

Tool 7.2.2 – Guide – Waste Audit

This guide applies to household and non-household waste generators (including commercial, institutional, and public spaces) for waste audits. In the following sections, relevant differences are highlighted. Whenever information applies to both waste generators, they are referred to as participants.

1. Plan and prepare the study

1.1 Household audit sample size

To select your sample size, a brief introduction to statistics is recommended. To conduct a representative study, **at least 96 samples should be chosen**. This sample size corresponds to a 95% confidence interval and an error of 10% for a population of 10,000 to 100,000, which is an acceptable trade-off between the precision achieved and the efforts required. For much larger population sizes, or if you aim for a lower error, you can use a sample size calculator online and define your sample size.

Income level and higher levels of goods consumption can greatly influence waste generation and composition. For this reason, it is recommended to **cluster the study if significant consumption differences are expected. This could be done according to income level, housing type or your own categories, considering access to consumer goods**. If there are low-, middle-, and high-income areas, you would sample 32 households in each region and perform your analysis, showing results based on the income level. When the income level is unknown or in cases where households with different income levels are interspersed throughout the same area, housing type can be used as a proxy for the clustering. Note that if you proceed to use clusters, you will need to have information about how many households or populations are part of each category that you defined to use your results to calculate total waste generation. Alternatively, distribute your samples proportionally to the number of households within each cluster. You can then calculate a unique result that would be a representative average value for your city or area of interest.

1.2 Non-household audit sample size

Waste generator type and unit of aggregation

There are multiple types of non-household municipal solid waste (MSW) generators. Typically, this includes commercial, institutional and public waste. In other contexts, such as refugee camps, for example, other non-household generators can be considered, including warehouses or distribution centres. List the non-household waste generator types relevant to your area of interest.

In the case of a non-household waste audit, you must define the unit of aggregation per waste generator type. The unit of aggregation is the unit that will allow you to calculate the total waste generation per type of waste generator. It is equivalent to the “per person” when assessing waste generation at the household level. **Table T 7.2 A** Suggests some recommended units of aggregation. You must group the types of generators in clusters that are expected to be similar generators, for which the aggregation unit makes sense and represents all of them. For example, it may be necessary to differentiate markets into subgroups based on the type of goods sold (e.g., food markets, clothing markets, etc.). When defining a waste generator type and the corresponding unit of aggregation, you must ensure that the following assumption makes sense:

All the waste generators in a given type are considered to generate a similar amount of waste per unit of aggregation, and/or there is no reason to believe there are particularities that would differentiate them in terms of waste generation. This hypothesis is critical as you will audit a sample of the waste generators and then use this data to extrapolate the total amount of waste generated by all the waste generators in each type.

As you define the unit of aggregation, keep in mind that for each type of waste generator, you will need to gather information about the total number of a given aggregation unit in your area of interest. For example, if you decide to use the number of students as a reference for schools, you will need to gather information from all the schools in your area about their total number of students. The aggregation unit must be a reasonable measure that allows you to obtain information about. The planning department or responsible entity can help you decide on the segregation unit to use and inform you about the data availability for each one. To list your waste generators, you can use the provided template in **Tool 7.2.3 – Reporting Sheet**.

Table T 7.2 A: Suggested units for aggregation (UN-Habitat, 2021. Waste Wise Cities Tool.)

Generator type	Recommended unit of aggregation	Comment
Hotels	# of beds	If there is a shopping centre or restaurant within the hotel, assess separately.
Restaurants	#of tables/chairs	
Shops	# shops / # square meters	
Supermarkets	# square meters	
Schools	# of pupils, of students	If there is a canteen, assess it separately as a restaurant Consider whether they are boarding schools or not
Offices	# of employees, square meters	If there is a canteen, assess it separately as a restaurant
Markets	# of stalls	Consider the type of goods (vegetable market vs electronics market)
Hospitals*	# of beds	
Public spaces	# square meters	Differentiating public spaces by their frequency of use, if possible, is recommended.
Food distribution centres	# people served	
Camp infrastructure	# people served	
Humanitarian agencies	# employee	
Warehouses	# people served	

**Hospitals generate municipal solid waste (MSW) as well as hazardous health care waste. Ensure that you capture only the MSW fraction and that hazardous healthcare waste is separated for safety reasons, as healthcare waste must be managed separately.*

Sample size

In contrast to the definition of sample size for household waste, the sample size for non-household waste should be determined with more considerations than relying solely on statistical calculations. The sample size can be defined for each type of waste generator, taking into account the following:

- **Give more importance to waste generator types that are expected to be the highest contributors to overall waste generation in your context.** If some waste generator types are expected to generate insignificant amounts of waste, you can decide not to audit them. Instead, you could apply a simple survey or even ignore them, as they are expected to contribute very little to the total waste generation by non-household waste generators.
- When there is a small number of waste generators per type (<100), statistics tell us that we should assess a high number of them to be statistically significant. Nonetheless, this could result in an unrealistic amount of effort being required to gather the data. Instead, aim to measure waste generation at 10 to 20 % of the waste generators (and at least one waste generator).
- **Do consider the share of units of aggregation of each waste generator of a given type, and not only the number of waste generators.** For example, having small schools with hundreds of students and one huge school with several thousand students, it might be prudent to separate these waste generators into two types. You would then audit the large school and a sample (10-20%) of the smaller schools.
- When there are a large number of waste generators of a given type (>100), you can rely on sample size calculations for your sample size. Use an online sample size calculator with the following parameters: a 95% confidence level, a 10% margin of error, and a population proportion of 50%. This could be the case, for example, for small shops or restaurants in a city. You can use this calculator, for instance: <https://www.calculator.net/sample-size-calculator.html>.

Remember that you will use the results measured from your samples to extrapolate the total amount of waste generated for the entire waste generator type. Make your own judgement based on common sense to assess whether the sample size is realistic for auditing and would yield a representative result for the entire waste generators of a given type category. You should strike a balance between the feasibility of the audit in terms of the work required and assess whether it is feasible. Reducing the number of samples is always possible, but it would yield less precise results. You can use the provided template to report the sample size in **Tool 7.2.3 – Reporting Sheet**.

Income level and higher levels of goods consumption can greatly influence waste generation and composition. For this reason, it is recommended to **cluster the study if significant consumption differences are expected. This could be done according to income level or your own categories, considering access to consumer goods.** If there are low, middle, and high-income areas, you would need to sample in each region and perform your analysis, showing results based on the income level. Note that if you proceed to use clusters, you will need to have information about how many units of aggregation are part of each clustered category that you defined to use your results to calculate total waste generation. Alternatively, distribute your samples proportionally to the number of aggregation units within each cluster. You can then calculate a unique result that would be a representative average value for your city or area of interest.

1.3 Waste types

The following Table T 7.2 B shows a list of 11 waste categories that can be used to classify waste. These categories can be further detailed; for example, plastic can be disaggregated into polymer types (such as PET, HDPE, and LDPE) or into categories reflecting local consumption trends, like diapers. Nonetheless, you are free to provide further details on the waste categories – for example, you might be interested in obtaining more detailed information regarding plastic types and subdividing the plastics into several categories.

Table T 7.2 B: proposed general waste type for waste composition study

Organic Food/Kitchen Waste
Organic Garden/Wood Waste
Paper and cardboard
Plastics
Metals
Glass
Textiles and shoes
Wood
Special wastes
Composite products
Other

Note that in some contexts, waste generators may use specific fractions, such as organics, to feed animals or recover materials for small income generation. In this case, it might not be convenient to ask them to hand in these materials when collecting the waste for the audit. An option would be to measure them daily, directly at the household, or to decide that this information is not part of your study – and make this clear in the study report.

1.4 Waste segregation and number of bags per day

During your waste audit, you can request that households and/or non-household waste generators use one bag per day to dispose of all their waste, which would then be mixed. Nonetheless, it may be relevant to request that participants use more bags and segregate their waste, especially in cases where they already do so daily. You could distribute **one, two or even three bags for each fraction**, which will make it much easier for you and your team to characterise. This will also help prevent confusion for the participants and allow them to continue with their regular practices—for example, using one bag for organics, one for recyclables, and one for residues. If you anticipate that significant hazardous waste will be generated (e.g., needles, PCR test samples), consider distributing a separate bag for participants to segregate this stream, allowing the characterisation study to be conducted safely for your team.

Some participants may feel uncomfortable sharing their waste with you. Make sure to highlight to them that the bags are anonymised, and that it is essential they put all of their waste generated into the bag, including the waste they usually self-manage.

Note that in the following sections of this guide, we assume only one bag is given; you should adapt your process accordingly if you decide that receiving several bags per day is more convenient.

1.5 Study length and seasonality

Waste generation and composition fluctuate; therefore, the proposed length of a waste audit is a complete week. It is **recommended to conduct a waste audit for an entire week to account for variations in** waste generation and composition. Furthermore, waste generation and composition might vary according to seasons (e.g. dry/rainy) or during holidays or special events. It is essential to plan your study and consider these variations. It is recommended to perform the survey during a typical week. For comparability, the study design should be kept identical when repeated during another season or for monitoring and comparability purposes throughout the years.

1.6 Inform and engage local authorities and key stakeholders

Key stakeholders who must be informed about your study and engaged as much as possible are the local authorities and the service provider. The local authorities can help by providing support to the initiative, especially with a signed information letter to hand to households and/or non-household waste generators to formalise the process. An example letter is given in [Annexe 1 of the Waste Wise Cities Tool \(UN-HABITAT, 2021\)](#). This could be signed by the municipality, a local leader, or an organisation (responsible for WASH coordination, for example).

The waste management company or entity responsible for waste management must also be informed to prevent inadvertent interference in the process. They can play a key role by providing space, transport, equipment, materials, and personnel for the study.

It is also essential for local stakeholders to be engaged, as they might benefit from redoing a waste audit in the future. Being fully involved in this process will help them learn, become empowered, and take ownership of the generated data, which is key to ensuring sustainability and long-term impact.

1.7 Locate an adequate site for weighing, sorting and doing the composition study

To perform a waste audit, you need a dedicated place where your team can work. This space should have the following characteristics for it to be convenient and safe:

1. Flat and covered area of at least 15m²
2. Located at a convenient distance from sampled households and/or non-household waste generators and accessible by vehicle
3. Have access to water for drinking and washing purposes
4. Restricts access from animals and pests, especially if you plan to store waste overnight

For large waste generators, it would make sense to allocate a space on-site for conducting waste audits for these individual generators. For example, if you need to assess the waste generated at a market, conducting the assessment on-site would significantly reduce the efforts required, as transportation to another location would not be necessary.

1.8 Consideration for large waste generators

For some large and complex waste generators, it may be necessary to inform them in advance and schedule meetings with their managers and waste handlers to discuss arrangements and plan the study. Analyse whether, in your case, advance notice is required and plan to include this additional process. Large waste generators may also require special considerations, such as measuring and analysing the waste on site, and you need to assess whether this is feasible and acceptable. Other options might be required, such as measuring the waste on a weighbridge. This can be the case for any waste generator, depending on its size, but will likely be required for humanitarian agencies, markets, public spaces, shopping malls, and large offices, schools, or hotels.

The daily measurement schedule proposed as a standard could also be adapted for large waste generators. Nonetheless, it must be ensured that the measured waste corresponds to the number of days accounted for in the study and that a typical week is captured in its entirety. You could arrange to start the audit the day after the waste collection service collects waste from this large generator and measure all the generated waste for a whole week. In your process, decide whether it is more convenient to do it daily, several times a week, or just once at the end of the week.

Note that collaborating with the company or entity responsible for waste collection is recommended, as they can provide support with means that may be necessary for assessing large waste generators, such as trucks or a weighbridge. Transportation of the waste to the disposal site after the assessment would also require coordination.

1.9 Train the audit team, plan for materials, equipment and transport

1.9.1 Transportation

You will need to secure transportation for collecting waste from households and/or non-household waste generators, and organise the logistics and schedule for the collection. There are various options for collecting and transporting waste. According to the location of the participants, the available transportation means, and the road quality, you can define how the waste will be collected. You might use one or several vehicles that stop at each location or at intermediate transfer points. Team members could also use individual motorbikes or handheld carts; they could either directly transport the waste to the handling area if it is nearby or bring the waste to a transfer point, from which a larger vehicle could transport it. You can also consider having mini-sorting stations where the team brings the waste on foot to a decentralised location for the audit.

1.9.2 Sizing the audit team

Household waste audit

The size of your audit team will highly depend on the location of the households and the time required to collect the waste. It will also depend on the type of schedule that you decide to implement. For the audit, you can estimate that one person can collect, sort, and characterise approximately 50 kg of waste per day. As a rough estimate, for 96 households with an average of five persons per household and producing an estimated 0.5 kg/person/day, this would require 5 team members for waste characterisation. Additionally, you need to account for the team that will **collect the waste from the households, which could range from 10 to 20 persons, depending on the location, access to the households**, and the methods of collection used. You may want to coordinate with the waste management entity and discuss with them what they consider appropriate and feasible. A **team coordinator, as well as someone responsible for supervision and monitoring of the work**, is also required.

Non-household waste audit

The size of your audit team will highly depend on the number of samples, the location of the sampled waste generators, and the time required to collect the waste. Ideally, you should engage the same team and the one involved in the household audit, and organise the non-household audit within the same time frame as the household one, if possible.

Regarding weighing and conducting the waste composition study, it can be estimated that one person can manage approximately 50 kg of waste per day. You should estimate the amounts of waste you expect to handle and then assess how many personnel you would need to characterise the waste. If you have large waste generators in your samples, consider a specific team to run the audit on-site when possible. As a rough estimate, at least 5 team members would be needed for waste characterisation. Additionally, you need to account for the team that will **collect the waste, which could be 10 to 20 persons**, depending on the location, access to the waste generators, and the methods of collection used. You may want to coordinate with the waste management entity and discuss with them what they consider appropriate and feasible. A **team coordinator, as well as someone responsible for supervision and monitoring of the work**, is also required.

1.9.3 Training the audit team

For the waste audit to run smoothly, you will need to train your team. You can prepare your training using and adapting the provided PowerPoint template: **Tool 7.2.4 – Training Template**. Each involved member will need to be trained on the following aspects:

- **Risks:** There are several risks when working with waste, and each individual must proceed with care to protect themselves and the rest of the team. A critical point is to account for the fact that we do not know what is inside the bags and that dangerous/hazardous items can be present. For example, sharp objects could cause cuts or punctures. Used needles can also be present. A key message to communicate is always to expect a dangerous object to be mixed in with the waste and to avoid plunging your hand deep into it. Instead, use the available tools and only touch and grab what you can see. When potentially dangerous objects are found, notify the team, set them aside, and manage them separately to prevent them from posing a risk to anyone.
 - **Safety and use of the personal protective equipment (PPE):** The use of the PPE is sometimes strenuous, but it is there to protect the health of each individual involved in the waste audit. Remind the team of the importance of using the equipment and ensure its proper use during the process. Eating and drinking outside of the work zone, only after washing your hands and face. Do not touch your eyes or face with gloves which are contaminated by the waste.
 - **Waste types:** Based on the waste types that you have decided to characterise, your team must be informed and trained to recognise and segregate the waste into such categories. You can train them with pictures and explanations for each type of waste, and be proactive when supervising and directing the team during the waste characterisation process.
5. **Schedule and process:** Each team member should understand the overall process and schedule. Additionally, each team member should be clearly informed of their roles and responsibilities, including advising and instructing participants, labelling and checking waste bags, collecting waste bags, weighing and segregating waste into categories, and reporting. Ensure that bags are clearly labelled with date and unique ID, as this will enable you to match the bag with the household and/or non-household waste generator when reporting the bag's weight. Staff should ensure that the bags are well-labelled when giving them to participants and double-check that the labels are readable when collecting the bags as well.

- **Information and instructions to the participants:** it is key that participants are well informed and understand their role in the process. You can use the provided draft template and adapt it to your needs: **Tool 7.2.5 – Instructions Template**. The information should contain the following:
 - o General objectives of the process, instructions and informed consent
 - o That all information gathered is handled confidentially
 - o Schedule for the collection of the waste
 - o To not use the regular waste collection service
 - o To not burn or dump waste
 - o To gather all the waste generated each day and dispose of it in the bags of the study
 - o If relevant: specific instructions in case of use of organics or recyclables (for example, to keep using them typically, that they will be measured each day at the door or not measured)
 - o To use one bag per day and to store it until the team comes to collect it (according to the schedule) – *it could be several bags if segregation is requested*
 - o That they will receive new bags (according to the schedule) every day
 - o Instructions in case nobody is home when waste is meant to be collected (deposit waste in a safe spot and indicate how you will hand in the new bag for the following day)
 - o For households: that they should inform all family members of the process, to avoid confusion within the household
 - o For non-households: that they should inform all persons involved in and relevant to waste management of the process, to avoid confusion, especially at large waste generators involving many persons.
 - o For needles and sharps, if possible, hand them in separately (applies only if needles are expected to be generated mainly at the household level). Providing a safe container might be necessary.
 - o To not change their habits for the study and discard only the daily waste as they usually do. In areas where waste collection services are not functioning well, households and/or non-household waste generators may take advantage of the study to dispose of accumulated waste. Informing participants to fill the bags with the daily waste generated is very important.
 - o Provide contact information in case they have any concerns or questions regarding the study.

1.9.4 Equipment and materials

The following **Table T 7.2 C** shows an estimate of the equipment and materials required for a waste audit of 96 households, as well as indicative values for a non-household waste audit (depending on the sample size).

Table T 7.2 C: required equipment and materials estimation

Item required	Estimated amount
Waste bags (60L)	Household: 800 (based on 1 bag per household per day) non-household: at least eight bags per waste generator sampled (1 per day) – consider large generators & consider if several fractions are segregated
Stickers to identify participants (<i>optional</i>)	As per the sample size
Identification tape to tag bags	1 per collection team
Pens	1 per staff
Markers	1 per collection team
Small scale up to 5 kg	1
Larger scale up to 30 kg (hanging scale)	1
Thick plastic sheet for floor protection	15 m ²
Containers for waste or bags (60L)	1 per waste category (and for each day if bags)
Scissors or a knife	1-2
Brooms	2
Shovel	2
Rake	2
Tool 7.2.3 – Reporting Sheet HHWasteAudit non-HHWasteAudit	1 per collection team and 1 for the supervisor
Tool 7.2.3 – Reporting Sheet HHWasteComposition non-HHWasteComposition	1 for supervisor
Informed consent letters	Households: 96 Non-household: as per sample size (0 if consent requested and given orally)

For the convenience and safety of your staff, you would also need:

1. Soap and water point
2. Hand sanitiser
3. First aid kit, including eye bath

1.9.5 Personal Protective Equipment (PPE)

For each team member who will be in close contact with waste, and especially when waste is taken out of the bags for processing, the following PPE is needed:

1. Hat or cap to protect from the sun and dust
2. Protective goggles
3. Face masks
4. Long sleeves and long pants clothing or overalls
5. Thick gloves – water resistant
6. Boots – water resistant (rubber boots, for example, or work-appropriate footwear)

1.10 Prepare official information and informed consent letters

To inform and request consent from households and/or non-household waste generators, you should prepare an official information letter and an informed consent letter that can be signed. The consent can also be given orally, simply by asking if the individual is willing to participate in the study. The information letter should include general information about the study, its objectives, the schedule, and the instructions that participants should follow. The authorities could endorse it through a signature.

1.11 Determine sampling points

Household

To guarantee representativeness of the study, your sampling points should be selected randomly. You have several options to do so:

1. **Lottery method:** each household in a given income group is assigned a unique number and randomly picked. You can complete this process by physically printing and randomly selecting the numbers, or by using a computer for random selection. For this method, you need to have a list of all the households available.
2. **Map and grid method:** Use a map of your area with a 1:2'500 scale and overlay a 1 cm x 1 cm grid. Assign a number to each grid cell and randomly select the sampled cells. You will then select a household from each of the chosen cells. To do so, use a consistent method for each cell; for example, start at the centre of the cell and visit the closest house to this point. If the household does not accept participation, proceed to the next nearest household and continue this process.

Non-household

For non-household waste generators, the most practical method is the lottery method. Each waste generator in a given group type is assigned a unique number and is then randomly selected. You can complete this process by physically printing and randomly selecting the numbers, or by using a computer for random selection. For this method, you need to have a list of all the waste generators available.

Representative areas

To ease logistics and limit the travel distance required to collect waste, the study can be performed in selected areas considered representative of the study area. Select **at least three representative areas within your study boundaries and apply random selection to each of them, distributing the number of samples equally across** each area. When relevant to cluster per income levels or other factors that you consider appropriate for waste generation, select at least one representative area for each category, such as low, middle, and high-income levels.

You must report **the method used for the study to be comprehensive, comparable and replicable in the future.**

1.12 Validate the schedule and confirm dates

There are several scheduling options for the waste audit. If possible, collecting daily is preferred, but it is more work-intensive as you will have to visit households and/or non-household waste generators daily. It is also possible to opt for a less frequent collection if you consider that participants can keep the waste for a longer period. In this case, you will need to distribute several bags to the participants and instruct them to use one bag per day. A daily schedule is shown in Table T 7.2 D.

Important point that you should consider for the schedule:

1. Visit the households and/or the non-household waste generators at the same time of the day throughout the study to ensure 24 hours of waste generation can be computed
2. Respect your schedule and don't miss a collection day to avoid confusing the participants
3. Waste should be processed as soon as possible, as decomposition is ongoing and will make the process more strenuous if too much time passes, especially in warm climates. In cooler climates, it may be possible to store the waste in a cool, covered place and process it within 2 to 3 days after it was generated. The stored waste must be kept in a cool, covered area and protected from flies, pests and animals.

Table T 7.2 D: example of waste sampling schedule for household and/or the non-household waste generators waste audit – with daily collection (adapted from UN-Habitat, 2021. Waste Wise Cities Tool)

Day	Team	Participant
Day 1	Enrol the household and/or non-household waste generators in the study – obtain informed consent. Register the number of persons living in the household, or register the number of units for aggregation for non-households Distribute labelled bag n°1	Use bag n°1 to dispose of all waste from day 1
Day 2	Collect bag n°1 Distribute labelled bag n°2 Discard bag n°1 – do not weigh or perform a composition study	Hand over bag°1 Use bag n°2 to dispose of all waste from day 2
Day 3	Collect bag n°2 Distribute labelled bag n°3 Weigh each bag on day 2 and report the weight Measure the sample composition on day 2	Hand over bag°2 Use bag n°3 to dispose of all waste from day 3
Day 4	Collect bag n°3 Distribute labelled bag n°4 Weigh each bag on day 3 and report the weight Measure the sample composition on day 3 and report the results	Hand over bag°3 Use bag n°4 to dispose of all waste from day 4
Day 5	Collect bag n°4 Distribute labelled bag n°5 Weigh each bag on day 4 and report the weight Measure the sample composition on day 4 and report the results	Hand over bag°4 Use bag n°5 to dispose of all waste from day 5
Day 6	Collect bag n°5 Distribute labelled bag n°6 Weigh each bag on day 5 and report the weight Measure the sample composition on day 5 and report the results	Hand over bag°5 Use bag n°6 to dispose of all waste from day 6
Day 7	Collect bag n°6 Distribute labelled bag n°7 Weigh each bag on day 6 and report the weight Measure the sample composition on day 6 and report the results	Hand over bag°6 Use bag n°7 to dispose of all waste from day 7
Day 8	Collect bag n°7 Distribute labelled bag n°8 Weigh each bag on day 7 and report the weight Measure the sample composition on day 7 and report the results	Hand over bag°7 Use bag n°8 to dispose of all waste from day 8
Day 9	Collect bag n°8 Give compensation (if applicable) Weigh each bag on day 8 and report the weight Measure the sample composition on day 8 and report the results	Hand over bag°8

Suppose households and/or the non-household waste generators can store the waste for more than a day. In that case, several bags can be handed over to the household at a time and collected every 2 or 3 days. Note that in this case, participants must be instructed to follow the process of using one bag per day and storing the used bags safely. This method will require less frequent waste collection but a higher workload on the days of collection, as several days of waste will need to be processed. A schedule with less frequent collection is shown in Table T 7.2 E.

Table T 7.2 E: example of waste sampling schedule for household and/or the non-household waste generators waste audit – with non-daily collection (adapted from UN-Habitat, 2021. Waste Wise Cities Tool.)

Day	Team	Participant
Day 1	Enrol the household and/or non-household waste generators in the study – obtain informed consent. Register the number of persons living in the household, or register the number of units for aggregation for non-households Distribute labelled bag n°1	Use bag n°1 to dispose of all waste from day 1
Day 2	Collect bag n°1 Distribute labelled bags n°2 and 3 Discard bag n°1 – do not weigh or perform a composition study	Hand over bag°1 Use bag n°2 to dispose of all waste from day 2
Day 3		Store bag°2 Use bag n°3 to dispose of all waste from day 3
Day 4	Collect bag n°2 and 3 Distribute labelled bags n°4 and 5 Weigh each bag on days 2 and 3 and report the weight Measure the sample composition on days 2 and 3 and report the results	Hand over bag°2 and 3 Use bag n°4 to dispose of all waste from day 4
Day 5	<i>Can be used to process waste of day 3 (only if storing conditions are appropriate)</i>	Store bag°4 Use bag n°5 to dispose of all waste from day 5
Day 6	Collect bag n°4 and 5 Distribute labelled bags n°6, 7, and 8 Weigh each bag on days 4 and 5 and report the weight Measure the sample composition on days 4 and 5 and report the results	Hand over bag°4 and 5 Use bag n°6 to dispose of all waste from day 6
Day 7	<i>Can be used to process waste of day 5 (only if storing conditions are appropriate)</i>	Store bag°6 Use bag n°7 to dispose of all waste from day 7
Day 8		Store bag°7 Use bag n°8 to dispose of all waste from day 8
Day 9	Collect bags n°6, 7, and 8 Give compensation (if applicable) Weigh each bag on days 6, 7, and 8 and report the weight Measure the sample composition on days 6, 7, and 8 and report the results	Hand over bag°6, 7, and 8
Day 10	<i>Can be used to process waste of days 7 and 8 (only if storing conditions are appropriate)</i>	

2. Conduct the study

2.1 Enrol the participants

On the first day of the study, the team should visit each household and/or the non-household waste generators to enrol them. Ensure that households and/or non-household waste generators are asked to participate and that they do so willingly. Give instructions and hand in the information sheet and the first bag. To identify participants and remember which ones to visit, a sticker can be used to mark them. You need to **register the number of persons living in the household at the time of the study** or **the number of units for aggregation for non-household waste generators**, as this is an indispensable piece of data required for the study. You can use the **Tool 7.2.3 – Reporting Sheet** to do so. Each participant will also be assigned an ID, which must be maintained throughout the study. Use a map to report the locations of the households and/or the non-household waste generators, along with their unique IDs. A good practice is to have your team record the GPS position and tag it with the unique ID. Throughout the process, refer only to the unique ID if necessary and never disclose the name to respect the participants' privacy.

2.2 Prepare the site for the weighing and characterisation process

Bring all the equipment and materials to the site. If the site is closed and secure, you could leave all of it there throughout the study. Use the plastic sheet to cover the floor where the waste will be manipulated.

2.3 Collect waste bags and hand in new waste bags according to the schedule

Each day or according to the defined schedule, visit the participants to collect the waste and distribute new waste bags for the following days. Collect the bag and distribute a new bag, even if the participants report that they have not generated waste on the given day. It is essential to visit according to the schedule. Request your team to report on which bags have been collected. This practice will help ensure that all households and/or non-household waste generators have been visited and are using the waste bags as instructed. Your team should also **record any deviation from the expected process** – for example, they should report if a participant gave the bag to the standard collection service by error or any reason for not handing in the waste bags. They should write down if nobody was present, and remember to collect the corresponding bag on the following day if possible. These details will help you analyse and validate the data.

2.4 Ensure bags are tagged appropriately

As each bag will be weighed and reported against the unique ID it was generated with, it is essential to mark the waste bags clearly. When distributing bags to participants, staff must verify that the bags are correctly tagged with the date and a unique ID. When collecting the bags, a second check should be performed to ensure the unique ID remains readable.

2.5 Weigh each waste bag and report its weight

The bags collected from day 1 will all be discarded directly, as they potentially contain waste accumulated from previous days. For subsequent days, the bags will be weighed individually, and the weight will be reported for each participant. The person responsible for supervision and monitoring can use the **Tool 7.2.3 – Reporting Sheet**.

2.6 Characterise the waste of each day

Household

The composition of the waste should be analysed for each cluster. For example, you would receive three compositions for low-, middle-, and high-income groups.

Non-household

The composition of the waste should be analysed for each type of waste generator. To analyse the composition of the waste, you can either analyse all the waste collected if the total amount is less than 200 kg or use the quartering method when the amount exceeds 200 kg (per waste generator).

2.6.1 Separate and measure all the waste

During the sorting process, your team will open all the waste bags and begin separating the waste into the different types that you have decided to measure. Use labelled plastic bags or containers to do so. It is advisable to ensure that the separation is done correctly. Once all the waste has been separated, each fraction is weighed individually, and the weight is reported in **Tool 7.2.3 – Reporting Sheet**. Remember to subtract the weight of the empty containers. Once the composition study is completed, the waste can be transported to and disposed of safely.

2.6.2 Use the quartering method

To analyse the composition of the waste, you can either use all the waste collected if the total amount is less than 200 kg, or use the quartering method when the total amount exceeds 200 kg. The quartering method involves thoroughly mixing all the waste to sample a fraction for composition study. Note that the quartering technique is convenient when mixed waste is collected, but it might be undesirable if waste is collected and segregated into two or more fractions. Furthermore, suppose the waste is high in wet organic materials and/or contains absorbent materials such as paper, toilet paper, or diapers. In that case, it might not be desirable to mix everything through the quartering technique. You can decide if it seems more convenient to segregate and measure all the waste or to use the quartering methods for your case.

The following steps should be followed:

1. Start on a clean, large plastic sheet, open and empty all the waste bags on it
2. Use tools (rake, shovel) to mix all the waste until it is mixed thoroughly
3. Spread the waste on the plastic sheet so that it forms a flat layer
4. Divide the waste into 4 quarters of the same size: A, B, C and D.
5. Discard two diagonally opposed fractions, for example, A and C
6. Combine and mix the two other diagonally opposed fractions, B and D
7. Repeat this quartering method until the combined remaining weight is about 50-70 kg
8. Measure the composition of this remaining 50-70 kg by separating the waste and weighing the individual fractions

You can visually see the steps in the course video: <https://www.youtube.com/watch?v=LgJ6f2dXS9o>.

3. Analyse and process the data and report the results

3.1 Calculate waste generation per capita

For the calculation, you can use the provided Excel sheet: **Tool 7.2.3 – Reporting Sheet**.

Household

First, you have to calculate the waste generation per capita for each household. To do this, you add the weights of each day (day 2 to day 8) and divide by the number of persons living in the household and the number of days for which you have valid data.

$$PCWG_{hh} = \frac{W_2 + W_3 + W_4 + W_5 + W_6 + W_7 + W_8}{\#Days \cdot \#Residents}$$

With the waste generation per capita for each household, you can now:

1. Average all the household values to have the waste generation per capita.
or
2. Average based on your cluster categories, and have one household waste generation per capita for each. For example, one for each income level.

This result can then be used to estimate the total amount of waste generated in the area of interest. You have to multiply the household waste generation per capita by the total population to have the total amount of waste generated. When considering clusters, such as different income levels, you use the population at each income level and multiply it by the corresponding household waste generation per capita.

Non-household

This analysis should be done for each type of waste generator individually. First, you have to calculate the waste generation per unit for each waste generator. To do this, you add the weights of each day (day 2 to day 8) and divide by the number of aggregation units and the number of days for which you have valid data.

$$PUWG_{wg} = \frac{W_2 + W_3 + W_4 + W_5 + W_6 + W_7 + W_8}{\#Days \cdot \#aggregation\ units}$$

With the waste generation per unit for each waste generator, you can now calculate the average value to obtain the waste generation per unit for this type of waste generator. This applies only if you do not have clusters.

This result can then be used to estimate the total amount of waste generated in the area of interest for this type of waste generator. You must multiply the waste generation per unit per day by the total number of units to determine the total amount of waste generated each day. Note that to be able to do this calculation, you have to gather the information about the total number of units for each of your types of waste generators.

To obtain the total waste generation from non-household sources, sum all the totals for each type of waste generator that you have measured and calculated.

Finally, calculate the **non-household waste generation per person** by using the total waste generation from non-household sources and dividing it by the total population living in the area of concern.

3.2 Calculate the waste composition

To calculate the waste composition, you can use the **Tool 7.2.3 – Reporting Sheet**.

Household

Report the values that you have measured. If you need to adapt the sheet to your own waste categories, ensure that the formulas are consistent in your new document. For each waste category, the sum of all days is first calculated. Then, the percentage of each category is calculated based on the total waste from all categories across all days.

Non-household

Report the measured values and use a separate sheet for each type of waste generator. If you need to adapt the sheet to your own waste categories, ensure that the formulas are consistent in your new document. For each waste category, the sum of all days is first calculated. Then, the percentage of each category is calculated based on the total waste from all categories across all days.

The waste composition of the non-household waste must be calculated based on the total amounts of waste generated for each waste generator type. The first step is to calculate the total weight of each fraction by multiplying the composition % and the total weight generated by this waste generator type. Once you have the total weights for each fraction of waste and for each waste generator type, the values are summed, and the final composition of non-household waste can be calculated. You can use and adapt the provided Excel sheet for the calculation **Tool 7.2.3 – Reporting Sheet**.

3.3 Presenting waste composition results

You can present your composition results either through a simple table, showing each category and its respective percentage, or visually through a graph. A typical way to visually show the composition results is with a pie chart, as shown in Figure T 7.2 A. You can use the **Tool 7.2.3 – Reporting Sheet** to prepare the presentation of your results.

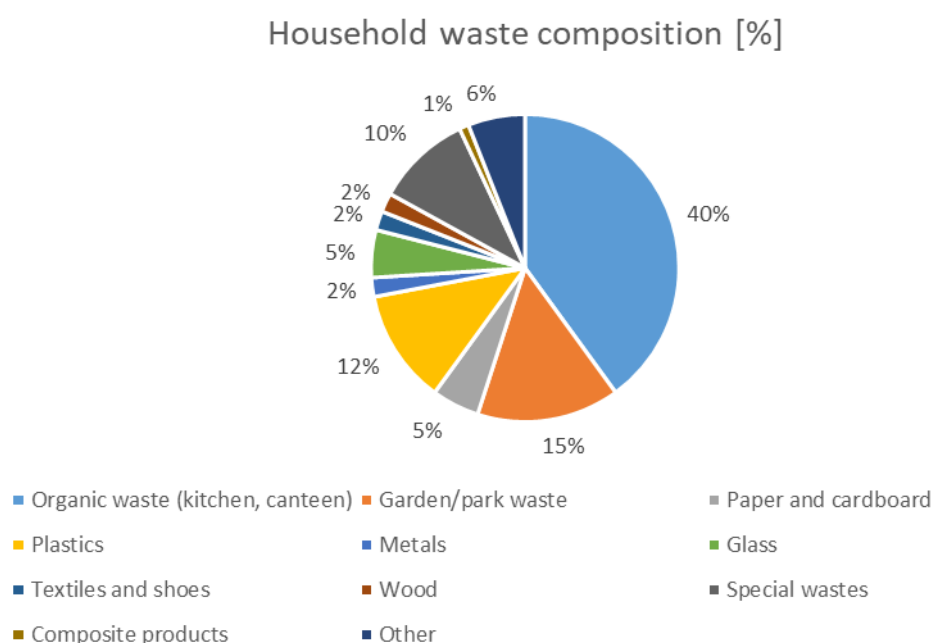


Figure T 7.2 A: example for visual representation of waste composition