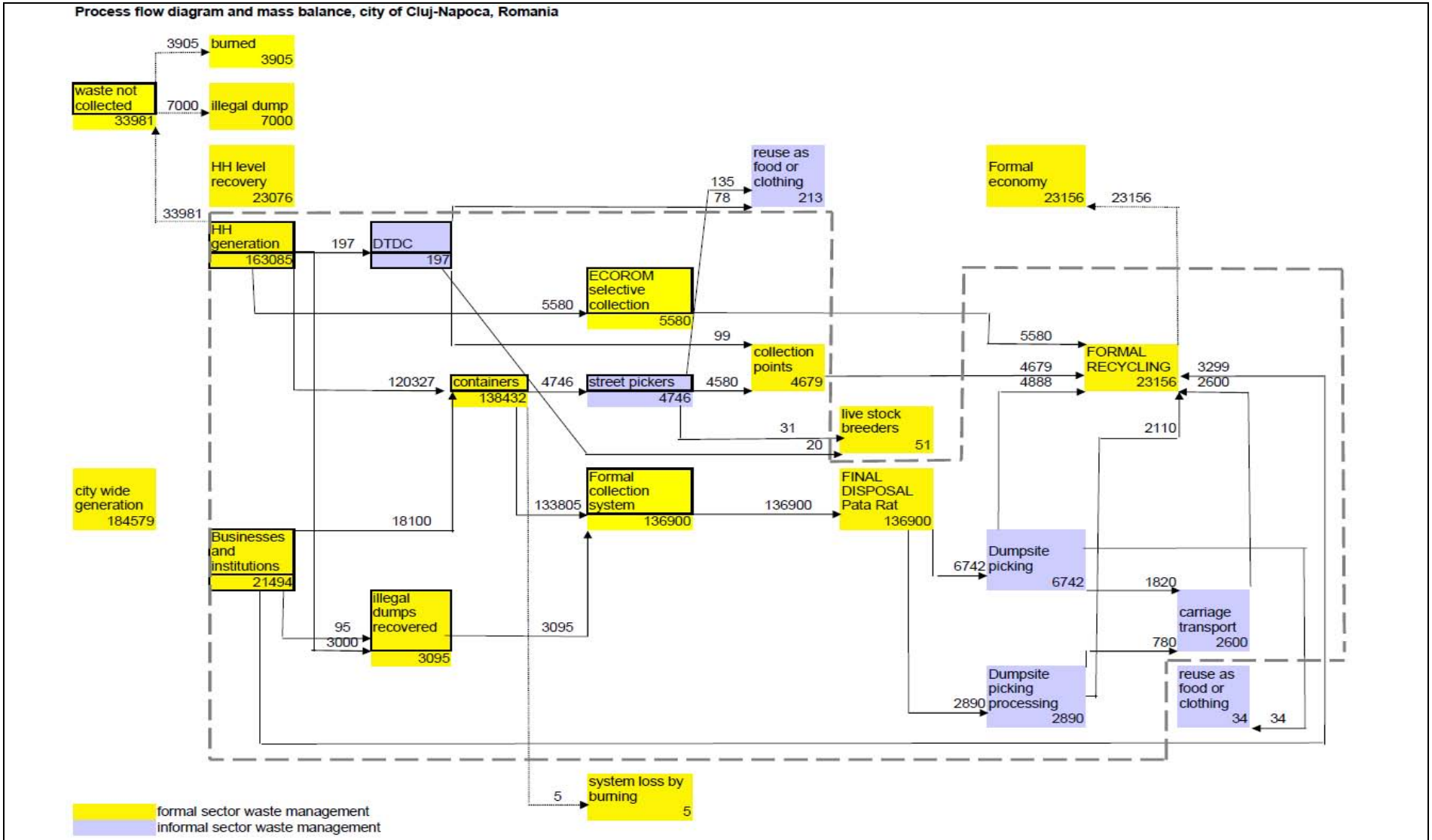
Wilson, Sir David C., (2007), "Development Drivers for Waste Management." Waste Management and Research vol. 25, pp 198-207.

Abstract
The seminal work which uses the concept of development drivers for analysing waste systems.

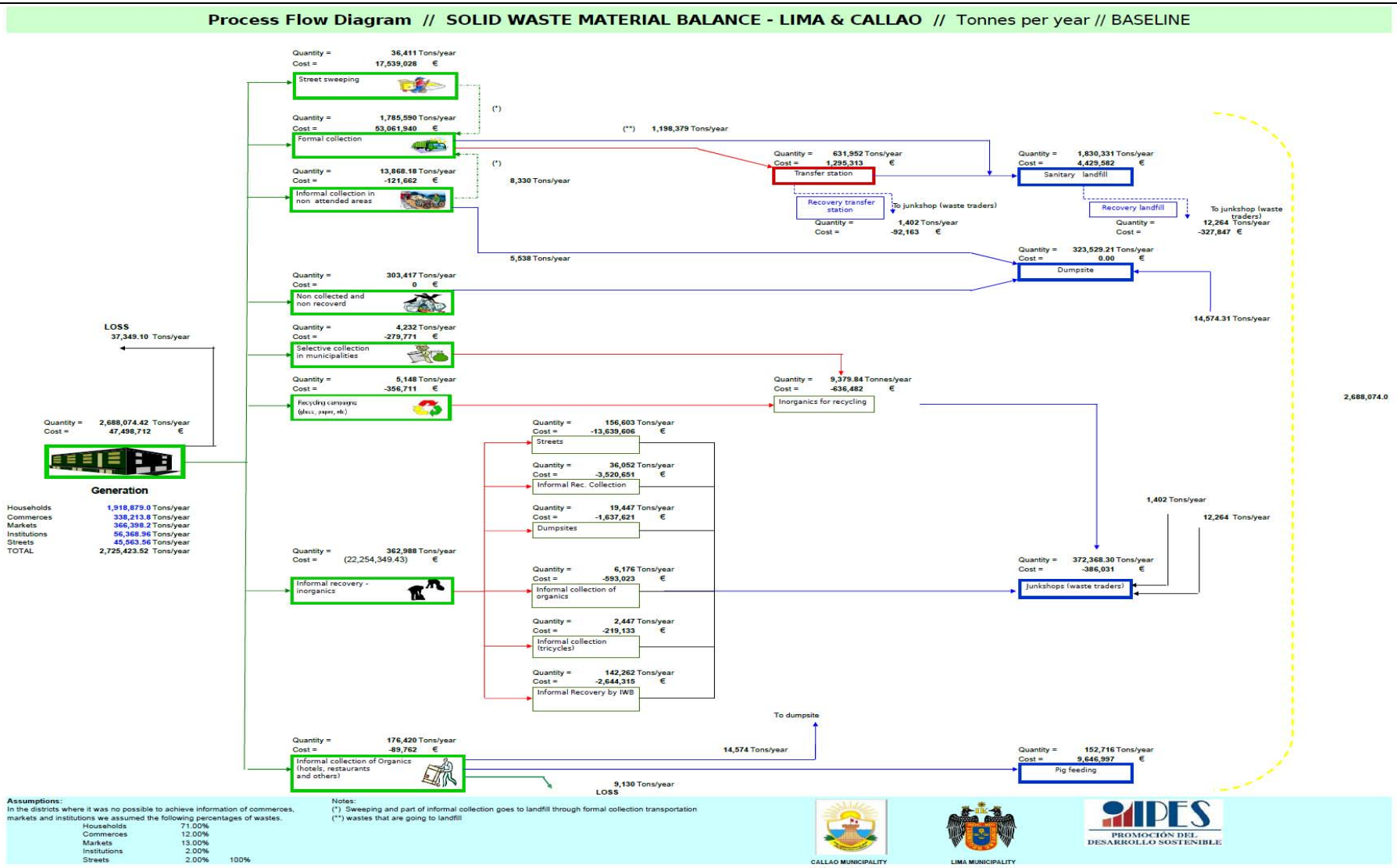
Annex 3, Process Flow Diagrams for all Cities printed as A3 pages



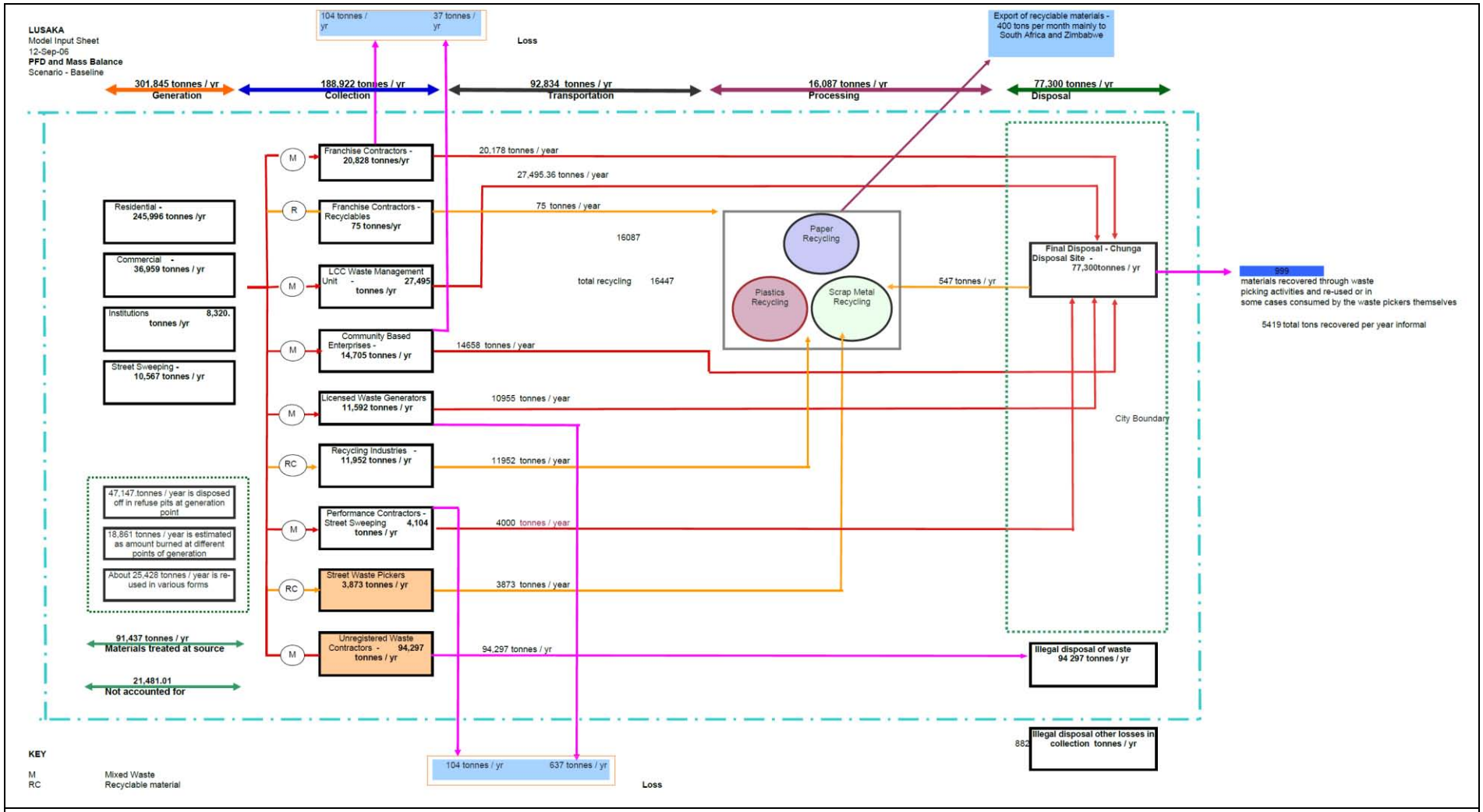
Process Flow Diagram for Cairo Governorate



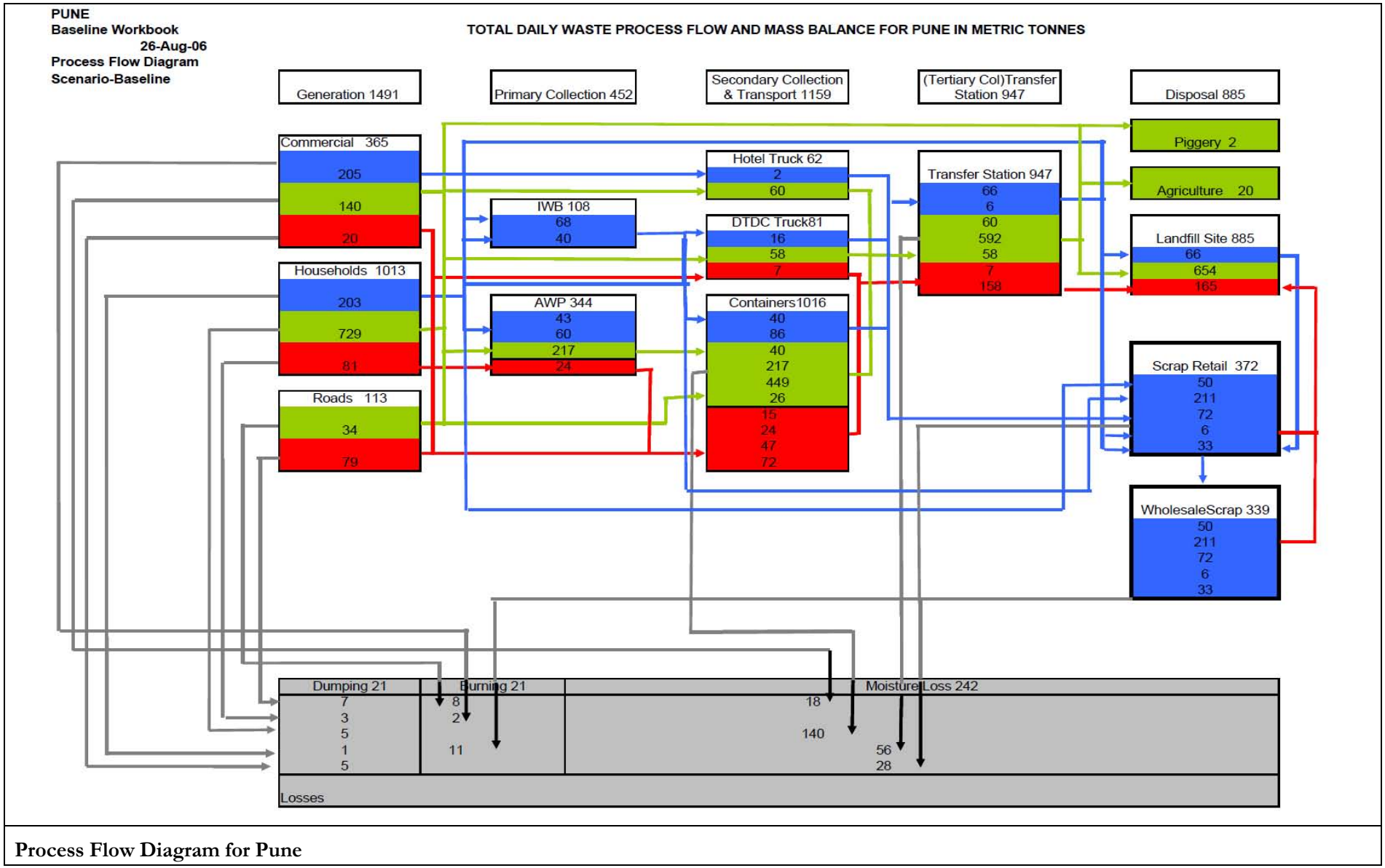
Process Flow Diagram for Cluj-Napoca



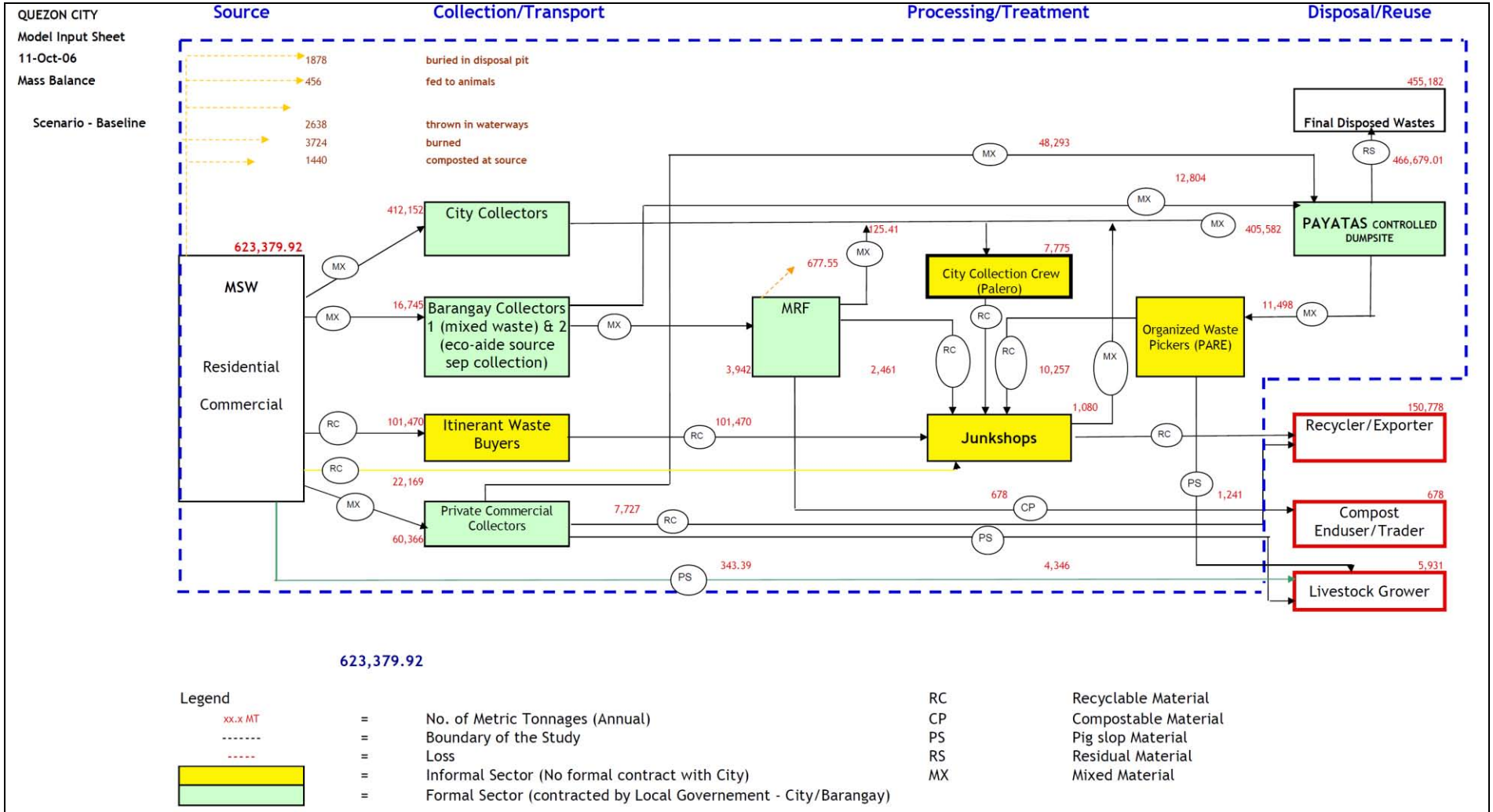
Process Flow Diagram for Lima and Callao



Process Flow Diagram for Lusaka



Process Flow Diagram for Pune



Process Flow Diagram for Quezon City

6 Volume 2 (DVD/CD-Rom)

6.1 Annex 4, Methodology Guidance Document

6.2 Annex 5, Excel Workbooks updated 2010

6.3 Annex 6, City reports

6.4 Annex 7, Full electronic versions of Volume 1 and Volume 2