Results of the SDG 11.6.1 Data Collection Exercise

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Waste Management Unit, UN-Habitat
Nairobi – City of 4 million inhabitants, Second largest city in African Great Lakes region, home of thousands of Kenyan businesses and over 100 major international companies and organizations
Produces this everyday
SDGs – Shed light on Waste

Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

Goal 12: Ensure sustainable consumption and production patterns
## Waste SDGs Indicators

### Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable

<table>
<thead>
<tr>
<th>Targets</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>11.6</td>
<td>By 2030, reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management.</td>
</tr>
</tbody>
</table>

### Goal 12: Ensure sustainable consumption and production patterns

<table>
<thead>
<tr>
<th>Targets</th>
<th>Indicator</th>
</tr>
</thead>
<tbody>
<tr>
<td>12.4</td>
<td>By 2020, achieve the environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment.</td>
</tr>
<tr>
<td>12.5</td>
<td>By 2030, substantially reduce waste generation through prevention, reduction, recycling and reuse.</td>
</tr>
</tbody>
</table>
Proportion of Municipal Solid Waste Collected and Managed in Controlled Facility

**Total Municipal Solid Waste Generated by the City:**
The sum of collected municipal solid waste and uncollected municipal solid waste.

**Municipal Solid Waste Collected:**
MSW that is moved from the point of generation such as specific addresses or designated collection points to the point of recovery or disposal. The remaining share of MSW generated is considered “uncollected”.

**Municipal Solid Waste Managed in Controlled Facilities:**
MSW received by facilities with BASIC control level according to the ladder of control level, which waste is treated or disposed with engineering and/or management control in place to limit health and safety risks and environmental impacts.

**Other things to considerate:**
Standardization of waste composition survey

**Data Sources:**
MSW generation: Household survey and visits to commercial other institution
MSW collected: Waste reception record of material recovery and disposal facilities
MSW managed in controlled facilities: Technical judgement on control level of material recovery and disposal facilities
Pilot Data Collection for SDG 11.6.1 in Nairobi

- From mid April to May from preparation to finish of data collection
- Waste generation from household and other premises
- Waste amount collected
- Control level of treatment and disposal facilities
How Do We Calculate Total MSW Generation by Nairobi?

- MSW from Household
- MSW generated by commercial enterprises
- MSW generated by institutions
- MSW generated from Markets
- MSW generated from public spaces

= Total MSW Generated by the City
How Do We Measure MSW Generated by Households in Nairobi?

= Household MSW Generation Per capita x Population in Nairobi

→ How to estimate household MSW generation per capita?
  - Sampling!
  - Distribute 8 liner bags for 30 sample households from high, middle and low income areas respectively and get average daily MSW generation for 7 days. Discard the first liner bag because it is not representative
  - Record number of residents in the household
  - Divide daily MSW generation by the number of residents in the household

Kamau Family
4 members

2.4kg + 3.2kg + 2.5kg + 1.8kg + 1.5kg + 2.1kg + 2.7kg

7 x 4

\[ = 0.57 \text{kg/day/person} \]
Household MSW Generation Survey
## Waste Composition Survey

<table>
<thead>
<tr>
<th>Categories</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchen / Canteen Waste</td>
<td>Bread, coffee grinds, cooked or uncooked food items, food leftovers, fruit and vegetables, meat and fish, pet foods, tea bags</td>
</tr>
<tr>
<td>Garden / Park Waste</td>
<td>Flowers; Fruit and vegetable garden waste; Grass Cuttings; Hedge trimmings; Leaves; Pruning; Tree branches; Weeds</td>
</tr>
<tr>
<td>Wood</td>
<td>Bottle corks, Cork packaging, Untreated Pallet, Solid timber and timber fragments, Wood from DIY, Wood furniture or toys</td>
</tr>
<tr>
<td>Paper / Cardboard</td>
<td>Brochures, magazines, newspapers, cereal packets, Cleaning product cartons, Cards, Books, Tissue Paper, Writing papers</td>
</tr>
<tr>
<td>Plastic Film</td>
<td>Biscuit wrappers, Cling film, Compost/peat bags; Crisp packets; Frozen food bags; Cellotape; Shopping Bags, Tarpalins</td>
</tr>
<tr>
<td>Plastic Dense</td>
<td>All plastic bottles/jars, Plastic bottles, Food packing trays, Roll on deodorant bottles, Bottle tops, Toothpastes, Plastic toys</td>
</tr>
<tr>
<td>Glass</td>
<td>Alcoholic and non-alcoholic drinks bottles, Food jars, Medicine bottles, Cookware, Flat glass, Light bulbs, Mixed broken glass</td>
</tr>
<tr>
<td>Textiles</td>
<td>Trousers; Skirts; Socks; Stockings; Tights; Balls of wool; Blankets; Braids; Carpets; Ropes; Rugs; Sheets; Threads; Towels</td>
</tr>
<tr>
<td>Metals</td>
<td>Biscuit containers; Packaging for carbonated drinks, Fish, Pet food etc; Aluminium foil sheets; Shoe polish cans; Soft drinks;</td>
</tr>
<tr>
<td>Hazardous Household Waste</td>
<td>Batteries/Accumulators;</td>
</tr>
<tr>
<td>Complex Products</td>
<td>Composite/Complex Packaging such as Aluminium Foil-coated card, liquid containers e.g. milk; fruit juice; Appliance parts</td>
</tr>
<tr>
<td>Other</td>
<td>Boulders; Bricks; Gravel; Pebbles; Sand; Soil; Stones; Ceramics; Clay plant pots; Crockery; Stone/ceramic floor and wall tiles; Children’s disposable nappies; Ashes; Sand; Small fragments &lt;10mm of all above categories</td>
</tr>
</tbody>
</table>
## Household Waste Generation Survey Results

<table>
<thead>
<tr>
<th>Income level</th>
<th>MSW Generation per capita (kg/capita/day)</th>
<th>Population</th>
<th>Population rate</th>
<th>MSW Generation from each income level (t/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Income</td>
<td>0.62</td>
<td>607,174</td>
<td>13%</td>
<td>378</td>
</tr>
<tr>
<td>Medium Income</td>
<td>0.89</td>
<td>1,629,660</td>
<td>35%</td>
<td>1,450</td>
</tr>
<tr>
<td>Low Income</td>
<td>0.19</td>
<td>2,408,719</td>
<td>52%</td>
<td>462</td>
</tr>
<tr>
<td>Total</td>
<td>N/A</td>
<td>4,645,553</td>
<td>100%</td>
<td>2,290</td>
</tr>
</tbody>
</table>

### Types

<table>
<thead>
<tr>
<th>Types</th>
<th>Recyclable waste generation from HH (t/day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food waste</td>
<td>1,259</td>
</tr>
<tr>
<td>Plastic film</td>
<td>96</td>
</tr>
<tr>
<td>Plastic dense</td>
<td>176</td>
</tr>
<tr>
<td>Paper and cardboard</td>
<td>198</td>
</tr>
<tr>
<td>Glass</td>
<td>90</td>
</tr>
<tr>
<td>Total</td>
<td>1,820</td>
</tr>
</tbody>
</table>

### Waste Composition

- **High Income Area**
- **Middle Income Area**
- **Low Income Area**
How Do We Measure MSW Generated by Other Premises?

= Unit MSW Generation of premise type x total unit of the premise type

→ How to estimate unit MSW generated by other premises?
  - Business licensing data gives total number of the premises in the city. Licensing fee is determined according to number of rooms for hotels, number of customers for restaurants, number of students for schools, sqm for shops and supermarkets, number of beds for hospitals.
  - Visit premises through random sampling and interview and record how much waste is generated per day and calculate unit MSW generation (e.g. 0.5kg/bed for hospitals)
  - Unit MSW generation x total unit of the premise = total MSW generation from the premise type (e.g. 0.5kg/bed x 15000 beds = 7500kg/day = 7.5t/day of MSW is generated in hospitals in the city)

→ However, we experienced overestimation through this methodology. Therefore 30% of total waste generation is used as a proxy to calculate MSW generated by other premises, based on 2009 JICA survey.

MSW generated by other premises in Nairobi = 2,290 ÷ 100 x 30 = 687 t/day
TOTAL MUNICIPAL SOLID WASTE GENERATED IN NAIROBI IN 2019

2,290 + 687 =

2,977 t / day

Slightly higher than JICA’s projection done in 2009 due to the population increase

Waste Generation Rate in Nairobi = 0.64kg/capita/day
MSW Collected and Managed in Controlled Facilities

- Visit both recovery and disposal facilities
- Record amount of waste received by the facilities through interviews
- Interview middlemen and recyclers about the approximate amount of MSW recovered from dumpsite
- Judge the operation control level according to ladder of the level of control
**MSW Collected**

Two Definitions on “Collection Rate”

**Quantity and Access**

*Quantity based definition:*

% of MSW that is *moved* from the point of generation such as specific addresses or designated collection points to the point of recovery or disposal out of total MSW Generated by city.

*Collected data through interviews:*

- MSW received by recovery facilities (t/d) – 654 t/d in Nairobi
- MSW received by disposal facilities (t/d) – 1,601 t/d in Nairobi
- MSW amount moved from disposal facility for recovery (t/d) – 39 t/d in Nairobi
- Residue from recovery facilities for disposal (t/d) – No Data

\[
\begin{align*}
654 + 1,601 - 39 &= 2,215 \text{ t/d}
\end{align*}
\]

**Product**

**Type**

**Amount (t/day)**

**Average recovery amount from Dandora Dumpsite**

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>Amount (t/day)</th>
<th>Average recovery amount from Dandora Dumpsite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic</td>
<td>PET</td>
<td>30</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>PP/PE</td>
<td>45</td>
<td>1.05</td>
</tr>
<tr>
<td>Paper/card</td>
<td>White</td>
<td>170</td>
<td>480</td>
</tr>
<tr>
<td></td>
<td>Brown</td>
<td>310</td>
<td>30</td>
</tr>
<tr>
<td>Metal</td>
<td></td>
<td>0.8</td>
<td>0.42</td>
</tr>
<tr>
<td>Glass</td>
<td></td>
<td>85</td>
<td>0.42</td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td>5</td>
<td>7.43</td>
</tr>
<tr>
<td>Textile</td>
<td></td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>Total (t/day)</td>
<td></td>
<td>653.8</td>
<td>39</td>
</tr>
</tbody>
</table>

**Quantity based “collection rate”**

\[
2,215 \div 2,977 \times 100 = 74.4\%
\]
**MSW Collected**

**Two Definitions on “Collection Rate”**

**Quantity and Access**

**Access based definition:**
% of population with access to BASIC waste collection service

**Access to waste collection service**
Person has access to waste collection service when the generated waste is removed from the point of generation regardless of the formality of the service provider.

**BASIC waste collection service**

- Door-to-door collection or collection point within 200m distance
- With adequate frequency at least once a week
- Collection efficiency more than 50%

<table>
<thead>
<tr>
<th>Population</th>
<th>Access to Basic Waste Collection Service</th>
<th>Population with access to basic waste collection service</th>
</tr>
</thead>
<tbody>
<tr>
<td>High income</td>
<td>607,174</td>
<td>607,174</td>
</tr>
<tr>
<td>Medium</td>
<td>1,629,660</td>
<td>1,085,354</td>
</tr>
<tr>
<td>Low</td>
<td>2,408,719</td>
<td>1,604,207</td>
</tr>
<tr>
<td>TOTAL</td>
<td>4,645,553</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Access based “collection rate”**

\[
\frac{3,296,734}{4,645,553} \times 100 = 71\%
\]
# Quality of Collection Services

<table>
<thead>
<tr>
<th>SERVICE LEVEL</th>
<th>DEFINITION</th>
</tr>
</thead>
</table>
| State of the art | • Fulfills the criteria of Improved service (see below)  
• SMART data management systems linked to monitoring and control  
• Collection efficiency is >95% |
| Improved | • Fulfills the criteria of basic service (see below)  
• Compliant to set sanitation standards for health protection for workers  
• Compliant to prevent waste spillage from collection vehicles.  
• Effective monitoring and control  
• Collection efficiency is >75%* |
| Basic | • In the form of either door-to-door collection or collection point within 200m distance  
• With adequate frequency  
• Collection efficiency is >50%* |
| Limited | • If one of the above criteria is not fulfilled then the service is “limited”  
• Collection point is farther than 200m distance (Note:  
Sporadically with limited frequency  
• Collection efficiency is < 50% |
| No | • No collection service.  
• No organized service.  
• Waste is managed by the waste generators themselves. |
## Level of Control for WM Facilities

<table>
<thead>
<tr>
<th>Level of Control</th>
<th>Disposal</th>
<th>Energy Recovery (Incineration)</th>
<th>Material recovery</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level 1:</td>
<td>No compaction</td>
<td>Uncontrolled burning</td>
<td>□ Unregistered locations with no distinguishable boundaries</td>
</tr>
<tr>
<td>No control</td>
<td>No cover</td>
<td>No air / water pollution control functions</td>
<td>□ No provisions made for worker health and safety</td>
</tr>
<tr>
<td></td>
<td>No fencing</td>
<td></td>
<td>□ No environmental pollution control</td>
</tr>
<tr>
<td></td>
<td>Fire/smoke existence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No leachate control</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No equipment / limited equipment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Uncontrolled burning</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No air / water pollution control functions</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 2:</td>
<td>Some compaction</td>
<td>N/A</td>
<td>□ Unregistered facilities with distinguishable boundaries</td>
</tr>
<tr>
<td>Limited control</td>
<td>No cover</td>
<td></td>
<td>□ No provisions made for worker health and safety</td>
</tr>
<tr>
<td></td>
<td>Some fire/smoke existence</td>
<td></td>
<td>□ No environmental pollution control</td>
</tr>
<tr>
<td></td>
<td>Site staffed</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Some level of access control / fencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>No leachate control</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Some equipment for compaction</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Level 3:</td>
<td>Waste compacted</td>
<td>Emission controls to capture particulates</td>
<td>□ Registered facilities with marked boundaries</td>
</tr>
<tr>
<td>Basic control</td>
<td>Some use of cover</td>
<td>Trained staff follow set operating procedures</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Site staffed</td>
<td>Equipment maintained</td>
<td>□ Provisions made for worker health and safety</td>
</tr>
<tr>
<td></td>
<td>Site fenced and control of access</td>
<td>Ash management carried out</td>
<td>□ Some environmental pollution control</td>
</tr>
<tr>
<td></td>
<td>No fire/smoke existence</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sufficient equipment for compaction</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Level of Control for WM Facilities

<table>
<thead>
<tr>
<th>Level of Control</th>
<th>Disposal</th>
<th>Energy Recovery (Incineration)</th>
<th>Material recovery</th>
</tr>
</thead>
</table>
| **Level 4: Improved control** | □ Waste compacted  
□ Waste periodically covered  
□ Site staffed  
□ Site fenced and control of access  
□ Leachate containment and treatment (depending on the local climate)  
□ Collection of landfill gas (depending on landfill technology) | N/A | □ Engineered facilities with effective process control  
□ Evidence of materials extracted being delivered into recycling or recovery markets.  
□ Pollution control compliant to environmental standards |
| **Level 5: Full control** | □ Waste compacted  
□ Waste daily covered  
□ Sitestaffed  
□ Site fenced and full control of access  
□ Properly sited and designed functional sanitary landfill site  
□ Leachate containment (naturally consolidated clay on the site or constructed liner)  
□ Leachate treatment  
□ Gas collection and flaring and/or utilization  
□ Post closure plan | □ Built to and operating in compliance with international best practice including e.g. EU or other similarly stringent stack and GHG emission criteria  
□ Emission controls is conducted compliant to environmental standards  
□ Fly ash managed as a hazardous waste using best appropriate technology.  
□ High energy conversion efficiency meeting European ‘R1’ or similar standard. | □ Built to and in compliance with international best practice  
□ Nutrient value of biologically treated materials utilised (e.g. in agriculture/horticulture)  
□ Materials extracted with high purity and delivered into recycling markets |
Dandora’s Level of Control

Level 2
Limited control

- Some compaction
- No cover
- Some fire/smoke existence
- Site staffed
- Some level of access control / fencing
- No leachate control
- Some equipment for compaction
Recycling Facilities’ Level of Control: Level 3 Basic

- Registered facilities with marked boundaries
- Provisions made for worker health and safety
- Some environmental pollution control
Controversial Case.. Limited or Basic?

Composting facilities in India
MSW Characterization Survey at Dandora Dumpsite
Comparison in Composition Survey at Generation and Disposal Site

- **Waste Composition from high income area**
- **Waste Composition from middle income area**
- **Waste Composition from low income area**

**Waste Composition at high income area**
- Food waste 50%
- Others 23%
- Textiles & Shoes 1%
- Glass 3%
- Metals 1%
- Plastics - Dense 4%
- Plastics - Film 4%
- Paper & Cardboard 14%

**Waste Composition at middle income area**
- Food waste 51%
- Others 15%
- Textiles & Shoes 5%
- Glass 1%
- Metals 1%
- Plastics - Dense 3%
- Plastics - Film 10%
- Paper & Cardboard 14%

**Waste Composition at low income area**
- Food waste 59%
- Others 3%
- Textiles & Shoes 4%
- Glass 18%
- Metals 0%
- Plastics - Dense 1%
- Plastics - Film 5%
- Paper & Cardboard 10%
Municipal Solid Waste Flow in Nairobi

- Waste Generators: 2,977 t/day
- NCC & Collection Companies: 1,601 t/day
- NCC: 654 t/day
- Private Recycling Companies: 40 t/day
- Uncollected Solid Waste: 774 t/day
- Dandora: 1,601 t/day
- Ngong: 28 t/day

Collected: 74%
Managed in Controlled facilities: 22%
1. Improve waste collection

2. Boost material recovery

3. Improve disposal

**Waste Generators**

- **2,977 t/day**

**NCC & Collection Companies**

- **22%** Managed in Controlled facilities

**Private Recycling Companies**

- **654 t/day**

**Uncollected Solid Waste**

- **774 t/day**

**Dandora**

- **1,601 t/day**

**Ngong**

- **28 t/day**

**Collected**

- **74%**
Possible Waste Management Interventions in Nairobi

**Hard Investment:**
- Several MRFs (Material Recovery Facilities for sorting and transfer) in proximity of low income areas
  - Harness the recyclables at the maximum
  - Improve collection (especially for secondary collection)
  - Create job opportunities
- Anaerobic digesters in major markets
  - Address high organic waste contents
  - Provide energy source
- Increase recycling facility capacity especially in:
  - Composting
  - plastics
  - Glass
Possible Waste Management Interventions in Nairobi

**Necessary Logistics Coordination:**

- Source separation and collection and transport arrangement for separated waste from point of generation to MRFs
  - Involvement of existing collection companies
  - Involvement of CBOs for waste collection
  - Organization of collection points

- Transport of recyclables from MRFs to recycling facilities
  - Identification of who will do transport
  - Identification of who will pay for transport

Use of technology (e.g. Apps) to bring efficiency in coordination?
Possible Waste Management Interventions in Nairobi
Today’s Goal

• Discuss most appropriate and feasible SWM improvement options among stakeholders engaged in waste management in Nairobi to achieve 100% of SDG 11.6.1

• Consider and discuss technical and governance strategies to realistically and gradually improve the current situation