WASTE WISE CITIES TOOL

Step by Step Guide to Assess a City's Municipal Solid Waste Management Performance through SDG indicator 11.6.1 Monitoring

Step-by-Step Guide to Assess SDG 11.6.1 Indicator
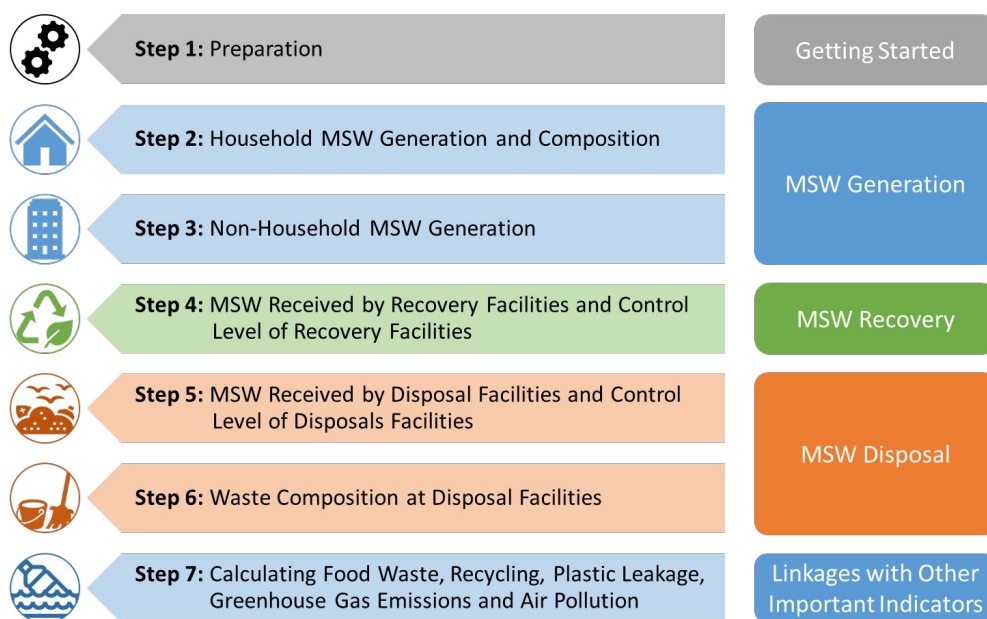
WASTE WISE CITIES TOOL'S 7 STEPS

The steps required to report SDG indicator 11.6.1 are divided into seven steps, following the waste management chain from generation to recovery and disposal. Additional steps will also be described in this chapter to identify the 'Access to Basic Municipal Solid Waste Collection Services' in relation to SDG indicator 1.4.1, and to identify the potential plastic emissions to the environment.

The steps a city needs to implement can be determined depending on the data available. UN-Habitat recommends cities to go through all the steps if the city has large amounts of uncollected waste or illegal dumping and has never done a waste amounts and composition survey (WACS) from households to estimate waste generation per capita, or if such a survey was conducted more than 5 years ago. In this context, it is important to understand that the waste received at recovery and disposal facilities sometimes does not represent the total MSW generated, especially in cities with large amounts of uncollected waste.

Cities that are confident about the accuracy of their total MSW generation data, are recommended to go through Steps 4 and 5 to identify the environmental and operational control level of their waste management facilities.

Figure 4: Waste Wise Cities Tool's 7 Steps

Step 1: Preparation	Getting Started
Step 2: Household MSW Generation and Composition	MSW Generation
Step 3: Non-Household MSW Generation	
Step 4: MSW Received by Recovery Facilities and Control Level of Recovery Facilities	MSW Recovery
Step 5: MSW Received by Disposal Facilities and Control Level of Disposals Facilities	MSW Disposal
Step 6: Waste Composition at Disposal Facilities	
Step 7: Calculating Food Waste, Recycling, Plastic Leakage, Greenhouse Gas Emissions and Air Pollution	Linkages with Other Important Indicators

STEP 1: PREPARATION

1.1 Gain political and senior management endorsement and support

It is important to gain the city's Mayor or top officials' support for the assessment. This will facilitate the different approval procedures and necessary resource mobilization within the city government. Make sure the intended purpose and significance of the assessment for the improved environmental management in the city is well communicated and gain political and senior management endorsement before starting the assessment.

1.2 Establish a working team

The whole assessment requires waste sampling from 10 households for 8 days in 9 survey areas (15 survey areas for mega cities[2]), which means waste from 90 households (150 households for mega cities) needs to be collected for 8 days. To implement this operation smoothly, establish a working team of **20-30 survey helpers who are dedicated full-time for 8-10 days, led by 2-3 well trained experts dedicated for a combined total of about 6 working weeks per city**. Members of the expert team need to be trained and familiarize themselves with the methodological steps, and should have a good understanding of MSWM systems, both concepts and flows.

A 1 or 2-day workshop should be organized to train the selected 20-30 survey helpers on the methodological steps, the purpose and importance of the assessment, the detailed survey requirements and environment, health and safety (EHS) procedures.

The following points should be taken into account when establishing the expert team:

» **Language:** make sure that at least one person from the expert team speaks the main local language/dialect fluently, and that the survey helpers cover the range of local languages/dialects prevalent in the survey area.

» **Mobility:** ideally most survey helpers should be based in the local areas where the assessment will be conducted.

» **Field visits:** the expert team, possibly accompanied by City officials, will have to conduct field visits to waste management facilities (recovery and disposal). Distance, accessibility and comfort of travel can greatly vary.

» **Environmental health and safety:** make sure that the survey team is briefed from the outset on EHS safeguards and procedures and provide the necessary tools, including personal protective equipment (PPE). --
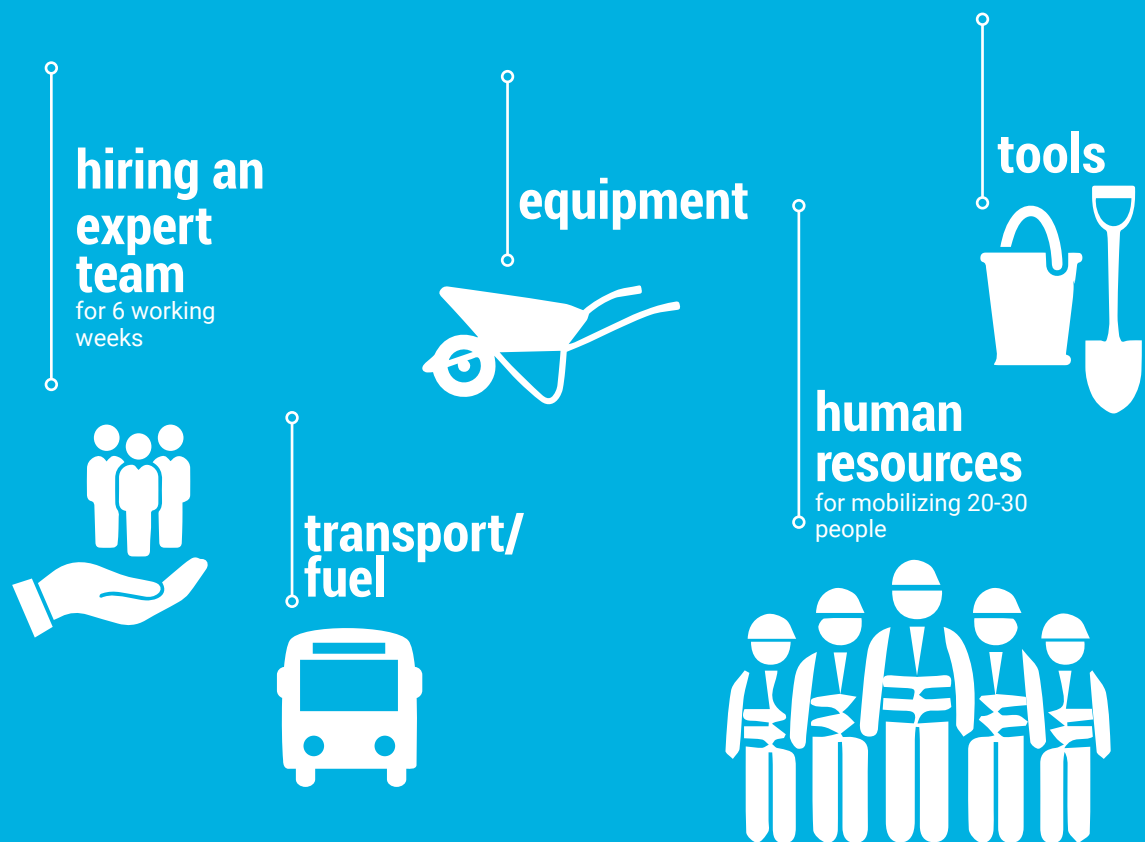
1.3 Prepare tools and equipment

The assessment requires waste sampling through visits to 10 households each from 3 survey areas (5 survey areas for mega cities) from 3 income groups (or household types), as well as waste composition analysis at the points of waste generation and disposal. The items to be made available are listed in Step 2 and Step 6.

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[2] Urban agglomerations having over 10 million inhabitants, "World Urbanization Prospects, The 2018 Revision" (PDF). UN DESA. Last access 18 June 2020. p. 55

PREPARATION
BUDGET FOR AND ORGANIZE FOR

hiring an expert team
for 6 working weeks

equipment

tools

transport/ fuel

human resources
for mobilizing 20-30 people

1.4   Identify key stakeholders and partnerships

Stakeholders include individuals and entities involved in the MSWM system in the city; those either providing, monitoring or receiving the service. Successful implementation of the assessment depends on identifying and obtaining information from the key stakeholders. The goal is to obtain as much accurate quantitative data as possible on MSW generated, collected, recovered and disposed. Gaining a clear understanding of the city's MSWM system is an essential basis for identifying key intervention areas for improvement.

Key stakeholders can include:

- **City waste management office and other departments**: Cities have statutory responsibilities for a wide range of MSWM service provisions. Different departments of the municipality besides the waste management department may need to be involved, including urban development authorities, business permit sections, environmental departments, public works departments and public health/hygiene departments

- **Public collection service providers**: often operated and supervised by the respective municipal department

- **Formal private collection service providers**: often collection services are outsourced to formal private companies or NGOs/CBOs which, in this case, are accountable to the municipality. Formal private collection companies may also be hired and paid directly by the waste generators (e.g. generators such as institutions, commercial units, industry).

- **Informal collection service providers**: organizations or individuals providing the collection service informally. These includes informal organizations or individuals providing collection services, picking recyclables from waste and/or collecting (or buying) recyclables from waste generators.

- **Informal and formal value chain enterprises:** businesses and enterprises based in the city that are involved in recyclables trading, including intermediate and apex traders.

- **Formal private recovery or disposal service providers:** registered or licensed entities involved in waste processing, recovery, and disposal. They have a business case to run their operations, need to adhere to regulations and are often supported by contract payments, gate fees or incentives from the city or national government.

- **Community-based organisations (CBOs)**: e.g. organisations engaged in self-help activities or in providing services in and to communities.

- **Non-governmental organisations (NGOs)**: organisations acting as intermediaries between governments and local communities, sometimes involved in solid waste service provision and/or providing support of informal collection/ recycling service providers.

- **National Ministries or environmental regulatory authorities** include the policy making, regulatory authorities, responsible for setting framework conditions, licensing/permitting, inspecting, and enforcing requirements for MSW collection, recovery, and disposal activities

- **Waste generators**: members of households, commercial units, institutions (schools, offices, etc.), industries, etc.

Stakeholder identification and analysis is typically an iterative process where, in interviews with stakeholders, information about other important stakeholders is obtained. Effective collaboration between key stakeholders is very beneficial. The waste management department needs to take the lead role as they will facilitate many steps of the process (contacting operators, accessing waste generators and community-based organizations, providing a list of waste collection, recovery and disposal companies operating in the city, etc.).

1.5   Prepare workflow and budget

The table below is an example workflow and lists the minimum human resources required from Step 2 to Step 7 put within 40 calendar days. Many of these steps and activities can take place in parallel if the size of the working team allows it, so the schedule can be compressed.

Preparation is of critical importance for the smooth conduct of the survey. The budget items required include hiring an expert team for a combined total period of approximately 6 working weeks, human resources cost for mobilizing 20-30 people for an 8-10 day survey, as well as tools, equipment and transport/fuel for survey activities.

Table 5: Typical workflow from Step 1 to Step 7

Activities	Days (shaded bars on a 1–40 day scale)	Minimum Human Resource Required
Step 1: Preparation		2-3 experts
1.1 Gain political and senior management endorsement and support	~Days 1–3	
1.2 Establish a working team	~Days 3–6	
1.3 Prepare tools and equipment	~Days 3–6	
1.4 Identify key stakeholders and partnerships	~Days 5–8	
1.5 Prepare workflow and budget	~Day 10	
1.6 Obtain necessary data from statistics office	~Day 10	
Step 2: Household MSW Generation and Composition		3 experts to supervise
2.1 Preparation	~Days 1–13	2 persons per survey are (18 people) for waste sampling
2.2 Waste sampling and waste composition analysis	~Days 13–21 (intermittent)	
2.3 Calculate per capita household solid waste generation	~Day 21	
Step 3: Non Household MSW Generation		1 person per survey area to visit and interview different premises
3.1 Using the proxy for non-household MSW	~Day 14	
3.2 Identify premises to interview	~Days 1–13	
3.3 Interview selected premises and each contracted collection company	~Days 14, 18–20	
3.4 Obtain waste data from public spaces	~Day 24	
3.5 Calculate MSW generated by non-household sources	~Day 25	
Step 4: MSW Received by Recovery Facilities and Control Level of Recovery Facilities		1-2 core members to establish contacts with recovery facilities
4.1 Identify recovery facilities	~Days 1–8, ~24	
4.2 Arrange visits and interviews with key recovery facilities	~Days 26–31	
4.3 Evaluate the level of control of recovery facilities	~Days 26–31	
4.4 Compile the collected information		
Step 5: MSW Received by Disposal Facilities and Control Level of Disposal Facilities		1-2 persons to visit disposal facilities to collect data
5.1 Identify disposal facilities	~Days 1–8, ~34	
5.2 Arrange visits and interviews with identified disposal facilities	~Day 35	
5.3 Evaluate the level of control of disposal facilities		
5.4 Compile the collected information	~Day 36	
Step 6: Waste Composition at Disposal Facilities		1-2 experts
6.1 Preparation	~Days 34–35	5-10 persons for waste composition survey
6.2 Waste sampling and composition analysis	~Day 37	
Step 7: Calculating food waste, recycling, plastic leakage, greenhouse gas emissions and air pollution		1-2 experts to observe different aspects of swm chain
7.1 Food waste	~Days 38–40	
7.2 Recycling	~Days 38–40	
7.3 City Plastic Leakage	~Days 38–40	
7.4 Greenhouse gas emissions and air polution	~Days 38–40	

1.6 Obtain necessary data from statistics office

The data necessary for the survey includes:

- Population of the city, if possible broken down in income categories; and

- Business licensing permit data (for non-household MSW estimation).

Population

Determining the population of the city can be done by the following sub-steps:

1. Find the official population census and check the year. If the data is not older than 5 years, use the data as it is. If the data is outdated, go to the next sub-step.

2. Check if an official population projection for your city is available from the national statistics office. If yes, use the data for the year you conduct the survey. If there is no official population projection data for the subject city, go to the next sub-steps.

3. If your city has more than 300,000 inhabitants, 'Population of Urban Agglomerations with 300,000 Inhabitants or More' data is available every two years from 'Urban Agglomerations' page at UN Department of Economic and Social Affairs Population Dynamics' World Urbanization Prospects website.

4. If your city has less than 300,000 inhabitants, 'Average Annual Rate of Change of the Urban Population' data is available from UN Department of Economic and Social Affairs Population Dynamics' World Urbanization Prospects website. Use this urban growth rate to estimate the current population in your city.

5. Additional to the overall population, find out if the city's or national statistics office have data on the distribution and share of high, middle and low-income groups in your city.

Business licensing data

Business licensing data may provide the number of units for different businesses and premises in the city, such as the number of beds for hospitals, chairs for restaurants, floor space for supermarkets, students for schools, etc. This data is essential to estimate MSW generation from non-household sources. Check if the data is available from the municipal or city statistics office for the system boundary and if the data is up to date (not older than 5 years).

If the data is neither available nor up to date, use the proxy to determine MSW generation from non-household sources (see Step 3).

STEP 2: HOUSEHOLD MSW GENERATION AND COMPOSITION

This step explains how to assess per capita household solid waste generation and average household waste composition. Apply this step if there is no up-to-date data on MSW generation and composition in your city. For this assessment waste samples are needed from a given number of randomly selected households. When selecting households, the following points need to be considered:

Waste generation differs according to the household's income-level or housing type, therefore waste samples should be collected from different income groups (or housing types) in the city;

Waste generation from households fluctuates depending on weekdays and weekends, therefore waste must be obtained daily throughout an entire week (7 days).

Human beings generate waste, not households. It is important to record the number of people actually living in the house, rather than taking the official average number of family members.

Waste generation varies seasonally, as well as during festive periods. It is important to take into account those local variables that may affect waste generation during the time of the survey.

Where large seasonal variations can be expected (very distinct dry and wet seasons for example), if possible, repeat the WaCT assessment. Keep in mind that every time the assessment is repeated, it is crucial to be

consistent with your method. This means, maintaining the same sample size and the same calculation methods. This will allow comparison of results at a later stage.

Waste characterization will be conducted in conjunction with waste sampling from households, and this information will give you a clearer understanding on the amounts of recyclables in your city's household waste. This information is essential, especially for expanding resource recovery efforts, and as first step towards establishing an urban circular economy.

2.1   Preparation

1. **Define sample size:** the sample size will determine the statistical significance of the results obtained. This is reflected by the statistical confidence level and margin of error. In a city with the population size of 10,000 – 10,000,000, at least 370 to 384 households need to be sampled in order to achieve the normally recommended values of a confidence level of 95% with a margin of error of 5%. However, in many situations, it may be unfeasible and costly to collect waste samples from 384 households for 7 days for a city, therefore this guide suggests to sample 90 households (10 households from 3 survey areas from high, middle and low income groups each[3]) for average cities and 150 households (10 households from 5 survey areas in high, middle and low income groups each) for megacities, which is still in the same confidence level, but with a margin of error of 10%.

2. **Select survey areas and households:** select 3 (5 for megacities) representative high, middle and low-income neighbourhoods[4] in your city and 10 households from each neighbourhood randomly. In cities where there is an updated and reliable digital census of households, the following methods could be used for simple random selection:

3   Or alternatively from three different housing types (e.g. low-income/slum dwellings, apartment blocks, individual houses.
4   Ibid.

- **Option A:** the simplest way is the lottery method, where each household in the income group is assigned a unique number and the sample households are selected from this thoroughly mixed list. This way, each household has an equal chance of being selected as subject.

- **Option B:** let a computer do a random selection from your list of all households in the selected neighbourhood.

- **Option C**: obtain a map of the city with larger scale than 1:2,500 and overlay a grid of 1cm x 1 cm over the map. Each cell represents a 25 m x 25 m piece of land on the map. Assign one number to each cell and randomly select 30 cells per survey area. One household per each cell will be the random sample of household. Once in the field, be consistent on how you select your sample household from each cell. For example, always start from the households

nearest to the top left corner of the cell and visit ground floor upwards in the case of high-storey buildings. If not successful, move to the next door and so on, always making sure you do not exit the cell of the grid.

- **Option D**: in the case of cities where households with different income levels are interspersed and it is difficult to clearly identify "areas" of low, middle and high income, use housing types to stratify your sampling areas instead. Obtain a map with the scale of 1:5,000 and overlay a 1cm x 1cm grid over the map. Select 30 cells randomly and identify one household per income level according to the housing types indicated in the table below.

Table 6: Housing types and income levels

Income Level	Housing Type Example
High	Luxury condominium, single detached house with garden, sophisticated alarm systems.
Middle	Apartments , single detached house without garden.
Low/ informal settlements	Slums, apartments with single rooms (apartments mud house, Rent less than 5% of GDP per capita

Figure 5: Household sampling

3. **Prepare informed consent letter from municipal government** explaining the purpose of the survey, how the information will be used and requesting the consent of households to participate in the survey. This can be shown, read to and signed by the selected households for waste sampling to obtain their consent, understanding and cooperation. Annex 1 provides an example letter.

4. **Prepare the survey team, equipment, and transport:** The below table shows the number of survey team members, transport for collected waste samples and other items needed per survey area and in total.

Table 7: Necessary tools and resources for household waste sampling

Things to Prepare	Quantity		
	1 Survey area	**9 survey areas (average city)**	**15 survey areas (mega-city)**
Survey team	2-3 people	18-27 people	30-45 people
Transportation for waste collection	1 collection vehicle trips	9 collection vehicle trips	15 collection vehicle trips
Liner bags (vol: 60L)	80	720	1200
Identification tape (tag bags)	1	9	15
Pens	3	27	45
Markers	1	9	15
Hanging Weighing scale (up to 60 kg)	1	9	15
Thick plastic sheet (at least 4 x 4 metres)	1	9	15
Waste containers or bags (60 L)	12	89	180
Scissors	1	9	15
Spades	1	9	15
Brooms	1	9	15
Camera/ Smart Phone	1	9	15
Reporting sheets	1	9	15
Informed consent letters (with space for signing and dating) for each sample member	10	90	150

The following table provides the list of compulsory personal protective equipment (PPE) required to conduct the waste composition survey. This is a basic requirement, and the list can be added to according to the specific situational requirements. The use of PPE is particularly important when the survey is conducted in a COVID-19 situation.

Table 8: Necessary PPE

Things to Prepare	Quantity		
	1 Survey area	9 survey areas (average city)	15 survey areas (mega-city)
Hat or cap (sun and dirt protection)	2-3	18-27	30-45
Glassess (eye protection)	2-3	18-27	30-45
Masks	2-3	18-27	30-45
Long sleeve shirts	2-3	18-27	30-45
Thick gloves	2-3 pairs	18-27 pairs	30-45 pairs
Apron (stomach protection)	2-3	18-27	30-45
Long pants	2-3	18-27	30-45
Rubber boots	2-3 pairs	18-27 pairs	30-45 pairs
Hand sanitizer	1	9	15
Disinfectant	1	9	15
Soap	1	9	15
First aid kit, including eye bath	1	9	15

5. **Mark each liner bag** with the house number and letter denoting the neighbourhood, the survey date and survey area. The bag will contain the waste generated in that household on the written date. Do not note the householder's name, in order to protect the confidentiality of the people who have kindly agreed to participate in your survey.

6. **Print recording sheets and prepare the WaCT Data Collection Tool**: Print the forms included in Annex 2 of this document and download the WaCT Data Collection Application (DCA) and Data Collection Manual (DCM) from the Waste Wise Cities website. Check for updated versions and make sure you are using the latest version. Carefully read the instructions on how to access and use the WaCT DCA so you can open and use the file.

7. **Find a location for the waste amounts and composition measurement:** According to the estimate of the volume of daily collected waste from the households, choose a site where you can store waste and conduct the measurement of waste as well as the composition survey. Ideally, this site should be flat and covered, have enough space, be accessible by vehicle, have access to water for drinking and washing purposes and offer protection from pests.

2.2   Waste sampling and waste composition analysis

The following is a suggested schedule for household waste sampling and composition survey, taking weekend days into consideration. Conduct the following exercise in all survey areas.

Day 0:   Deploy survey team for each survey area with marked liner bags, and distribute four linerbags with the dates of day 1, 2, 3 and 4 to each household. It is important to gain the household's consent and cooperation by explaining the purpose of the survey. Once the householder has agreed to participate, ask them to store **all** the waste generated that day at home in the respective bag and not to give any materials (e.g. recyclables) to anyone outside the home.

Day 1:   Use this day to check whether all the survey households have been identified, to overcome any problems or gaps, and to initiate the non-household waste survey (Step 3)

Day 2:   Weekend

Day 3:   Weekend

Day 4:   The survey teams collect the bags of day 1, 2 and 3 (filled) while distributing the two liner bags of day 5 and 6 to each household. Bring the collected waste to the identified location for sample measurement. Before beginning with the weighing and sorting, **it is important to discard the day 1 samples**, as these might contain waste generated before the start of the survey, which would distort the data. Measure the weight of waste generated on day 2 and 3 separately, following the below steps:

    a.   First, weigh the collected bags from each household (for each day) separately and record the weight in the sheet (Annex 2). Weigh an empty bag and deduct the weight of the bag from each sample weight. Remember, there is no need to weigh the bags from day 1, and these should already have been set aside.

    b.   Prepare the buckets labelled with the 12 sorting categories around the thick plastic sheet.

1. Kitchen/canteen	7. Glass
2. Garden/park	8. Textiles/shoes
3. Paper & cardboard	9. Wood (processed)
4. Plastic – film	10. Special wastes
5. Plastic – dense	11. Composite products
6. Metals	12. Other

    c.   After making sure that the individual sample weights per household per day have been recorded, open the bags and spread the waste on the plastic sheet. You can mix the samples together at this point, as the composition is an average for the whole sample (i.e. not per household per day).

    d.   Sort the waste into the 12 categories. Annex 4 contains a sorting guideline.

    e.   Weigh each fraction and record it in the sheet (Annex 3). Remember to subtract the weight of the empty container from the total weight.

Day 5: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 6: The survey teams collect the bags of day 4 and day 5 (filled) and provide the labelled bags for day 7 and 8 to each household. Process the collected waste following the same steps done on Day 4.

Day 7: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 8: Use this day to follow-up and cross check on the household sampling, overcome any problem or gaps, and conduct non-household waste survey (Step 3)

Day 9: The survey team collects the bags of day 6, 7 and 8 (filled) and repeats the same steps as on Days 4 and 6

The schedule is summarized in the table below for reference:

Table 9: Schedule for MSW generation survey

Day nº	Survey Teams	Households
Day 0	Distribute bags for day 1, 2, 3 and 4 to households Ask the number of people staying at households	Provide the number of people staying at household
Day 1	Use the day for non-household waste survey (Step 3)	Fill the bag of day 1
Day 2	Weekend	Fill the bag of day 2 Store the bag of day 1
Day 3	Weekend	Fill the bag of day 3 Store the bag of day 1 and 2
Day 4	Collect the waste bags from day 1, 2, and 3 Distribute empty bags for day 5 and 6 Discard the waste bag from day 1, do not weigh it or include it in the composition survey Weigh and conduct waste composition survey for waste bags from day 2 and 3 Insert data in the reporting sheet	Provide waste of day 1, 2 and 3 Fill the bag of day 4
Day 5	Use the day for non-household waste survey (Step 3)	Fill the bag of day 5 Store the bag of day 4
Day 6	Collect the waste bags from day 4 and 5 Distribute empty bags for day 7 and 8 Weigh and conduct waste composition survey on waste bags from day 4 and 5 Insert data in the reporting sheet	Provide waste sample of day 4 and 5 Fill the bag of day 6
Day 7	Use the day for non-household waste survey (Step 3)	Fill the bag of day 7 Store the bag of day 6
Day 8	Use the day for non-household waste survey (Step 3)	Fill the bag of day 8 Store the bags of day 6 and 7
Day 9	Collect bags of day 6, 7, and 8 Weigh and conduct waste composition survey for bags of day 6, 7 and 8	Provide waste samples of day 6, 7 and 8

Note:

If the climate does not allow households to store the waste for three days, arrange more frequent waste collection to obtain the 8 days waste samples. Make sure to discard the 1st sample.

Important:

Remind households not to sell or take out recyclables so that the genuine total waste generation in the household can be properly captured.

In some cases, you might need to collect the generated waste every day from the households. For such cases, use the following schedule:

**Table 10: Model waste sampling schedule for every day**

Day nᵒ	Survey Teams	Households
Day 0	Distribute empty bags for day 1 and 2 to households Ask the number of people staying at households	Provide the number of people staying at household
Day 1	Use the day for non-household waste survey (Step 3	Fill the bag for day 1
Day 2	Collect and discard the waste bags for day 1. Do not weigh or conduct composition survey on bags from day 1. Distribute empty bags for day 3	Provide waste bag from day 1 Fill the bag for day 2
Day 3	Collect the waste bags from day 2 Distribute empty bags for day 4 Weigh and conduct waste composition survey for bags from day 2 Insert data in the reporting sheet	Provide waste bag from day 2 Fill the bag for day 3
Day 4	Collect the waste bags from day 3 Distribute empty bags for day 5 Weigh and conduct waste composition survey for bags from day 3 Insert data in the reporting sheet	Provide waste bag from day 3 Fill the bag for day 4
Day 5	Collect the waste bags from day 4 Distribute empty bags for day 6 Weigh and conduct waste composition survey for bags from day 4 Insert data in the reporting sheet	Provide waste bag from day 4 Fill the bag for day 5
Day 6	Collect the waste bags from day 5 Distribute empty bags for day 7 Weigh and conduct waste composition survey for bags from day 5 Insert data in the reporting sheet	Provide waste bag from day 5 Fill the bag for day 6
Day 7	Collect the waste bags from day 6 Distribute empty bags for day 8 Weigh and conduct waste composition survey for bags from day 6 Insert data in the reporting sheet	Provide waste bag from day 6 Fill the bag for day 7
Day 8	Collect the waste bags from day 7 Weigh and conduct waste composition survey for bags from day 7 Insert data in the reporting sheet	Provide waste bag from day 7 Fill the bag for day 8
Day 9	Collect the waste bags from day 8 Weigh and conduct waste composition survey for bags from day 8 Insert data in the reporting sheet	Provide waste bag from day 8

Note: if you are able to store the collected samples in a cool and secure area, protected from flies, pests and animals, you may be able to weigh bags and conduct the waste composition surveys in accordance with the three times weekly schedule (Table 9) while still collecting waste bags daily from households.

2.3   Calculate per capita household solid waste generation

1. **Calculate average per capita household waste generation rate:** Enter the data into the WaCT DCA. The figure below shows how the per capita household waste generation is calculated from the data collected through the waste sampling. First, it is important to discard the sample from Day 1, as people tend to put waste in the bag which has been accumulating at their home, making the sample not representative. Second, take the sum of the results from the other 7 days and divide it by the number of days and the number of people residing in the household.

Figure 6: How to estimate household MSW generation per capita for a household
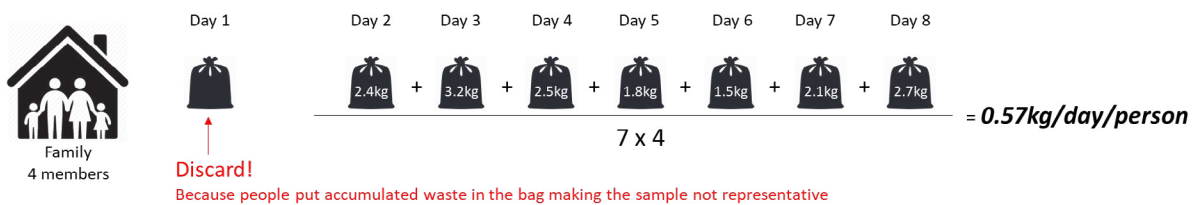
2. **Add population data for each income group:** Enter population data for each income group into WaCT DCA, then the automated excel sheet will provide total household solid waste generation in your city. This is calculated by multiplying the calculated per capita household waste generation per income level, by the population of each income level. All these are summed up to calculate the total household waste generation.

STEP 6: WASTE COMPOSITION AT DISPOSAL FACILITIES

This step provides the instructions to measure the composition of waste at disposal facilities. The waste composition survey takes one or two days.

6.1   Preparation

1. **Recruit and train workers:** for the composition survey around 15 workers are needed. If there are many waste pickers working at the disposal site, consider hiring some of them. All workers should be trained properly on the aim of the composition survey, the main steps and the health and safety procedures. Since sorting waste can be hazardous, personal protective equipment (i.e. gloves, masks and boots) must be used, avoid dehydration and take adequate breaks. Give clear instructions that if any medical or other hazardous waste is spotted in the sample, the sorting procedure must immediately stop.

2. **Acquire necessary equipment**: Table 12 shows the main items that are required for characterizing the waste at a disposal site. This includes a basic PPE requirement which can be added according to the specific situational requirements. The use of PPE is particularly important when the survey is conducted in a COVID-19 situation. Check with the disposal facility in advance whether they have some or all of these items, and whether there are additional requirements for fluorescent jackets, protective hats, and protective shoes (e.g. steel toe cap and soled boots).When working on a disposal facility, always take great care to ensure that your survey team strictly follows health and safety protection requirements.

Table 12: Items required for a waste composition survey per survey group

Items	Quantity
Pencil and notebook	At least one person noting
Recording sheet	3
Standing/ hanging weigh scale (up to 100 kg)	1
Shovels	8
Thick plastic sheet (at least 5 x 5)m	2
Waste containers or bags (60 L)	24
Scissors	2
Brooms	2
Camera/smart phone	1

Table 13: Necessary PPE Composition Analysis Disposal Site

Items	Quantity
Hat or cap (sun and dirt protection)	1 per survey team member
Glasses (eye protection)	1 per survey team member
Masks	1 per survey team member per day
Long sleeve shirts	1 per survey team member
Thick gloves	1 pair per survey team member
Apron (stomach protection)	1 per survey team member
Long pants	1 per survey team member
Rubber boots	1 pair per survey team member
Hand sanitizer	2
Disinfectant	2
Soap	2
First aid kit, including eye bath	1

3. **Prepare site for the survey:** find a place where you can store and handle a sample of around 200 – 300 kg of waste. Ideally, this site should be flat and covered, have enough space, be accessible to vehicles, and have access to water for drinking and washing purposes and offer protection from pests. Cover the surface with a thick tarpaulin, on top of which the waste sample will be deposited.

6.2   Waste sampling and composition analysis

1. **Number of samples:** for this assessment a minimum of 3 trucks per income level (low, medium and high) service areas (or correspondingly from different household-type service areas) needs to be sampled.

2. **Select trucks for waste sampling:** before selecting a truck for sampling, check with the truck drivers (or the disposal facility manager) from which area the truck is delivering the waste. Make sure only trucks containing purely MSW are sampled. Take a 200-300kg sample from the truck. Direct the driver to safely park alongside the tarpaulin. Deposit (either through hydraulic or manual unloading) the sample on top of the tarpaulin. Be extremely careful to ensure that the truck emptying process is safely completed, and that no one is in proximity to the falling waste as it is being unloaded.

3. **Quartering technique:** once you accumulated the MSW sample of 200-300 kg you need to derive a representative sample of around 50-70 kg for the analysis. The most commonly used technique for this is called "The Quartering Technique":

   • First mix the waste sample as thoroughly as possible. You can use your shovels for this.

   • Then spread out the waste on the surface so that it forms a flat layer.

• Divide the waste layer into four parts: ABCD (see Figure 11 left).

• From those four portions, discard two opposing quarters, say B and D.

• Mix the remaining two quarters.

• Repeat the quartering process once more. The derived sample will be approximately one quarter of the size of the original sample, around 50-70 kg.

4. **Sort the waste:** Prepare labelled containers and sort the sample of 50-70 kg into 12 categories in the respective container (see Figure 11 right):

1. Kitchen/canteen	7. Glass
2. Garden/park	8. Textiles/shoes
3. Paper & cardboard	9. Wood
4. Plastic – film	10. Special wastes
5. Plastic – dense	11. Composite products
6. Metals	12. Other

5. **Weigh the waste fractions**: weigh each fraction in their containers and record the weight. Remember to subtract the weight of the empty container from your results.

Figure 11: Quartering technique (left) and sorting (right)
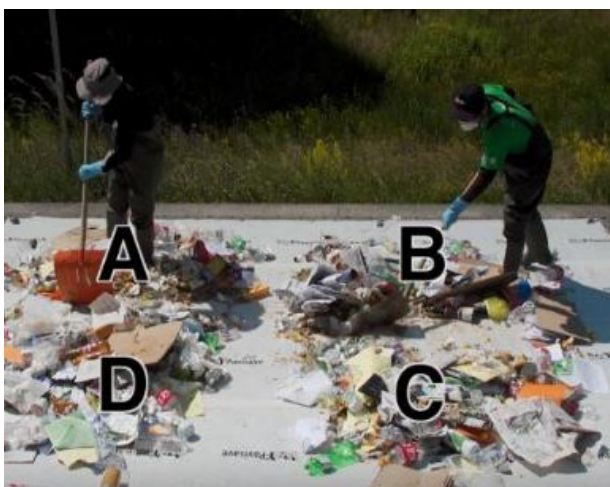
Annexes

Annex 1: Sample introduction letter

LETTER OF INTRODUCTION

Dear Madame, Sir,

We are glad to inform you that *[name of organisation/local government]* is conducting a survey to collect data on the Sustainable Development Goal indicator 11.6.1 in *[name of city/municipality]*. This includes collecting information and waste from households and institutions.

Background of the study is the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, which provides a shared blueprint for peace and prosperity for people and the planet, now and in the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action to all countries in a global partnership.

SDG 11 aims at "making cities and human settlements inclusive, safe, resilient and sustainable". Target 11.6 intents "by 2030, [to] reduce the adverse per capita environmental impact of cities, including by paying special attention to air quality and municipal and other waste management".

To monitor the progress towards this target, an indicator 11.6.1 "proportion of Municipal Solid Waste collected and managed in a controlled facility out of total Municipal Solid Waste generated, by cities" was set, and *[name of organisation/local government]* would like to obtain information to assess this. The data obtained from the survey will be used to develop strategies and plans to improve waste management and achieve better urban living environment for residents in *[name of the city]*.

We would appreciate your collaboration in allowing *[name of organisation/ local government]* staff to collect the information and material necessary for assessing SDG indicator 11.6.1.
Sincerely,

_____

Name of signatory
Position
Name of organisation/local government

Annex 2: Recording sheet for household waste sampling

This form should be used for each survey area.

Survey Area:	HH1	HH2	HH3	HH4	HH5	HH6	HH7	HH8	HH9	HH10
Number of residents										
Weight of bag (in kg)										
Day 2, Date:										
Day 3, Date:										
Day 4, Date:										
Day 5, Date:										
Day 6, Date:										
Day 7, Date:										
Day 8, Date:										

Annex 3: Recording sheet for waste composition analysis

This form should be used for both household surveys (Step 2) and disposal facility surveys (Step 6). Print one of these sheets for each survey area (total 9 sheets), and for the disposal facility composition survey (total 3 sheets).

| Survey Area: Categories	Composition analysis 1 (kg)	Composition analysis 2 (kg)	Composition analysis 3 (kg)	Sum (kg)	Average (kg)
1.Kitchen/ canteen waste					
2. Garden/ park waste					
3. Paper & cardboard					
4. Plastics - film					
5. Plastics - dense					
6. Metals					
7. Glass					
8. Textiles & shoes					
9. Wood (processed)					
10. Special wastes					
11. Composite products					
12. Other					
Total					

Annex 4: Sorting guideline

Waste shall be sorted in the following categories:

1	Kitchen/ canteen waste	Cooked or uncooked food, organic waste from food preparation
2	Garden/ park waste	Non-food biodegradable materials resulting from landscaping
3	Paper & cardboard	Paper & cardboard packaging, paper & cardboard products
4	Plastics - film	Thin plastic used in packaging and for other purposes
5	Plastics - dense	Hard plastics used in packaging and for other purposes
6	Metals	Ferrous and non-ferrous metals packaging and products
7	Glass	Glass packaging and products
8	Textiles & shoes	Clothes and other textiles, as well as shoes
9	Wood (processed)	Untreated and treated processed wood
10	Special wastes	Waste electric and electronic equipment (anything with a cable), batteries/ accumulators, other hazardous waste
11	Composite products	Products that are made of more than one of the above, for example drink containers ("tetra pack"), products made of a combination of plastic, metal and glass and similar.
12	Other	Anything that cannot be classified in one of the above categories

Remarks for sorting:

- **Packaged food**
  Separate as far as possible,
  e.g. eggshells in plastic packaging: put the egg shells to "1: Kitchen/canteen waste" and the plastic packaging to "5: Plastics – Dense"

- **Hazardous waste**
  Handle with care! Do not drain! Keep in packaging and classify content and packaging as "10: Special Wastes"
  Empty packaging is not any longer considered hazardous, thus classify it according to the packaging material.

1	Kitchen/ canteen waste
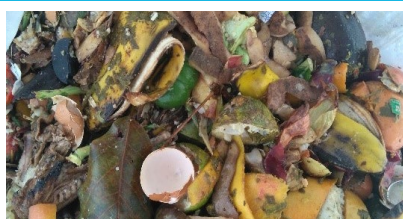
Bread, coffee grinds, cooked or uncooked food items, food leftovers, fruit and vegetables, meat and fish, pet foods, tea bags, peels, skins, shells, pips and stones,
etc.

2	Garden/ park waste

Flowers; Fruit and vegetable garden waste; Grass Cuttings; Hedge trimmings; Leaves; Pruning; Tree branches; Weeds,
etc.

3	Paper & cardboard

Brochures, magazines, newspapers; cereal packets, noodle boxes; Fast Food Paper bags/wrapping; Cards, books, wallpapers; Paper bags, tissue boxes, wrapping paper, tissue paper, Writing paper, printouts, envelopes, folders, files, letters, directories, tickets,

etc.

4	Plastics - film

Biscuit wrappers; Cling film; Frozen food bags; Packaging plastic film; Cellotape; Garden sheets; Non-packaging film; Plastic bags; waste liner bags;

etc.

| 5	Plastics - dense

All plastic bottles/jars;

Appliance packaging; Egg boxes; Food packaging trays; Plastic lids; Ready meal trays; Bank/credit cards; Buttons; CDs; music cassettes; Cosmetic/glue/paint applicators; lighters; pens;

etc.

6	Metals

Packaging for carbonated drinks;

Shoe polish cans; Tinned food; Aerosols (deodorant, perfume, hairspray); Aluminium foil sheets;

Other food/non-food/pet food containers;

Bike parts; Building materials; Car parts; Cutlery; Keys; Metal shelves; Nails; Paper clips; Plumbing; Pots and pans; Radiators; Ring pulls; Safety pins; Screws; Tools; Locks;

etc.

7	Glass
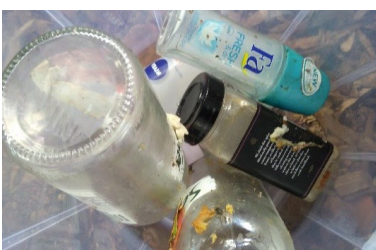
Alcoholic and non-alcoholic drinks bottles/jars;Food jars;

Medicine bottles;Cookware;Flat glass (e.g. table top, window, mirrors, reinforced, windscreens);Mixed broken glass;

etc.

8	Textiles & shoes

Clothes

Balls of wool; Blankets; Carpets; Cloths; Cords; Curtains;

Household soft furnishings and upholstery; Mats; Pillow cases; Rags; Ropes; Rugs; Sheets; Threads; Towels;

Shoes (incl. flip-flops);

etc.

9	Wood (processed)

Bottle corks, Cork packaging,: Pallets;

Solid timber and timber fragments;

Particle board (e.g. chipboard, plywood, mdf)

Wood fencing; Wooden furniture; Wood work tops;

etc.

10	Special wastes

All Waste Electric and Electronic Equipment, such as clocks, toaster, electric tools, hair dryer, telephones, Laptops, PCs, printers, screens, smoke detector, etc;

Batteries/Accumulators (e.g. Lead acid, Nickel cadmium, Lithium Ion);

Other Hazardous Waste such as Asbestos; Fire extinguishers; chemicals; Glues and solvents; Medicines; Paint products, etc.;

Used face masks and gloves

11	Composite products

Composite Packaging, such as Aluminium-foil coated card and drinking containers ("tetrapack");

Products made out of different materials, e.g. Scissors, knifes, razors, umbrellas, etc.

12	Other

e.g.

inert (Boulders; Bricks; Gravel; Pebbles; Sand; Soil; Stones; Ceramics, Clay plant pots; Crockery; Stone/ceramic floor and wall tiles; Vases);

Nappies/diapers;

Rubber;

Light bulbs (all kinds)

WASTE WISE
CITIES