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Guide for waste composition analysis at Brazilian street markets

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Contents

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INTRODUCTION

This document describes the methodological approach as well as the operational and practical aspects of a waste composition study in Brazilian street markets. This report is based on practical experience in a pilot study in the city of Sao Paulo, Brazil and literature studies.

The guide was developed as part of the project "Quantification of food waste in street markets in the city of São Paulo" funded by the Swedish Environmental Protection Agency and led by the Resource Management Group in the Swedish Centre for Resource Recovery at the University of Borås. The purpose of this report is to provide tools for the implementation of similar studies in the Brazilian context, aiming to increase the comparability between the studies. The guide is primarily intended for use in waste composition analysis of street markets food waste.

1.

Planning a waste quantification study

1.1. STUDY PURPOSE

Food waste quantification studies, in general, provide important information for a better understanding of the magnitude, composition and location of food waste originating in the supply chain. This information allows better defining and prioritizing different prevention and valorisation measures, as well as monitoring food waste prevention over time.

At the beginning of the study, the objectives and questions that are sought to be answered through the study must be defined. It is crucial to clearly define the objectives early on in the study, as it influences where and how often waste will be collected, what types of waste will be investigated, what fractions will be classified and how the results will be documented.

There are different reasons for quantifying food waste, for example, a quantification with less precision and detail can be used to create a case for change. Food waste quantification can also be used to understand the context of waste generation and prioritize actions. A quantification with greater detail and precision may be necessary for the study to be able to monitor the progress in the amounts of food waste over time. Box 1 describes an example of the definition of the goals in a waste quantification study.

BOX 1: EXAMPLE OF A QUANTIFICATION STUDY OBJECTIVES

The main objective of the pilot project in São Paulo is the quantification and characterization of food waste generated in street markets. The objective is to support actions at two distinct levels: food waste prevention and waste management.

The information generated in this project will be used to identify critical points in the system, that is, food waste fractions with significant waste generation, large environmental impacts, and/or nutritional loss. This information can be used to develop studies that seek to understand the reasons for the high levels of waste of such products and propose effective prevention measures. In addition, the waste quantification can identify products that are not frequently consumed, but could be. This is commonly defined in the literature as possibly avoidable food waste. This category includes foods that some people eat and others do not, such as stalks. These products can be used by food banks or as raw material in food industries.

In relation to waste management, this study intends to provide valuable information for the planning of waste management systems. Street markets represent an interesting place for the management of segregated waste as most of the waste is organic, in contrast, for example, to households where the waste is composed of many different types of materials. This gives the opportunity for these wastes to be treated through composting or anaerobic digestion without the need for complex pre-treatment or sorting. In the specific case of São Paulo, the municipality plans to increase the volume of food waste from street markets treated through composting and needs information on the quantities and composition to be treated. Furthermore, the municipality also seeks information on specific waste fractions, namely:

- Products of animal origin, due the requirements of the legislation
- Coconut and sugarcane bagasse, which influences the operational process of the composting plant
- Non-organic materials such as packaging.

Therefore, when planning a study, it is important to cover as many objectives as possible, as it may be necessary to add just a few fractions to the study, saving money in the long run.

2.

Inventory

The area under study, for example, the district, the city, or the region, must be described in relation to variables that may influence the results. In order to be able to reach significant results and compare them with other analyses, it is recommended to describe the investigated area in as much detail as possible.

Important variables to be considered:

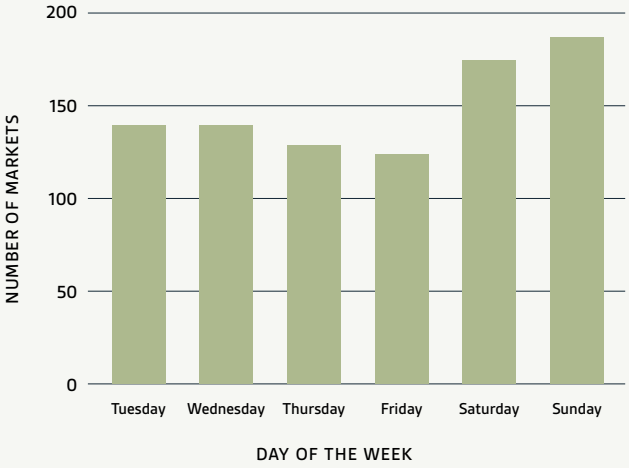
1. Time of the year. It may be interesting to repeat the quantification in different seasons of the year. At least one quantification in summer and another in winter is suggested.
2. Time of the month. It can be crucial for some markets, due to variables such as salary payday.
3. Day of the week.
4. Market size.
5. Human Development Index (HDI).

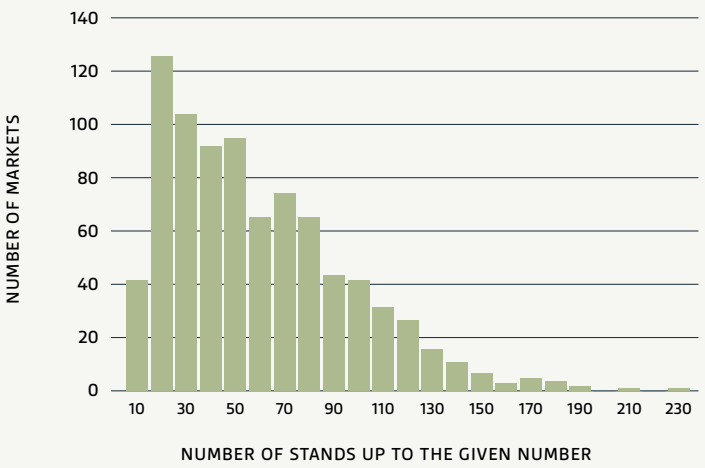
BOX 2: EXAMPLE OF INVENTORY

To select the street markets to be quantified, is relevant to define relevant parameters, such as the day of the week, the size of the street markets, here represented by the number of stalls, and the Human Development Index (HDI) of the district where the street market is located.

PARAMETERS

The figure below shows the distribution of markets in São Paulo by day of the week and size. A sampling covering different variables can provide a better extrapolation of the waste generation.





3.

Food waste quantification and characterization

3.1. STAFF

The operational team can be divided into two different teams, the sorting team and the protocol team. In addition, a project leader must be designated, who is responsible for planning, training the staff, preliminary study and evaluation of results. All staff contributing to the project must be knowledgeable about local waste management and the waste composition analysis methodology. All staff must be well trained in waste handling, know exactly what role they will play in the project, and work accurately and carefully. All staff must be in good physical condition and not be allergic to dust or sensitive to odours. All vaccinations must be up to date.

The results from the pilot study suggested a sorting efficiency of 0.3 kg per minute per person, including the waste unloading, the weighting of the mother sample, waste classification, and cleaning of the space.

The quantification team should be divided according to the tasks that are under their responsibility. These tasks are described below.

3.2. SORTING TEAM

The sorting team are the people directly responsible for sorting the food waste fractions. In addition, they are responsible for bringing the waste to be weighed by the protocol team and subsequently disposing of the waste. Tasks for the classification team are described in detail in Section 3.8.

3.3. PROTOCOL TEAM

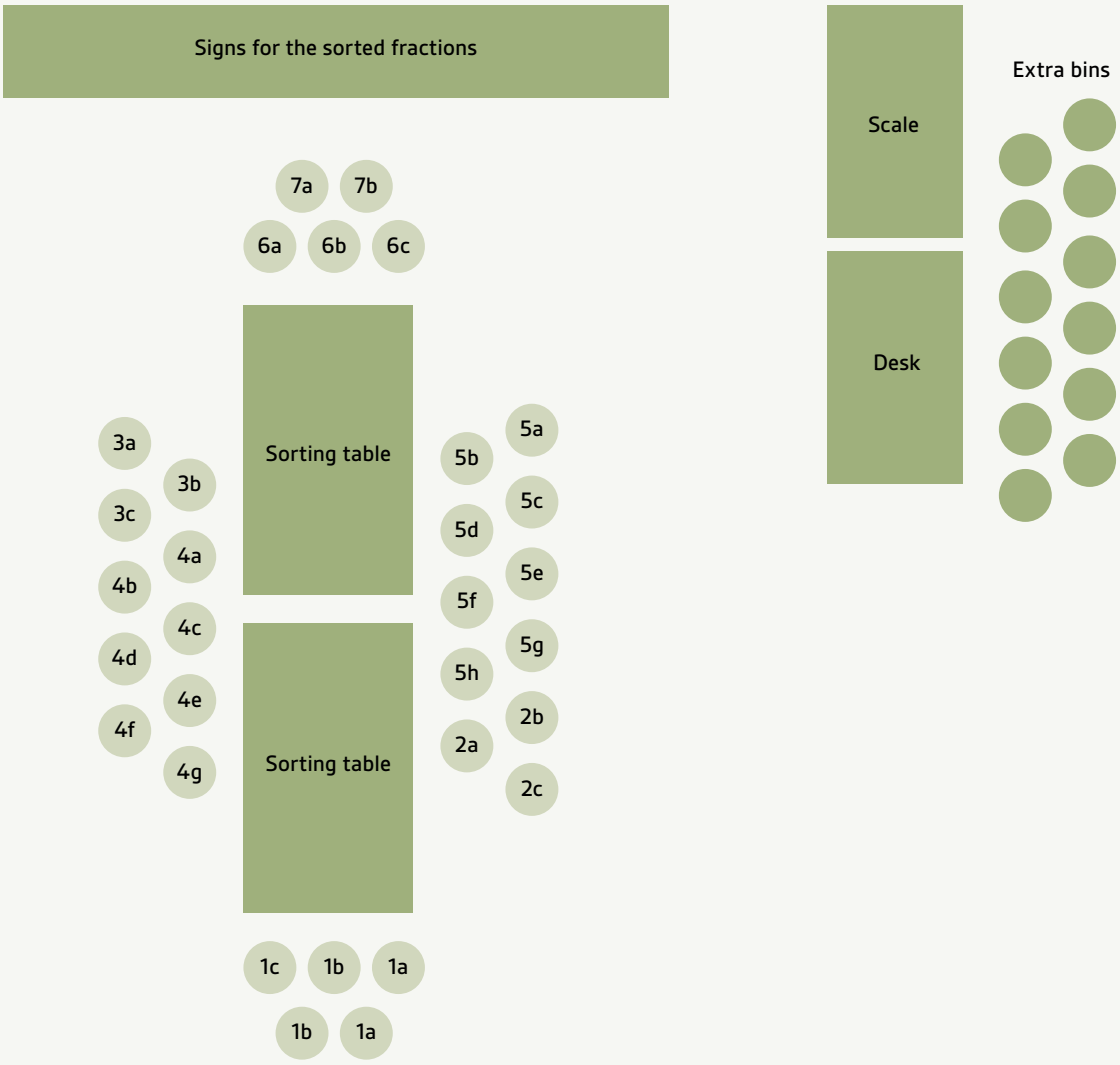
The activities under the responsibility of the protocol team are handling the weighing, filling out the protocol, taking pictures and writing notes. These activities are described in detail in Section 3.8.9. The protocol team will not be involved in sorting activities. There must be at least two people responsible for handling the protocol. The proportion of people classifying and people responsible for weighing and protocol should not exceed 1 in 4; ideally, the ratio should be 1 to 3.

3.4. THE SPACE

A suitable workplace must be selected. It is important to ensure that the workplace is accessible during scheduled sorting times, is large enough, well ventilated, and provides sufficient light and access to electricity and water. A suitable place to work can be a garage, storage area or other installation on hard ground (e.g. asphalt or concrete) with possibilities for loading and unloading waste. It is necessary to consider enough space for the classified and unclassified materials. It is also important that restrooms and a cafeteria are available.

When organizing the space, different areas should be considered for the delivery of waste and for sampling the waste, if necessary. It is also necessary to have a place for classification and quantification. Figure 1 shows an example of a workspace organization. Note that the containers for each fraction are labelled with plaques and that the most frequent food waste fractions are the easiest to access. It is also important that the table is large enough so that the classification team can work simultaneously without interfering with each other.

Figure 1 - Organization of the workplace



Prepare the sorting site at least one day before the first sorting according to the recommendations outlined in this manual. Arrange the table, containers and scale, and provide the identification plates for the containers, as well as the document describing the food waste fractions to be sorted. Make sure all necessary equipment is provided.

3.5. WASTE CLASSIFICATION

A classification system for food waste with three levels of subcategories is proposed (Table 1). Level 0 is divided into three categories and includes packaging waste and avoidable and unavoidable food waste. Packaging waste refers to wholesale packaging materials and packaging used for product transportation. Food waste is defined accordingly to UNEP (2021), as "(...)food and the associated inedible parts removed from the human food supply chain and sent to landfill, controlled combustion, sewer, anaerobic digestion, composting or land application."

Food waste is further classified in Level 0 as avoidable food waste, including products that were edible at some point in time before being discarded and unavoidable waste, which refers to parts of the products that are typically not consumed by people, such as bones and peels.

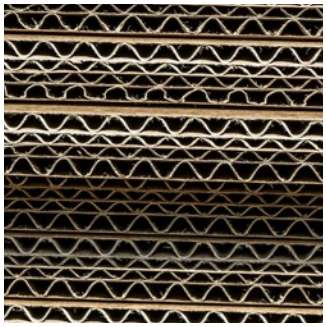
Level I distinguishes the avoidable fraction into six categories, namely (1) leaves, flowers and stems, (2) processed products, (3) tubers, bulbs and roots, (4) vegetables, (5) fruits and (6) meat. Definitions of the terms 'fruits' and 'vegetables' are not universally shared and their classification varies in the literature depending on the goal of the study. In this study, the most common culinary use was applied for food. Processed products refer to produce that are washed, peeled, cut or minced and sold in packages, typically in plastic trays.

Level 2 categorize the food groups at the product level (Table 1). The unavoidable category was disaggregated into peels, sugarcane bagasse, and coconut waste. Sugarcane bagasse and coconut waste are generated when producing 'caldo de cana' and coconut water, two common beverages sold in Brazilian street markets. Three criteria were used to select the individual products at level 2, namely:

1. Products that large amounts of waste were observed during the pre-study,
2. Products with a high consumption per capita based on data from IBGE (2020),
3. Products that are relevant for the waste management operators, particularly for the operation of composting plants. It includes packaging, meat, coconut and sugarcane bagasse.

Table 1 – Food waste category levels

Fractions (Level 0)	Fractions (Level I)	Fractions (Level II)
Packaging	Packaging	Packaging
Avoidable	Leaves, flowers and stems	Broccoli and Cauliflower Cabbage Other
	Processed products	Tubers Fruits Leaves and flowers
	Tubers, bulbs and roots	Potato Carrot Onion Other
	Vegetables culinary vegetables	Tomato Pumpkin Bell pepper Chayote Other
	Fruits	Banana Orange Watermelon Papaya Other
	Meat	Meat
Unavoidable	Unavoidable	Coconut Sugarcane bagasse Peels
External waste	External waste	External waste



1. Packaging
It includes materials such as plastic, wood, straw, paper and others.

2. Leaves, flowers and stems
This group refers to vegetables whose commonly used parts are found above ground and include leaves such as lettuce, cabbage and spinach. This group also includes stalks such as asparagus and celery and flowers and inflorescences such as cauliflower and broccoli.

3. Processed products
They include foods that have undergone some processing, such as peeling or dicing. These products are often sold in plastic trays (Figure 2).

4. Tubers, bulbs and roots
Typically, products that the usable parts grow underground. This group includes tubers, rhizomes, tuberous roots and bulbs such as carrots, beets, sweet potatoes, cassava, yam, onions and garlic.

5. Vegetables
It includes botanically classified fruits that are culinarily classified as vegetables and seeds.

6. Fruits
It includes fruits, classified under their culinary use.

7. Meat
This group include meat products such as beef, pork and fish.

8. Unavoidable
This category includes coconut, peels and unidentifiable residues.

9. External waste
The 'external waste' fraction refers to materials that were not generated by the street market but were collected together. Examples of 'external waste' were diapers, household waste and construction material. Although this fraction is not part of the street market, this fraction is presented taking into account that it can be relevant to waste management operators.

Table 2 - Examples of products and their classification

Packaging	Leaves, flowers and stems	Processed products	Tubers, bulbs and roots	Vegetables	Fruits	Meat	Unavoidable
Wood	Chard	Leaves, flowers and stems	Garlic	Pumpkin and squash	Avocado	Bovine	Sugarcane bagasse
Straw	Cress	Tubers, bulbs and roots	Potato	Zucchini	Pineapple	Swine	Peels
Paper	Celery	Vegetables	Sweet potato	Eggplant	Plum	Sheep	Coconut
Plastic	Artichoke	Fruits	Beetroot	Chayote	Banana	Goat	
	Lettuce		Onion	Pea	Citrus	Fish	
	Leek		Carrot	Bean	Orange		
	Almeirão		Yam	Snap bean	Lemon		
	Asparagus		Manioc	Chickpea	Papaya		
	Broccoli		Turnip	Lentil	Mango		
	Chicory		Radish	Maxixe	Watermelon		
	Green cabbage			Green corn	Melon		
	Chinese cabbage			Cucumber	Strawberry		
	Brussels sprouts			Bell pepper	Pear		
	Cauliflower			Peppers	Tangerine		
	Endive			Okra	Grape		
	Spinach			Tomato			
	Mustard						
	Cabbage						

3.6. EQUIPMENT

It is important to plan the equipment needed for quantification. If new equipment is to be purchased, it must be done at an earlier stage of the project. All necessary material must be available at the time of quantification. Examples of equipment are scales with adequate precision, sorting tables with adequate heights, and safety equipment. The document describing the different fractions should be prepared with sufficient text and possibly symbols and images.

The following list describes the basic material and equipment needed for quantification.

Table 3 – List of materials

Item	Description
Tables	1x2, about 0.9m high, adjustable
Containers for waste fractions	Plastic drums
Plastic bags	100 litres
Waste disposal containers	
Plates and Labels	
Scales	100 g accuracy and 5 g accuracy
Knives	
Cloths	
Brooms	Long and short
Wet wipes	
Disinfection liquid to clean tables	
Hand and face sanitizing paper	
First aid kit	
Highlighter	
Calculator	

3.7. WASTE COLLECTION

A staff member must supervise the collection of waste from the street market. Join the collection team on the waste collection day to guide and document information about the respective street market. Make observations and ask questions to increase your knowledge of the route details, if necessary. The waste collection must take place at the end of the street market's operation to ensure that all waste generated is collected. It is advised that the study is not divulgated among the vendors, to avoid bias in the results.

Due to the requirements for preserving the quality of food waste for sorting, waste should be handled as little as possible during collection. Ideally, it is not touched, moved or transferred until sorting begins. The waste should not be compressed in compactor garbage trucks.

A member of the team, we suggest the sorting leader, should collect data from the street market on the day of collection. The data to be collected are:

- Mapping of stalls, including the number of stalls in the street markets and the products sold in each stall, as exemplified in Figure 4.
- Observation and photography of waste generated throughout the day
- Visual characterization of the generated waste fractions. This data will be used for the inclusion of additional fractions that are not in the protocol. For example, if a large amount of beet waste is observed during the street market, and this residue is not in the list of original fractions, it should be included.

3.8. WASTE COMPOSITION ANALYSIS PROCEDURE

3.8.1. PRELIMINARY WORK

The procedure starts with organizing the workplace. All staff must wear the necessary safety equipment and the sorting table and sorting bins must be organized. The use of plastic drums as described in Figure 6 is recommended. Staff should be briefed on quantification procedures, including safety, equipment, reasons for the study, responsible staff, bathroom location, etc.

Before starting the quantification, the protocol team must ensure that:

1. All containers are weighed empty and the weight is recorded for each secondary fraction in the protocol.
2. All recipients must be identified with a sign describing the fraction they will receive.

3.8.2. TRAINING

Training should be done before the first quantification if the team does not have prior knowledge about waste quantification. The first quantification can also be used to refine procedures and to find information that is needed to prepare an appropriate classification scheme and plan for food quantities. The most important topics to be covered during training are:

1. The purpose of the study
2. The methodology used
3. Knowledge about classified fractions, how they are defined and why
4. Individual roles and responsibilities
5. Safety rules and equipment
6. Contact of all project leaders
7. Rules for working procedures
8. General hygiene requirements
9. Proper cleaning routines

3.8.3. WASTE UNLOADING

Empty the collected waste onto a clean, flat surface. Make sure that the waste is protected from the weather and animals, that it does not mix with other materials and that all samples are separated. Define a location for the mother sample storage. If necessary, divide the waste into sub-samples as quickly as possible. In the case of simultaneous quantification of two or more street markets, the waste from each street market must be stored separately.

3.8.4. QUANTIFICATION OF THE MOTHER SAMPLE

Before the classification procedure, the mother sample must be weighed. All bags received are weighed individually. For greater accuracy, empty bags should be weighed and the weight subtracted from the total weight of the mother sample. In case of receiving waste from two or more street markets on the same day, the mother samples must be

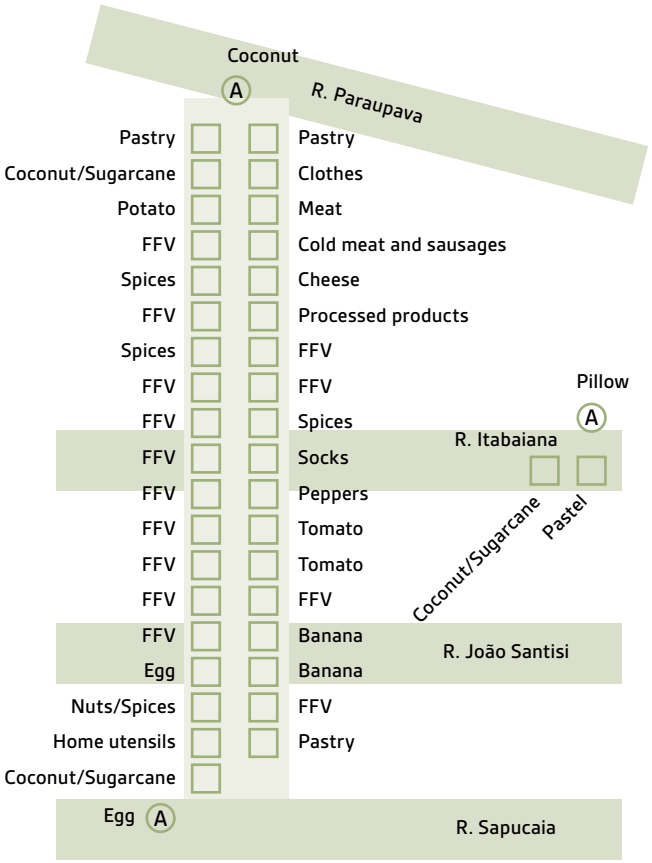


Figure 5 – Example of spatial distribution scheme of the street market. FFV refer to fresh fruits and vegetables

weighed before the start of classification.

In the first quantifications, the efficiency of the quantification team is still uncertain. Therefore, especially in the first quantifications, the time needed for the quantification should be calculated. In this way, at the following street markets, the need for the sampling procedure can be evaluated if necessary or not. The calculated parameters are:

- Time for quantification of mother samples.
- Time required for quantification. Total quantification time divided by the quantity in kg of classified waste.

3.8.5. SAMPLING

In case the amount of waste from a street market is deemed too large to be sorted by the team, sampling must be done. For sampling, the collected waste must be unloaded in line. The height of the residue must not exceed 50 cm. Depending on the amount of waste, a plastic bag of 50 or 100 litres can be used to collect a sample of this waste. Without any judgment, multiple piles with the same waste volume will be randomly selected from the waste in the line. The total sample must not be less than 500 kg. Some important points: the mixing of food waste must be done with care to avoid damaging it; placing the food waste from each pile in

the bins can be done by hand or with a shovel, when a pile is chosen, take all the residue from that pile for classification. Protect the sub-samples by placing them somewhere protected from any form of contamination. Take pictures of the process for a later description of the methodology.

This step will probably not be necessary for most street markets in the pilot study, as the amount of waste will not be large enough to justify using the sampling methodology. It is anticipated that only the largest street markets may need to be sampled. Mixing and dividing organic waste for sampling is considerably difficult, potentially destroying some of the characteristics that are important for classification. Therefore, when necessary, sampling must be carried out with care. The total weight of the collected waste (mother sample) must be always measured before splitting.

3.8.6. CLASSIFICATION AND WEIGHING PROCEDURE

The classification must be done individually for each street market. The start of the second classification is conditional on the end of the first street market classification. In other words, the quantifications must be preferably done in series and not in parallel.

Quantification starts with placing the waste on the table and sorting the fractions. There will be a container for each fraction described in the protocol. It is important to inform the team that if there is any doubt about the category in which a particular product should be placed, the sorting team should ask the responsible person. Containers are identified by signs on a handle to simplify exchange, as exemplified in Figure 6.

A situation may arise where it is not clear which category a product belongs to. In this case, the project leader makes the decision. The quantification leader needs to register the category decided for that product in the protocol, in order to maintain the harmonized categorization throughout the quantifications.

Place the waste on the sorting table. The table must be solid, that is, not barred. Carefully open the bags and carry out a first optical analysis of the contents. Bags with hazardous waste must not be opened but disposed of quickly to minimize the risk of accidents. In the case of weapons or ammunition, stop sorting and contact the police immediately. For effective time management, one person should be designated as responsible for ensuring that there is always waste on the table.

Sort carefully and accurately. Food remains must be separated from the packaging and separated in the appropriate container. If the food cannot be separated from the packaging, classify according to the type of food. Do not open containers with dangerous liquids or substances. Hazardous waste is collected separately for later handling correctly.

The unidentifiable products must be placed in a specific container for the unidentifiable fractions. Any product that falls on the floor must be classified as usual.

Once the container has reached its maximum capacity, a member of the sorting team brings it to the scale to be weighed. The container is then weighed again by the protocol team, with the second weight corresponding to (2) in Table 6. The value is registered in the protocol next to the empty weight value, previously recorded during the preliminary work, as described in Section 3.8.1. Afterwards, the trash can is emptied at the disposal site by a member of the sorting team and the empty weight is noted again in a new line in the protocol.

To increase the efficiency of the process, it is recommended to have one third more containers than the number of classified fractions. These extra containers should be kept empty close to the scale site so that when a full container arrives, an empty one can be given as a substitute. These containers can also be used in case of an unexpected fraction. It is also recommended that empty signs are available to label any new fractions. It is recommended that containers are always weighed without the plate, to simplify switching between full and empty containers.

Once a container has reached its capacity and is weighed and emptied, it must be weighed again before returning to the quantification area. This is because residues can contaminate the container, changing the “empty weight” from one measure to another.

The ideal process is:

1. The empty container is weighed and the weight is recorded in the protocol.
2. The sorting team arrives with a full container.
3. The identification plate is switched from the full container to the empty container.
4. The empty container is handed over to the sorting team
5. The full container is weighed and the weight is recorded in the protocol.
6. The container is emptied.
7. The process is repeated from (1)

Figure 6 - Example of 200 litre plastic container and plate used for quantification

If the residues of a single product arrive in different containers than the normal ones (examples in the photo gallery in Section 3.10), the full container is weighed first and then emptied and weighed again. If bags are used during the analysis, the weight of an empty bag must be noted at the beginning.

There may be a situation in quantification where a new fraction not previously described in the protocol is created. There can be several reasons for this, for example, a large amount of a fraction is observed during waste collection or when inspecting the mother sample. In this case, it is recommended to use the following procedure:

1. A person from the classification team is named as fraction owner.
2. The person requests an empty container for the protocol team
3. The empty container is weighed and the weight is recorded in an additional line in the protocol.
4. The container is equipped with an identification sign with the name of the fraction.
5. The person responsible for sorting the fraction starts sorting
6. The full container is brought to the scale
7. The full container is weighed without the plate, and the weight is recorded in the protocol.
8. The full trash is emptied and the label is erased

It is important to consider when to weigh the containers. The container doesn't need to be full to be weighed. This is especially important for fractions with a high density. The maximum weight to be carried by one person must not exceed 25 kg.

When weighing mixed fruit and vegetable secondary fractions, it is recommended to take pictures for every container weighed, to understand the composition of the mixed fraction.

Any improvements to the suggested sorting routine can be applied immediately if they do not affect data collection (for example, rearranging sorting containers). In addition, new procedures must be communicated to other workers so that everyone can benefit from them. Make sure to make a note of any changes made and try taking pictures. In the case of unexpected events, e.g. waste that cannot be collected, the collection is delayed or incomplete, improvisations should always be done in such a way that detailed and continuous data collection is guaranteed. It may be necessary to reschedule the collection. In case of uncertainty, the project leader should be contacted.

Note anything unexpected or exceptional happening during sorting. Check the total weight of all fractions and compare it to the total weight measured previously. It is not uncommon for there to be a difference of up to several kilograms between the two values. However, if the difference is too large, check for possible sources of error.

Care must be taken to avoid any systematic error during separation analysis. However, if an error occurs, it must be immediately communicated to the project leader, recorded and described in the quantification protocol. A systematic error is one that results from a persistent problem and leads to a consistent error in measurements. For example, if the scale is not calibrated, the results will always differ from the true value. In case of systematic errors, the affected samples must be quantified again.

3.8.7. ERROR SOURCE

This section is based on the work of Dahlén and Lagerkvist (2008) where seven different types of errors related to the quantification of residuals are described.

- **Long-range heterogeneity fluctuation error**
  It is related to spatial variation, where a sample from one market or area may not be representative of another market or area. This type of error can be corrected by increasing the number of quantifications in different street markets, on different days of the week and time of year.
- **Periodic heterogeneity fluctuation error**
  Periodic variations are related to seasonal variations in waste composition or variations due to special events such as holidays. This type of error can be corrected by sampling the residues at different times of the year. Ideally, waste quantification will cover every day of the week.
- **Fundamental error**
  Basic errors arise from inadequate sampling techniques when smaller particles are not properly classified. To avoid this type of error it is recommended to increase the sample size.
- **Grouping and segregation error**
  This error is related to a sample not being properly mixed, causing an uneven material distribution. This error can be avoided by properly mixing the sample or increasing its size.
- **Increment delimitation error**
  When splitting samples, particles that exceed the edges of the split volume may or may not be included. For prevention, place samples in a long, flat line.
- **Increment extraction error**
  Sometimes, when splitting samples, particles belonging to a sample are lost, perhaps during transport or handling. For prevention, choose tools and work procedures carefully.
- **Preparation error**
  This error occurs due to sample contamination. For example, dust or other debris can contaminate the sample, particles can stick to tools, a chemical or physical reaction can occur, or staff errors can occur (e.g. mislabelling). For prevention, train staff properly.

3.8.8. CHECKLIST FOR COLLECTION AND CLASSIFICATION

COLLECTION

- ✓ The legal requirements for waste collection and transportation are organized with the municipality.
- ✓ All equipment is prepared
- ✓ The quantification site is prepared for waste unloading
- ✓ The collection vehicle is ready and empty
- ✓ Names and telephone numbers of the collection team are registered
- ✓ The collection routes were discussed with the team
- ✓ The collection team is informed about the collection method
- ✓ The designated team leader is ready to join the collection team.
- ✓ Protocol is ready

CLASSIFICATION

- ✓ All equipment is prepared for classification
- ✓ All workers are vaccinated and no one is allergic to any of the potential waste items
- ✓ All workers are trained and know their shift times
- ✓ A team leader and protocol writer have been assigned.
- ✓ Disposal of waste after sorting is organized
- ✓ The protocol was delivered by the leader of the collection team and is ready to be completed
- ✓ The waste was delivered and the collection team leader ensured that the waste was collected correctly

3.8.9.FILLING THE PROTOCOL

The protocol header (Table 5) must be filled in with all the necessary information. The information includes the name of the sample, the weight of the mother sample, identification of the street market, date of collection and quantification, name of the person responsible for quantification, name of the person responsible for the protocol and name of the staff involved in the quantification.

The sorting team must handle the waste at all times, that is, the waste to be weighed will be brought by the sorting team, which will place it on the scale and finally take it to the disposal site.

Quantification results must be written for each weighting procedure. Table 6 exemplifies the process. The first number written is the weight of the empty container. As soon as a full container is brought to the scale, it is weighed again and the second weight is noted next to the empty weight. Therefore, every time a bin is weighed, two values are written in correspondence. Care must be taken to avoid registering pairs of numbers that are too close to each other, as it can confuse data analysis. If many people are involved in the sorting team, one of them must help the protocol writer, taking care only of weighing and disposal. If necessary, weighing and disposal can be split between two people. The description column should be used to describe any details relevant to analysing the fractions.

After the end of the quantification day, all protocols must be photographed as a backup for safety reasons. In addition, data should be transferred as quickly as possible to the project's digital protocol in spreadsheet software. Physical protocols must also be backed up.

Table 5 - Protocol header

Sample name:	Collection date:	Sorting date:
Weight of the mother sample:	Collection leader:	
Street market name:	Protocol leader:	
Number of stalls:	Staff:	

Table 6 - Example of filling out a protocol

Primary fraction	Primary fraction	Secondary fraction	Weight (kg)	Description
Packaging		Packaging	6.55/10.85 = 4.3 6.69 / 9.44 = 2.75	

(1) The empty weight of the container
(2) The total weight of the container
(3) The difference between (1) and (2)

3.9. DATA ANALYSIS

After quantification, all documents must be collected for analysis. The type of analysis is defined according to the purpose of quantification. It is common to calculate the mean values and the standard deviation for different samples. If possible, preliminary calculations should be made right after quantification, so that any doubts that may arise can be checked with the quantification team.

Key values for calculation for data analysis:

- The proportion of each food waste fraction in relation to the total residue (percentage)
- Amount of waste in relation to the size of the street market (kg per stall, kg per meter)

If sufficient data is collected, correlation factors can be calculated for the relative waste in relation to variables such as HDI, day of the week and street market size. These values are used to identify critical points, which can be prioritized in prevention measures or waste recovery. The results can also be used to extrapolate waste generation to larger populations.

3.10. REGISTRATION AND PHOTOS

The protocol team is also responsible for taking pictures during the quantification. Photos must include:

1. The organization of space, for example, the arrangement of tables and bins;
2. The quantification process;
3. Relevant waste fractions, i.e. when opening a container, if the majority of waste is from a single product, a photo should be taken. It is even more important to record fractions that are not individually described in the protocol.
4. When weighing mixed fruits and vegetables, it is recommended to take pictures to get an idea of what the mixed fraction consists of.
5. If it is necessary to split and sample the waste, the process must be documented.

3.11. PROTOCOL

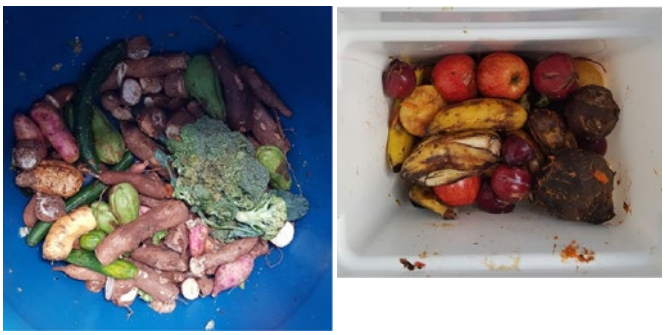
The protocol described below was designed specifically for the project “Quantification of food waste in street markets in the city of São Paulo” following the project’s objectives. For other studies, the protocol should be changed accordingly.

Example of photos

1. The organization of space, for example, the arrangement of tables and waste bins

2. The quantification process

3. If when opening a container, the majority of waste is from a single product, a photo should be taken. It is even more important to record fractions that are not individually described in the protocol.



4. When weighing mixed fruits and vegetables, it is recommended to take pictures to provide information on the composition of the mixed fraction.

5. If it is necessary to divide and sample the waste, the process must be documented.

Protocol

Sample name:	Collection date:	Sorting date:
Weight of the mother sample:	Collection leader:	
Street market name:	Protocol leader:	
Number of stalls:	Staff:	

Packaging

Primary fraction	Secondary fraction	Weight (kg)	Comments
Packaging	Packaging		

Leaves, flowers and stems

Primary fraction	Secondary fraction	Weight (kg)	Comments
Leaves, flowers and stems	Broccoli and cauliflower		
	Cabbage		
	Other		

Processed products

Primary fraction	Secondary fraction	Weight (kg)	Comments
Processed products	Tubers, bulbs and roots		
	Fruits and vegetables		
	Leaves, flowers and stems		

Tubers, bulbs and roots

Primary fraction	Secondary fraction	Weight (kg)	Comments
Tubers, bulbs and roots	Potato		
	Carrot		
	Onion		
	Other		

Fruit vegetables – commonly vegetables

Primary fraction	Secondary fraction	Weight (kg)	Comments
Vegetables	Tomato		
	Pumpkin and squash		
	Bell pepper		
	Chayote		
	Others		

Fruit vegetables – commonly fruit

Primary fraction	Secondary fraction	Weight (kg)	Comments
Fruits	Banana		
	Orange		
	Watermelon		
	Papaya		
	Other		

Unavoidable, meat products and external waste

Primary fraction	Secondary fraction	Weight (kg)	Comments
Others	Coconut		
	Sugarcane bagasse		
	Peels		
	Beef		
	External waste		

Comments

4.

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