Tratamiento y Gestión de los Desechos Sólidos

Foro Internacional

Bogotá - Berlin - Beijing

Desafíos y Soluciones para las Megaciudades

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• Waste Management in Latin America - Overview
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• Waste Arising and Waste Composition – Some data
• Waste Mass Flow Diagram for Santiago de Chile
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The „Risk Habitat Megacity“ Project

Local Stakeholders

Scientific Advisory Board

Cross-Cutting Concept: Sustainable Development
Cross-Cutting Concept: Risk
Cross-Cutting Concept: Governance

Programme Coordinator
Programme Steering Group

Development and Dissemination of Knowledge
- Methods
- Indicators
- Toolkits
- Scenarios

Capacity Building
- Scientific training
- Training of practitioners
- Workshops

Land use management
Socio-spatial differentiation
Energy system
Transportation
Air quality and health
Water resources and services
Waste management

Capacity Building
Human Activities Endanger the Environment

air

energy

goods

waste

water

food

soil

ground water

ores, coal, oil

Human Activities Endanger the Environment
<table>
<thead>
<tr>
<th>Environmental Problems</th>
<th>Health Risks</th>
<th>Exposed Population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inadequate Generation and Storage</td>
<td>Environmental hazard due to hazardous materials, pathogen organisms, food contamination, bad odors</td>
<td>Gastrointestinal diseases, poisoning of infants and pets, Dengue</td>
</tr>
<tr>
<td>Inadequate Disposal in Public Areas</td>
<td>Pathogen organisms, air contamination due to open air burning, surface water contamination, food contamination, bad odors, landscape deterioration</td>
<td>Gastrointestinal and respiratory diseases</td>
</tr>
<tr>
<td>Collection, Transportation, Transferstations</td>
<td>Landscape deterioration, bad odors, noises</td>
<td>Respiratory, gastro-intestinal dermatology diseases, occupational diseases and accidents</td>
</tr>
<tr>
<td>Segregation and Recycling</td>
<td>Reuse bottles and containers, feeding of beef cattle and pigs with unhealthy organic waste</td>
<td>Respiratory, gastro-intestinal, dermatological diseases, occupational diseases and accidents;</td>
</tr>
<tr>
<td>Treatment and Final Disposal</td>
<td>Soil contamination, air contamination from open air burning, surface and underground water contamination, landscape deterioration, fires</td>
<td>Allergic diseases, respiratory tract, skin and mucous, occupational diseases and accidents, mental health</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Population adjacent to final disposal sites, peri-urban population where waste is accumulated or burnt</td>
</tr>
</tbody>
</table>
## Waste Arising in Santiago de Chile

<table>
<thead>
<tr>
<th>Type of Waste</th>
<th>Total Amount</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Municipal Solid Waste</td>
<td>2,645,966</td>
<td>46%</td>
</tr>
<tr>
<td>residuos solidos urbanos (RSU)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial Waste</td>
<td>920,336</td>
<td>16%</td>
</tr>
<tr>
<td>residuos solidos industriales (RSI)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Construction Waste</td>
<td>2,128,277</td>
<td>37%</td>
</tr>
<tr>
<td>residuos de construccion (ResCon)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Waste</td>
<td>57,521</td>
<td>1%</td>
</tr>
<tr>
<td>residuos hospitalarios (ResHos)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5,752,100</td>
<td>100%</td>
</tr>
</tbody>
</table>
Specific Waste Production – Correlation with GDP

Sources: PAHO, Global University

[Graph showing the correlation between specific waste production and gross domestic product (GDP) for countries like Peru, Bolivia, Chile, Brazil, and Germany.]

Specific Waste Production [kg/person.day]

Gross Domestic Product [US$/person.a]

Sources: PAHO, Global University
Waste Management in Latin America – Overview

Materials recovery occurs at all phases of the management chain (at the source, during transportation, and at the disposal sites).

There is a trend towards source separation due to
- an improvement in the management of dumps, which has forced waste pickers to find work elsewhere;
- factories that pay more for cleaner materials;
- households getting paid a small amount of money for their recyclable materials.

In some large Argentine, Brazilian, Colombian, and Mexican cities, recycling bins have been set up, where glass and paper products can be deposited.

Waste pickers are not allowed in managed landfills in the region.
Waste Management in Latin America – Overview
Waste Management in Latin America – Overview
Waste Management in Latin America – Transfer- Stations

Throughout Latin America transfer-stations have been installed or are in the process of being installed.

The need for the transfer-stations has grown significantly as the distance between the city and the disposal sites grows.

In cities such as Rio de Janeiro, Mexico City, Caracas, and Buenos Aires, more than 50% of the wastes go through a transfer-station.
Waste Management in Latin America – Transfer-Stations
Waste Management in Latin America – Composting

Centralized composting has not been successful in Latin America.

In the last 20 years, at least 30 plants were purchased, some of which were never installed.

Approximately 15 composting plants were closed only a few years after installation.

One plant in São Paulo, Brazil is owned and subsidized by the municipal government of São Paulo, which is interested in its continued operation due to the lack of landfill space in the metropolitan area.

Four large composting plants operated in Mexico, but none of these is still working. Two others were purchased there, but were never installed.
Waste Management in Latin America – Composting

Reasons for composting plants not being successful are

- High operating costs
- No feasibility studies
- No existing market for the product
- Availability of cheaper (though less environmentally friendly) options.
- Deficient management of the plants resulting in problems for public health.
Waste Management in Latin America – Incineration

Up to now no incinerators operate in Latin America although there have been a number of feasibility studies.

The costs of this technology are far too high to be considered by local governments as an appropriate waste management technology.

One municipal incinerator did operate in Mexico City; however, it was closed in 1992 because it could not meet emission standards.

MSW incinerators were also tried in São Paulo and Buenos Aires, but they are not operative at the present time. In these cases operation and maintenance costs were too high.
Waste Management in Latin America – Incineration
Waste Management in Latin America – Landfills

Some large cities in the region do have state-of-the-art landfills.

Landfill design in these cities typically consists of an initial clay layer, followed by a sand or ground stone layer. Synthetic liners are not usually used except for some new landfills in Argentina, Brazil, and Chile.

Leachate collection systems are used, the landfills are subdivided into cells, and they have chimneys for gas ventilation.

Wastes are covered daily with topsoil. When full, landfills are closed by covering with a clay layer and topsoil, then re-vegetated.
Waste Collection and Waste Disposal in Latin American Cities

<table>
<thead>
<tr>
<th>City</th>
<th>Waste Collection (%)</th>
<th>Waste Disposal in Landfills (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mexico</td>
<td>50</td>
<td>Good</td>
</tr>
<tr>
<td>Bogotá</td>
<td>80</td>
<td>Good</td>
</tr>
<tr>
<td>Caracas</td>
<td>90</td>
<td>Good</td>
</tr>
<tr>
<td>Lima</td>
<td>60</td>
<td>Poor</td>
</tr>
<tr>
<td>Sao Paulo</td>
<td>70</td>
<td>Good</td>
</tr>
<tr>
<td>Buenos Aires</td>
<td>50</td>
<td>Good</td>
</tr>
<tr>
<td>Santiago de Chile</td>
<td>80</td>
<td>Good</td>
</tr>
</tbody>
</table>
Waste Management in Latin America – Landfills
Waste Management in Latin America – Landfill gas collection

Because of the high organic content of the region's wastes, landfilled wastes tend to produce methane relatively quickly.

Nevertheless, this gas is only used in Chile (Santiago and Valparaiso), where three landfills have gas collection systems.
Waste Management in Beijing - Overview

The amount of MSW increased from 2.2 Mio tons in 1990 to 3.6 Mio tons in 2003 (13 Mio inhabitants).

In 2004 there were 5 transfer stations, 13 sanitary landfills, 2 compost plants and 2 incineration plants.

Some treatment facilities have to operate at a load > 100%, e.g. the Gaoantum sanitary landfill at a load of 197%.
Waste Management in Beijing - Overview

The share of treatment of MSW is

- 94% for sanitary landfills
- 4% for composting
- 2% for incineration

Only two landfills were designed to collect methane.

A moderate garbage collection fee is applied, but the willingness to pay for solid waste collection and treatment is still low.
Specific Arising of MSW in Selected Cities (kg/(inhab*day))

- Sao Paulo
- Buenos Aires
- Ciudad de Mexico
- Santiago
- Lima
- Bogota
- Caracas
- Berlin
- Beijing
- Germany
Specific Production of MSW for Different Regions

<table>
<thead>
<tr>
<th>Region</th>
<th>1997</th>
<th>2004</th>
</tr>
</thead>
<tbody>
<tr>
<td>Latin America</td>
<td>0.75</td>
<td>0.91</td>
</tr>
<tr>
<td>Santiago de Chile</td>
<td>0.87</td>
<td>1.18</td>
</tr>
<tr>
<td>EU-25 Countries</td>
<td>1.39</td>
<td>1.44</td>
</tr>
<tr>
<td>Germany</td>
<td>1.52</td>
<td>1.60</td>
</tr>
</tbody>
</table>

Specific Waste Production (kg/(inhabitant*day))
Mean Composition of MSW in Santiago According to the Socioeconomic Level

- Organic Matter
- Paper and Cardboard
- Slag, ashes and pottery
- Plastics
- Textile
- Metals
- Glass
- Others

Socioeconomic level in Santiago:
- Average
- High
- Medium High
- Medium Low
- Low

Comparison with MSW Berlin and MSW Peking.
Materials Recycled in Santiago de Chile

- **Paper / Cardboard**
- **Glass**
- ** Metals**
- **Plastics**

- Municipal Program
- Charity
- Informal Sector
Municipal Solid Waste (2.8 Mio. Mg)

Formal Collection
Mixed Waste (2.55 Mio Mg)

Informal Curbside Collection
(Mg 260,000)

Drop off
(Mg 19,000)

Segregated Curbside Collection
(Mg 4,000)

Transfer Station: Quilicura

Transfer Station: Puerta Sur

Landfill: Santiago Poniente
(313,000 Mg)

Landfill: Loma Los Colorados
(1.5 Mio Mg)

Landfill: Santa Marta
(734,000 Mg)

Recycling
Mg 283,000
Municipal Solid Waste (2.8 Mio. Mg)

- Formal Collection
  Mixed Waste (2.55 Mio Mg)
    - Informal Collection: 9.1 %
    - Drop off: 0.7 %
      - Transfer Station: Quilicura
      - Segregated Collection: 0.1 %
      - Transfer Station: Puerta Sur
    - Recycling: 9.9 %
      - Landfill: 89.8 %
Conclusions and Outlook

A brief overview about waste management in large cities was given.

This overview has shown that there are many deficits.

What can be done to achieve a more sustainable system of waste management?
Conclusions and Outlook

Analyse the actual system of waste management in detail (waste arising, waste composition, waste treatment)

Work out main deficits

Set up different options for future waste management systems, e.g. on the basis of scenarios on the development of waste arising and waste composition

Analyse and evaluate these options/scenarios and discuss the results with scientists and stakeholders from the resp. city

Work out recommendations for a better (more sustainable) waste management system
Acknowledgement

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Thanks for your Attention