Caracterização do desperdício de frutas, legumes e verduras no varejo supermercadista

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Resumo: O desperdício de alimentos ocorre em toda a cadeia de produção. Por ser considerado um elo entre os consumidores e a cadeia de alimentos, o varejo supermercadista possui um papel relevante e pode contribuir para a redução do descarte de alimentos. Para a prevenção do desperdício é necessário investigar a causa, e a mensuração do volume pode contribuir para evidenciar esse problema na cadeia de alimentos. As frutas, legumes e verduras (FLV), são alimentos altamente sensíveis, e percorrem um longo caminhão até a chegada aos supermercados e casa do consumidor. Esta pesquisa caracterizou o desperdício de FLV em três supermercados varejistas, por meio da mensuração direta dos produtos, no período de dois dias em cada um deles. Como resultado observou-se que as frutas foram os alimentos mais descartados, seguidos pelos legumes e verduras. Os

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produtos comestíveis apresentaram maior quantidade de descarte, seguidos pelos parcialmente comestíveis e não comestíveis, e os resíduos foram direcionados para aterro sanitário e compostagem.

Palavras-chave: Desperdício de alimentos. Perda de alimentos. Supermercado. Segurança alimentar.

Waste characterization of fruits, legumes, and vegetables in grocery retailers

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Abstract: Food waste occurs throughout the production chain. As it is considered a link between consumers and the food chain, supermarket retail has a relevant role and can contribute to reducing food waste. To prevent waste, it is necessary to investigate the cause, and measuring the volume can help to highlight this problem in the food chain. Fruits, legumes, and vegetables (FLV) are highly sensitive foods and travel a long truck to reach supermarkets and the consumer. This research characterized the FLV waste in three retail supermarkets, through the direct measurement of the products, in the period of two days in each of them. As a result, it was observed that fruits were the most discarded foods, followed by vegetables. Edible products had the highest amount of disposal, followed by partially edible and inedible products, and the waste was sent to landfill and composted.

Keywords: Food waste. Food lost. Retail. Food security.

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Caracterización de residuos hortofrutícolas en rede de supermercados

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Resumen: El desperdicio de alimentos se produce a lo largo de la cadena de producción. Al ser considerado un eslabón entre los consumidores y la cadena alimentaria, la rede de supermercados tiene un papel relevante y puede contribuir a reducir el desperdicio de alimentos. Para evitar el desperdicio, es necesario investigar la causa, y medir el volumen puede ayudar a resaltar este problema en la cadena alimentaria. Las frutas y verduras (FLV) son alimentos altamente sensibles y viajan en camiones largos para llegar a los supermercados y al consumidor. Esta investigación caracterizó los residuos FLV en tres supermercados minoristas, a través de la medición directa de los productos, en el periodo de dos días en cada uno de ellos. Como resultado, se observó que las frutas fueron los alimentos más descartados, seguidos de las verduras. Los productos comestibles tuvieron la mayor cantidad de eliminación, seguidos de los productos parcialmente comestibles y no comestibles, y los residuos se enviaron a vertedero y se compostaron.

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Palabras clave: Desechos alimentarios. Pérdida de alimentos. Supermercado. Seguridad alimentaria.

1. Introduction

Food waste occurs throughout the production chain and causes socio-environmental impacts (WRI, 2017). According to the Food and Agriculture Organization – FAO (2015), one third of all food is wasted worldwide. It is also estimated that 14% of fotado production was wasted before reaching supermarkets globally (FAO, 2019). In Brazil, the losses of all supermarkets in 2019, food products or not, accounted for R$ 7.6 billion, about 1.79% of gross sales (ABRAS, 2021) and fruits, legumes, and vegetables (FLV) presented the greatest loss and waste (SANTOS, 2021).

Grocery retailers are important actors in the food production chain, considered to be the link between production and end-consumers. They have the power to influence upstream and downstream actors in this chain, in addition to being notable waste generators. Due to the concentration of products and proximity to the consumer, a grocery retailer (or supermarkets) has a great responsibility in this chain (FILIMONAU; GHERBIN, 2017). For this reason, the investigation of the volume of waste, its causes and preventive measures can contribute to the reduction of food waste in the sector and reduce the sociology-environmental impacts, both in production and disposal, as well as the implementation of preventive measures for waste in the retailers (BRANCOLI et al., 2017). Thus, in the hierarchy of food waste generation, prevention of food waste is the first element to be considered (GARCIA-GARCIA; WOOLEY; RAHMIFARD, 2015), and not the end-of-pipe approach, which focuses on waste treatment and disposal.

Food waste is an important issue due to its direct relationship with environmental degradation. The Sustainable Development Goals (SDGs) highlight the complex challenges the world faces in the Anthropocene era, such as food insecurity, still not solved. It is worth noting that food insecurity is more related

to the lack of access to food than a lack of production (GUSTAVSSON; STAGE, 2011; BIERWAGEN; GONÇALVES-DIAS, 2018).

Loss and waste are currently different concepts. While loss refers to food discarded at the beginning of the production chain, waste typically and not exclusively occurs at the end of the chain, in retailers and consumers (LIPINSKI et al., 2013). While loss can be characterized as unintentional, waste could be avoided.

There are a few studies that quantify food waste in supermarkets (BUZBY et al. 2015; CICATIELLO et al., 2016). Research that uses analyze (inventory or auditing) data provided by the retailer was done in Sweden (GUSTAVSSON; STAGE, 2011), United Stated of America (BUZBY et al., 2015), Italy (CICATIELLO et al, 2016; CICATIELLO et al., 2017), Austria (LEBERSORGER; SCHENEIDER, 2014) and Poland (RIBEIRO et al., 2019). Direct weighting of food waste was done in Italy (CICATIELLO e FRANCO, 2020) and New Zealand (GOODMAN-SMITH; MIROSA; SKEAFF, 2020).

The cost of food waste is greater than that of prevention (ERIKSSON et al., 2017). In addition, in quantifying discarded products each retailer has a measurement method that is not standardized (CHABOUD, 2017; WRI, 2017; SANTOS, 2021). Although waste is measured through operational breakdowns, this internal measurement is not considered reliable (CICATIELLO and FRANCO, 2020; BUZBY et al., 2015).

The use of pre-existing information that is sometimes based on unreliable and non-comparable methodologies (CHABOUD, 2017) demonstrate the urgency of expanding and deepening research in the area (GUSTAVSSON; STAGE, 2011). Thus, standardizing the waste quantification methodology both locally and globally is an important step in the investigation of food wastage (CORRADO, 2019; CHABOUD, 2017) and it is essential for intervention in that problem (DREYER;

DUKOVSKA-POPOVSKA; QUAN, 2019; CORRADO et al. 2019).

The aim of this study was to characterize the waste of fruits, legumes, and vegetables (FLV) in retailers located in the cities of São Paulo and Santo André.

2. Methodological procedures

Data collection was carried out in three grocery stores belonging to supermarket retail chains (Case A, Case B and Case C), located in the cities of São Paulo and Santo André. The characterization of these stores is shown in Table 1 (Appendix 3).

Table 1 – Characterization of the stores studied

Stores	Size	Employes	Cashiers	Store type	Localization
Case A	2,200 m2	130	11	Supermarket	Santo André
Case B	1,044 m2	124	12	Supermarket	São Paulo
Case C	21,000 m2	160	18	Wholesale hypermarket	São Paulo

Source: Reasearch data.

The weighted foods were fruits, legumes, and vegetables (FLV), both edible and inedible parts. The measurement of the mass of FLV was performed by directly weighing the food that was being discarded using a scale calibrated in kilograms. Data collection duration was of two days in each store, from April 17, 2019, to October 7, 2020.

As a study guideline, the World Resources Institute - WRI protocol was followed, which proposes to standardize the results of different measurements (Appendix 1).

Sample collections in the surveyed stores were carried out in the morning (cases A, B and C) and in the afternoon (cases A and C). For weighing the food, the discarded products were sent to the area outside the establishment, where the scales are located (place for receiving goods). After weighing and completing the

waste characterization form (Appendix 2), the food was placed in appropriate containers, then, it was discarded or sent for reuse, according to the routine of the store under study.

The weighing of food waste included only damaged and matured FLV at different stages, not considering the packaging of these products. As an example, damaged products in the store, expired products, not suitable for sale and exceptionally damaged products were included. Due to the shorter time provided by Case B, the mass measurement was smaller. However, according to the employees, the measured mass corresponded to 50% of the total mass of the day.

3. Results

3.1 FLV waste quantities

The characteristics of each of the stores are presented below. The tables with the FLV waste values for each case are found in Appendix 4. In cases A and B, the waste value can be observed in percentage in relation to daily sales of each category of product.

3.1.1 Case A

Case A is a collaborative store and is not for profit. Responsibility for the FLV sector belongs to an outsourced company, which maintains an employee in the store with the objective of guaranteeing the quality and supply of the products, in addition to placing the purchase order. In this store, operational measures to avoid food waste include a 50% discount on food items five days before expiration date.

Another measure that was being implemented at the time of the visit was the installation of air conditioning, in order to reduce the maturation of perishable products, such as FLV, in the sales areas (ERIKSSON; STRIS; HANSSON, 2016).

In the daily routine, the discarded products are accounted for by the employee of the outsourced company. After weighing, the

products with the proper packaging were discarded in the waste bin that are sent to a landfill. Table 3 shows the volume of FLV wasted, the volume of sales and the percentage of products that were on sale that were discarded in the two days of data collection can be seen. Detailed data can be found on Tables 4.1, 4.2 and 4.3 of the Appendix 4.

Table 2 – Quantity in kg of FLV in the two days of data collection for Case A: waste, sales and percentage of discarded products

FLV	Disposal (kg)	Sales (kg)	Percentage of discarded products (%)
Fruits	234	1,503	16%
Legumes	94	737	13%
Vegetables	11	331	4%
Total	339	2,551	13%

Source: Research data.

In Case A, fruits were the most wasted foods, followed by legumes and vegetables, both in terms of volume and daily sales.

3.1.2 Case B

This retail chain is focused on selling fruits, legumes, and vegetables, which corresponds to 25% of the store's merchandise. The FLV sector is managed by the store itself. In this store, there are internal operational measures with the aim of reducing food disposal: use in the processed food department, use of FLV for employees in the cafeteria, food donation, sales of imperfect FLV products (business to business), training programs for environmental education and vegetable garden on the establishment's terrace. In addition, the store has refrigerated areas for storing FLV products and air conditioning in the sales area.

In this store, products that are not used in any of the above processes are sent to the organic gallons of the outsourced company that manages waste, which is finally composted. Table 4

shows the waste data in Case B can be seen. In Appendix 4, detailed data can be found on Tables 4.4, 4.5 and 4.6.

Table 3 – Quantity in kg of FLV in the two days of data collection for Case B: waste, sales, and percentage of discarded products

FLV	Disposal (kg)	Sales (kg)	Percentage of discarded products (%)
Fruits	106	858	12%
Legumes	52	264	20%
Vegetables	11	63	17%
Total	169	1,185	14%

Source: Research data.

In Case B, as in Case A, fruits were the most wasted foods, followed by legumes and vegetables in terms of volume. However, legumes stood out with the highest percentage of waste, followed by vegetables and fruits respectively.

3.1.3 Case C

Case C is a wholesale hypermarket, where the pilot project was carried out for the first measurements. The FLV sector is managed by an employee who makes the purchase orders and there is no consignment of products. FLV waste is stored in containers owned by the outsourced waste collection company, and FLV products are sent to the outsourced company's own landfill and composted.

As for the measures to prevent waste, the store donates food to Mesa Brasil three times a week and separates products close to the expiration date for promotional sales in the sales area. On the day of data collection, food donations could be observed. Food donation is considered an emergency and short-term palliative measure, not being the solution for reducing food waste (BIERWAGEN; GONÇALVES-DIAS, 2018). The waste data in Case C can be seen below. Detailed data can be found in Tables 4.7, 4.8 and 4.9 of Appendix 4.

Table 4 – Waste volume in kg of FLV on the two days of data collection in Case C

FLV	Disposal (kg)
Fruits	1,025
Legumes	596
Vegetables	32
Total	1,653

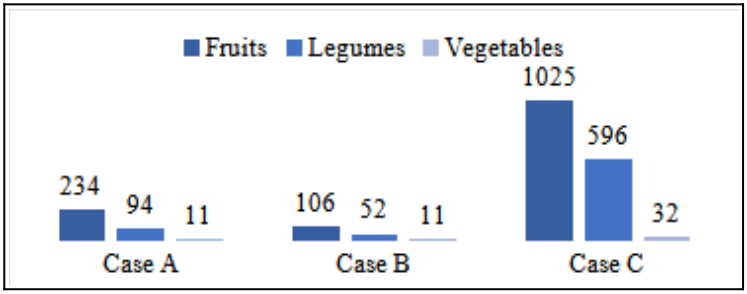
Source: Research data.

In Case C, as in Case A and B, fruits were the most wasted foods, followed by legumes and vegetables in terms of volume.

3.1.4 Cases A, B and C

The total amount of waste verified in the six days of data collection in the three cases was 2,165 kg. Of this amount, 76.5% was quantified in case C, 15.7% in case A and 7.8% in case B. The total discarded fruits considering the three cases was 1,364.14 kg, followed by 746.93 kg of legumes and 53.91 kg of vegetables. Among wasted foods, fruits are the ones that represent the highest amounts of waste, followed by legumes and vegetables in all three cases, as it can be seen in Figure 1.

Figure 1 – Amount of disposal of Fruits, Legumes and Vegetables in Cases A, B and C (kg)



Source: Research data.

The percentage of FLV waste quantity can be seen in Table 2 and it shows the amount of FLV waste proportional to the daily

sales in two stores. The FLV waste percentage per day in Cases A and B ranged from 3% to 27%. This value was calculated based on the daily sales of the stores. In case C, it was not possible to obtain data on the daily sales volume of the products.

Table 5 – Percentage of waste in relation to sales of fruits, legumes, and vegetables (%)

Foods	Case A day 1	Case A day 2	Case B day 1	Case B day 2	Average A and B
Fruits	21%	10%	12%	13%	14%
Legumes	12%	13%	22%	18%	16%
vegetables	6%	3%	12%	28%	12%

Source: Research data.

The difference in the amount of FLV wasted in supermarkets may have been caused by several factors, such as internal operational processes for reuse and measures to prevent food waste. Case B, for example, has implemented internal reuse processes that contribute greatly to the reduction of FLV waste, such as partial use of food to make juices and salads, in addition to internal reuse in the cafeteria. Despite these factors, the waste was greater than that of Case A.

Despite the internal operational processes for reducing waste, there are many factors that can contribute to FLV waste, such as the pre-established quality standards (BERETTA et al., 2013) and the forecast of purchase, order, and supply (TELLER et al., 2018). The high-quality requirement was cited by the employees of Cases B and C as one of the causes for removing food from the sales area.

The manipulation of sensitive products, such as FLV, can lead to product maturation (GUSTAVSSON; STAGE, 2011; TELLER et al., 2018). This manipulation occurs both by employees and consumers. The high temperature in the refrigeration and store counters is another important factor that contributes to the increased maturation of FLV products in

supermarkets (ERIKSSON; STRID; HANSSON, 2016).

The Table 6 presents the fruits, legumes, and vegetables that were discarded in greater quantities in cases A, B and C.

Table 6 – FLV products discarded in greater volume in Cases A, B and C

Category	Product	Case A	Case B	Case C
Fruits	Banana	x	x	x
	Mango	x		
	Orange	x		
	Papaya		x	
	Pear		x	
	Tangerine			x
	Watermelon			x
Legumes	Tomato	x	x	x
	Potato	x		
	Green corn	x		
	Manioc		x	
	Cassava		x	
	Chayote			x
	Zucchini			x
Vegetables	Lettuce	x		x
	Cabbage	x		x
	Kale	x		
	Watercress	x		
	Artichoke		x	
	Foliage		x	
	Broccoli			x

Source: Research data.

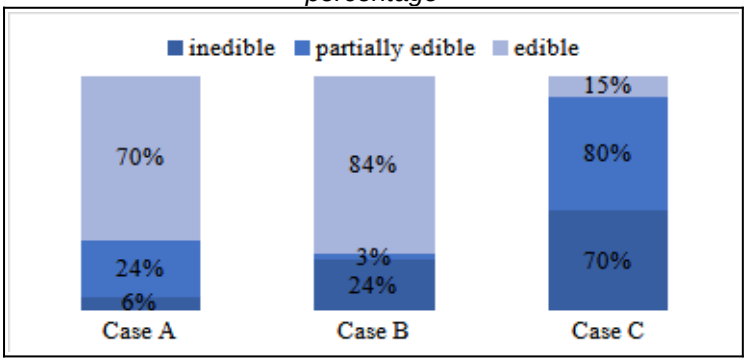
Bananas and tomatoes were the foods that stood out in volume of waste in the three cases. Lettuce and cabbage were the most discarded products in cases A and C in terms of volume.

3. 2 Edibility of FLV products

Edibility was evaluated according to the sensory characteristics of FLV foods: physical appearance, odor, and texture. The edibility of discarded products can be seen as a

percentage in Figure 2, in cases A, B and C. This percentage shows the amount of food that was removed from the sales area towards disposal, that was able to be consumed, partially consumed, and not consumed. However, some stores did not dispose of all these foods and sent them to direct sales and donations, which was not accounted for in this research.

Figure 2 – Edibility of FLV discarded in Cases A, B and C in percentage



Source: Research data.

It could be observed that part of the food was removed from the sales area even when it was fit for consumption, due to the decrease in the probability of sale and consumer demand, mentioned by store employees. Thus, edible foods were removed from the sales area for the following reasons: upcoming expiration date on the packaging label, proximity to maturation, maturation, and damaged packaging.

3. 3 FLV Disposal

Disposal of FLV products in the three cases were different. Of the three supermarkets investigated, two had solid waste managed by outsourced companies (Cases B and C), directing waste to composting. In Case A, the destination of the waste was the responsibility of the municipality, and it was sent to the

sanitary landfill. In Brazil, 59.5% of solid waste goes to landfill, 23% to controlled landfills and 17.5% to landfills (ABRELPE, 2020).

4. Discussions

Although different methodologies for measuring the FLV waste were used throughout literature, Table 7 presents a rough comparison between the results of this study and other studies globally.

Table 7 – Percentage in waste of FVL localized in this study and scientific articles

FLV	Percentage of FLV waste	Type of store	Country	Reference
Fruits (Cases A and B)	12% - 16%	Supermarket	Brazil	This study
Fruits	4.1% - 43.1%	Supermarket	USA	Buzby et al. (2015)
Fruits	2 – 17%	Supermarket (directed for you landfills)	New Zealand	Goodman-Smith, Mirosa e Skeaff (2020)
Fruits and vegetables	9%	Supermarket	Brazil	Fehr and Romão (2001)
Fruits and vegetables	13%	Hortifruti	Brazil	Fehr and Romão (2001)
Fruits and vegetables	6%	Wholesale	Brazil	Fehr and Romão (2001)
Fruits and vegetables	1.9%	Supermarket	Poland	Ribeiro et al. (2019)
Fruits and vegetables	8 – 9%	Supermarket	Switzerland	Beretta et al. (2013)
Fruits and vegetables	4.2%	Supermarket	Austria	Lebersorger and Scheneider (2014)
Fruits and vegetables	0.4% - 6.3%, one year	Supermarket	Europe	Gustavsson and Stage (2011)
Legumes (Cases A and B)	13% - 20%	Supermarket	Brazil	This study
	4.3%	Supermarket	Colombia	Chaboud (2017)

FLV	Percentage of FLV waste	Type of store	Country	Reference
Tomatoes				
Vegetables (Cases A and B)	4% - 17%	Supermarket	Brazil	This study
Vegetables	6 – 27%	Supermarket	New Zealand	Goodman-Smith, Mirosa e Skeaff (2020)
Vegetables	2.2% - 62.9%	Supermarket	USA	Buzby et al. (2015)

Source: Research data.

It was observed that there is variation between the wasted volumes. The results found here cannot be compared because some research used data informed by the supermarkets, while others, such as this study, used data from measurement in loco.

Another import difference between the studies is the period and the number of supermarkets studied. This study was an exploratory study, using two days in each supermarket as a sample, while others carried out long-term data collection, for instance, as found in Gustavsson and Stage (2011). In addition, the time of year (seasonality), temperature and type of food are examples of variables that directly influence the volume of FLV waste.

These studies could be useful estimates that can serve as a guide in reducing waste and even with different methodologies between chains or supermarkets, internal measurement can serve as a fundamental tool for controlling waste.

5. Conclusions

It could be observed that fruits were the most discarded foods, followed by legumes and vegetables. The most discarded foods were bananas, tomatoes, and lettuce, respectively, considering tomatoes as legume. Comparison with data in the literature is not feasible due to the lack of methodological

standardization used in the measurements found (FEHR; ROMÃO, 2001, BUZBY et al., 2015).

In the characterization of foods removed from shelves towards disposal, edible foods were discarded more, followed by partially edible and inedible. Thus, the change in legislation regarding the validity of products such as fruits and vegetables, which recently occurred in Brazil (BRASIL, 2022), will probably considerably reduce the amount of disposal of these foods and will bring a significant advance in the food waste agenda. Consequently, the extension of the exposure time of products suitable for consumption and the increase in donations are examples of this achievement.

This research demonstrated that approximately two tons of FLV were removed from three supermarkets in six days, destined for disposal. In the cases studied, FLV waste was directed both to composting and to the sanitary landfill. This small sample can already demonstrate the high volume of food that is directed to waste and not necessarily sent for reuse. If this amount was extrapolated by year, the average daily amount of FLV waste discarded is 360 kg and, in 365 days, there is a total of 131 tons of FLV waste discarded by three supermarkets only. If we think that most of this amount is edible, as was investigated in this research, we have surprising data on food waste.

Measuring the volume of FLV waste makes it possible to investigate the foods that are discarded and allows preventive actions to be taken, such as reducing the order volume and correctly storing these foods in the internal areas of supermarkets. Thus, the reduction of waste and the correct disposal of organic waste contribute to the reduction of socio-environmental damage. In addition to the internal operational processes of supermarkets, the study of the supply chain of each food can contribute to investigate the critical points in which this food has a higher risk of being damaged and becoming unfit for consumption.

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APPENDIX 1 – WRI PROTOCOL METHODOLOGY

Table 3.1 – WRI Protocol held in this search

Protocol	**Description**
1. Define goals	The measurement of this research aimed to quantify the volume wasted in FLV in one sampling, and characterize the profile in waste, through weighing of FLV waste.
2. Review principles for accounting and reporting	Principles of relevance, completeness, consistency, transparency and precision were used in the elaboration and collection of the data, aiming to obtain a larger accuracy in protocol.
3. Establish the scope	It was realized through measurement in FLV waste in 2 days in each store, totaling 3 stores.
4. Decide how to quantify food loss and waste	Data collection through direct weighting was realized with high accuracy in Case C and medium accuracy in Cases A and B.
5. Collect and analyze data	Data collected in loco in stores selected.
6. Calculate results of inventory	Calculate FLV waste quantities in kg.
7. Evaluate the uncertainty	Uncertainties are related to total waste quantities in a day, and they were checked with employees to have the highest degree of accuracy as possible.
8. Review (Optional)	Not carried out.
9. Report inventory in food loss and waste	Not carried out
10. Set target and accompany over time	Not carried out because it was initial exploratory research.

Source: Research data.

Table 3.2 – Principles gives accounting of losses and waste in foods

Principles	WRI principles	This research
Relevance	Ensure the Food Loss and Waste (FLW) inventory appropriately reflects the FLW of the company and serves the decision-making needs of users – both internal and external to the company.	Measurement was the chosen method because it has larger accuracy for this research, whose aim was to sample FLV waste in retail and study its causes.
Completeness	Account for and report on all FLW sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions of emission sources.	In this research, the degree of completeness was moderate, because in measuring the FLV in the stores some products were not accounted for.
Consistency	Use consistent methodologies to allow for meaningful comparisons of FLW over time. Transparently document any changes to the data, inventory boundary, methods, or any other relevant factors in the time series.	Despite being carried out in only two days, this research had consistency in the collection method. On the other hand, the short data collection period did not allow a meaningful mass of FLV waste to be tracked.
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies and data sources used.	This research presents a high degree of transparency, all relevant matters were revealed and described.

Principles	WRI principles	This research
Precision	Ensure that the quantification of FLW is systematically neither over nor under actual FLW, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.	Precision was considered moderate. Case A revealed that part of bananas could not be measured, while case B the products measured accounted for 50% of the whole day, reducing the degree of precision.

Source: Research data.

APPENDIX 2 – FOOD WASTE CHARACTERIZATION FORM

Characterization sheet food waste – first campaign NAME OF FOOD	CODE OF PRODUCT	WEIGHT (kg)	
		WITH PACKAGING	WITHOUT PACKAGING
POSSIBILITY IN DISASSOCIATE THE PACKING			
( ) YES ( ) NO	( ) YES, BUT WITH DIFFICULTY		
DESTINATION OF FOOD WITH PACKAGING			
( ) COMPOSTING ( ) SANITARY LANDFILL			
DESTINATION OF FOOD WITHOUT PACKING			
( ) COMPOSTING ( ) SANITARY LANDFILL			
CAUSES GIVES GENERATION IN WASTE/REASON IN DISCARD			
( ) MATURATION ( ) DUE DATE			
( ) BREAKDOWN OF FOOD ( ) BREAKDOWN OF PACKAGING ( )OTHERS			
POSSIBILITY OF BEING DONATED TO MESA BRASIL ( ) YES ( ) NO			
WAS IT DONATED TO MESA BRASIL ( ) YES ( )NO			
POSSIBILITY OF BEING USED AS FOOD ANIMAL ( )YES ( )NO			
PRODUCT CONSIGNED (EXCHANGE) ( ) YES ( )NO			
STAGES IN CLASSIFICATION IN WASTE			
EDIBILITY	( )EDIBLE ( ) NOT EDIBLE		
STATE	( )EDIBLE ( ) DAMAGED OR DAMAGED		
SOURCE	( )BASE ANIMAL ( ) BASE VEGETABLE		
COMPLEXITY	( )PRODUCT SIMPLE ( ) PRODUCT MIXED		
PRESENCE IN ANIMAL PRODUCT	( )MEAT ( ) ANIMAL PRODUCTS ( ) BY-PRODUCTS OF PARTS ANIMALS NOT INTENDED TO HUMAN CONSUMPTION		

INTERNSHIP AT JAIL	( ) TABLE AND KITCHEN WASTE ( ) NON-KITCHEN WASTE
TREATMENT	( ) PROCESSED ( ) NOT PROCESSED
PACKAGING	( ) YES, WITH WHAT TYPE OF MATERIAL? ( ) POSSIBILITY IN UNPACKING? ( ) NOT PACKED
BIODEGRADABILITY OF PACKAGING	( ) BIODEGRADABLE ( ) NOT BIODEGRADABLE

APPENDIX 3 – ANALYSIS UNIT CHECKLIST

Description gives unity in study	
Operation hours	
Number in employees	
Type of retail: mini market, super, hyper, wholesale	
Size of retail (in m²)	
Number of commercial units in Sao Paulo	
Does the supermarket sell products with self-owned brands?	
Description of Prevention in FLV Losses	
How long in advance are products with upcoming expiration date are withdrawn from shelves?	
Is there a department responsible for the reduction of food waste or reduction of food losses? if yes, what is the scope of its functions?	
Is there an attempt to sell products with upcoming expiration date that are withdrawn from shelves?	
How is the control of food losses/how are losses classified? Examples: cause, type of product, waste management.	
Segregation of waste	
Is there a place for storage of waste?	
Are there disposal days for all items or specific days for specific products?	
Is there an employee responsible for waste management?	
Is there a selective collection for recyclable waste?	
Are there companies/project that collaborate on waste management?	
Which are the companies or projects?	
Are the products stored separated by origin? Examples: FLV, meats, etc.	
Is there a scale to weight products?	
In the disposal moment, are products separated from their packaging?	

Are all products weighted before disposal?	
Are the products that demand refrigeration stored in refrigerators in the area of food losses?	
Where are the products that are expired or close to expiration date stored?	
Are there consigned products?	
Which are the consigned products?	
What is the disposal of these consigned products when they are ruined?	
Packaging, Storage, Collection of waste and disposal	
Number in collections per week	
Does the collection occur on weekends?	
At the same time?	
Number in companies in collection	
Time of waste collection	

APPENDIX 4 – TABLES CASES A, B AND C

Table 4.1 – Quantity in kg of disposal and sales of fruits in case A

Fruits	Thursday, 12 March 2020			Friday, 13 March 2020		
	Disposal	Sale	%	Disposal	Sale	%
banana	91.2	252.6	36.1%	42.1	272.9	15.4%
coconut	3.2	12.0	26.2%	0.0	0.0	0.0%
orange	0.2	160.5	0.1%	16.0	210.6	7.6%
melon	0.0	0.0	0.0%	2.6	42.9	6.1%
lemon	0.3	75.2	0.3%	0.0	0.0	0.0%
papaya	8.0	104.4	7.7%	7.5	130.6	5.7%
mango	52.8	116.3	45.4%	7.8	103.9	7.5%
passion fruit	2.0	20.7	9.7%	0.0	0.0	0.0%
Total	158	742	21%	76	761	10%

Source: Research data.

Table 4.2 – Quantity in kg of disposal and sales of legumes in case A

Legumes	Thursday, 12 March 2020			Friday, 13 March 2020		
	Disposal	Sale	%	Disposal	Sale	%
pumpkin	1.9	29.7	6.4%	1.5	23.5	6.4%
potato	0.3	108.6	0.2%	35.7	113.3	31.5%
aubergine	0.8	1.0	75.0%	0.0	0.0	0.0%
beetroot	0.6	1.0	60.0%	0.0	0.0	0.0%
onion	0.0	0.0	0.0%	3.8	99.3	3.8%
chayote	0.0	0.0	0.0%	6.6	22.1	29.9%
carrot	6.3	30.0	21.0%	0.0	0.0	0.0%
cauliflower	1.6	20.0	8.0%	0.0	0.0	0.0%
scarlet eggplant	2.0	0.2	812.5%	0.0	0.0	0.0%
cassava	1.1	1.0	105.0%	0.3	22.3	1.3%
green corn	13.6	24.0	56.7%	0.0	0.0	0.0%
chili	2.6	7.5	34.2%	0.0	0.0	0.0%
Bell pepper	3.0	10.0	30.0%	0.0	0.0	0.0%
okra	0.3	4.0	7.5%	0.0	0.0	0.0%
tomato	3.7	77.3	4.8%	9.1	159.2	5.7%
Total	37	314	12%	57	440	13%

Source: Research data.

Table 4.3 – Quantity in kg of disposal and sales of vegetables in case A

Vegetables	Thursday, 12 March 2020			Friday, 13 March 2020		
	Disposal	Sale	%	Disposal	Sale	%
chard	0.0	0.0	0.0%	0.2	3.0	6.7%
cress	1.2	2.0	60.0%	0.0	0.0	0.0%
lettuce	1.0	9.0	11.1%	1.7	142.0	1.2%
chive	0.0	0.0	0.0%	0.7	2.0	35.0%
parsley	0.0	0.0	0.0%	0.0	43.0	0.1%
kale	0.2	8.0	2.3%	3.7	36.0	10.3%
endive	0.2	6.0	2.5%	0.4	7.0	5.7%
spinach	0.0	0.0	0.0%	0.2	2.0	10.0%
basil	0.0	0.0	0.0%	0.4	3.0	13.3%
cabbage	0.9	22.0	3.9%	0.3	17.0	1.8%
arugula	0.0	0.0	0.0%	0.4	9.0	4.4%
Total	3	47	6%	8	264	3%

Source: Research data.

Table 4.4 – Quantity in kg of disposal and sales of fruits in case B

Fruits	Tuesday, 6 October 2020			Wednesday, 7 October 2020		
	Disposal	Sale	%	Disposal	Sale	%
banana	22.0	110.0	20%	17.3	89.0	19.4%
guava	0.3	4.0	7.5%	0.0	0.0	0.0
white guava	0.0	0.0	0.0	0.6	7.0	8.6%
orange	5.7	59.0	9.6%	4.7	25.0	18.8%
lemon	5.8	54.0	10.7%	0.2	43.0	0.5%
apple	3.0	21.0	14.3%	0.2	20.0	1%
papaya	4.3	105.0	4%	8.7	111.0	7.8%
mango	1.6	88.0	1.8%	2.0	77.0	2.6%
passion fruit from cerrado	0.0	0.0	0.0	0.7	0.0	-

Fruits	Tuesday, 6 October 2020			Wednesday, 7 October 2020		
quince	0.0	0.0	0.0	1.1	0.0	-
tangerine	0.5	8.0	6.2%	0.0	0.0	0.0
pear	12.7	6.0	211.1%	10.2	4.0	255%
peach	0.0	0.0	0.0	0.7	12.0	5.8%
pinecone	0.0	0.0	0.0	2.6	2.0	130%
pomegranate	0.4	1.0	40%	0.0	0.0	0.0
grape	0.6	12.0	5%	0.0	0.0	0.0
Total	57	468	12%	49	390	13%

Source: Research data.

Table 4.5 – Quantity in kg of disposal and sales of legumes in case B

Legumes	Tuesday, 6 October 2020			Wednesday, 7 October 2020		
	Disposal	Sale	%	Disposal	Sale	%
zucchini	0.6	22.0	2.6%	0.0	0.0	0.0%
pumpkin	0.8	12.0	6.9%	0.0	0.0	0.0%
artichoke	0.0	0.0	0.0%	5.2	20.0	26.2%
sweet potato	0.0	0.0	0.0%	0.5	22.0	2.1%
beetroot	1.8	10.0	17.8%	0.0	0.0	0.0%
onion	0.0	0.0	0.0%	0.3	62.0	0.4%
carrot	0.0	0.0	0.0%	0.3	27.0	1.1%
manioc	0.0	0.0	0.0%	11.1	1.0	1105.5%
cassava	0.0	0.0	0.0%	10.0	19.0	52.4%
cucumber	1.2	4.0	30.2%	0.0	0.0	0.0%
Bell pepper	0.6	10.0	5.9%	0.0	0.0	0.0%
tomato	15.1	33.0	45.8%	4.6	22.0	20.9%
Total	20	91	22%	32	173	18%

Source: Research data.

Table 4.6 – Quantity in kg of disposal and sales of vegetables in case B

Vegetables	Tuesday, 6 October 2020			Wednesday, 7 October 2020		
	Disposal	Sale	%	Disposal	Sale	%
artichoke	0.0	0.0	0.0%	5.5	20.0	27.5%
foliage	5.2	43.0	12.2%	0.0	0.0	0.0%
Total	5	43	12%	6	20	28%

Source: Research data.

Table 4.7 – Quantity in kg of disposal and sales of fruits in case C

Fruits	Wednesday, 17 April 2019	Saturday, 25 April 2019	Total
avocado	32.0	1.0	33.0
banana	19.9	130.0	149.9
khaki	73.7	3.9	77.7
guava	2.7	0.0	2.7
orange	72.2	0.4	72.6
lemon	88.9	2.3	91.2
apple	63.6	0.8	64.4
papaya	27.5	1.6	29.0
mango	7.6	25.6	33.2
passion fruit	33.9	0.7	34.6
watermelon	105.8	116.8	222.6
melon	0.0	1.0	1.0
pinion	0.7	0.0	0.7
tangerine	43.0	169.1	212.1
grape	0.2	0.0	0.2
Total	572	453	1025

Source: Research data.

Table 4.8 – Quantity in kg of disposal and sales of legumes in case C

Legumes	Two days		Total
	Wednesday, 17 April 2019	Saturday, 25 April 2019	
zucchini	11.4	48.5	59.9

Legumes	Two days		
potato	0.9	0.2	1.1
sweet potato	0.5	0.0	0.5
aubergine	0.0	1.4	1.4
onion	4.6	4.0	8.6
carrot	12.1	1.0	13.1
chayote	66.6	90.7	157.3
ginger	0.5	0.0	0.5
yam	0.8	0.0	0.8
cassava	4.9	0.0	4.9
green corn	1.8	0.0	1.8
cucumber	34.6	14.3	48.9
bell pepper	9.3	8.2	17.5
tomato	280.1	0.0	280.1
Total	428	168	596

Source: Research data.

Table 4.9 – Quantity in kg of disposal and sales of vegetables in case C

Vegetables	Two days		Total
	Wednesday, 17 April 2019	Saturday, 25 April 2019	
lettuce	23.1	0.0	23.1
broccoli	3.0	0.0	3.0
chive	0.4	0.0	0.4
endive	2.1	0.0	2.1
cabbage	3.3	0.0	3.3
Total	32	0	32

Source: Research data.